Voiding dysfunction after vaginal prolapse surgery: etiology, prevention and treatment
Hakvoort, R.A.

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Robert Alexander Hakvoort was born on the 31st of March 1972 in Vorden (The Netherlands) as the youngest son of Maria Antonia Johanna Hakvoort-Aarnink and Gerardus Antonius Johannes Hakvoort. He graduated from high school in 1991 (Baudartius college, Zutphen) after which, by drawing lots, he was excluded several times from medical school. In these years he worked and he studied chemical technology at Wageningen University. He received a bachelor’s degree in this field after which he was finally admitted to medical school at the Vrije Universiteit in Amsterdam in 1993. In his internship obstetrics and gynaecology in the Spaarne Hospital in Haarlem he became interested in this field. After receiving his medical degree in 2000 he worked as a house officer in obstetrics and gynaecology in the Spaarne Hospital for 2 years. Here he finalised his first randomised trial about incomplete voiding after vaginal prolapse surgery. This manuscript is now part of this thesis. In 2002 he started his training in obstetrics and gynaecology at the Medical Center Alkmaar and subsequently at the Academic Medical Center in Amsterdam. In this period he became president of the Dutch society of trainees in obstetrics and gynaecology and member of the board of the Dutch society of obstetrics and gynaecology. In 2006, he returned to the Spaarne Hospital in Hoofddorp to complete his training. Here, he initiated more studies about incomplete voiding after vaginal prolapse surgery. Since 2007 he is working in the Spaarne Hospital as a staff consultant gynaecologist. In this period he became member of the organising committee of the Dutch gynaecological surgery congress (COBRA), member of the public relations committee of the international urogynaecology association (IUGA) and secretary of the Dutch society of obstetrics and gynaecology. In 2011 he was registered as a subspecialist urogynaecology. The author lives in Haarlem, the Netherlands, with his wife Kirsten Stuurman, his daughter Guusje and his two sons Reinier and Gijs.
Voiding dysfunction after vaginal prolapse surgery
Etiology, prevention and treatment

Robert Alexander Hakvoort
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ACADEMISCH PROEFSCHRIFT

Ter verkrijging van de graad van doctor aan de Universiteit van Amsterdam op gezag van de Rector Magnificus prof.dr. D.C. van den Boom ten overstaan van een door het college voor promoties ingestelde commissie in het openbaar te verdedigen in de Aula der Universiteit op woensdag 20 juni 2012, te 13.00 uur

door

Robert Alexander Hakvoort

Geboren te Vorden
Promotiecommissie

Promotor: Prof.dr. M.P.M. Burger

Co-promotores: Dr. J.P.W.R. Roovers
Dr. M.H. Emanuel

Overige leden: Dr. M.G.W. Dijkgraaf
Prof.dr. J.C.J.M de Haes
Prof.dr. M.J. Heineman
Prof.dr. D. de Ridder
Prof.dr. J.J.M.C.H. de la Rosette
Prof.dr. C.H. van der Vaart

Faculteit der Geneeskunde
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Chapter 1

Introduction and outline of the thesis
Clinical problem of incomplete voiding

Pelvic organ prolapse (POP) is a common disease \(^1\)-\(^3\) for which a significant number of patients will require and demand surgical correction in order to correct anatomical abnormalities and to restore normal pelvic floor function. \(^4\) After this type of surgery sometimes a total inability to void develops (urinary retention) and more frequently the problem of incomplete bladder emptying occurs resulting in an abnormal postvoid residual volume (PVR). With a prevalence of 1 to 22% the occurrence of this incomplete voiding is one of the most frequent complications directly related to vaginal prolapse surgery. \(^5\)-\(^7\) When incomplete voiding is left untreated, the bladder can be stretched beyond its physical limits which can decrease achievable detrusor pressure and change elasticity. \(^8\)-\(^10\) This can lead to impairment of bladder function in the long term. \(^8\), \(^9\)

To prevent such sequelae, bladder drainage through catheterisation is applied. However, often the initiation and continuation of catheterisation in hospitalised patients is poorly indicated. \(^10\)-\(^13\) Reported reasons for prolongation of catheterisation are negligence (i.e. forgetting the presence of a catheter) and convenience for nursing staff. \(^11\), \(^14\) Also a large practice variation exists in type and duration of catheterisation. Presumably, a lack of evidence can be held accountable for this practice variation. To improve awareness and recognition, to develop optimal preventive measures and to optimise treatment more evidence is needed that evaluates common practice and to optimise this practice.

Prevention and treatment: Standard prolonged catheterisation and catheterisation when indicated

For decades gynaecologists routinely applied bladder catheterisation for several days after vaginal prolapse surgery. \(^12\) This postoperative standard insertion of a catheter may initially be prompted by the presence of a vaginal gauze, by inhibition of bladder sensibility and contractility through the action of anaesthetics and by impaired mobility of the patient post-operatively. It can also be considered necessary to prolong catheterisation as postoperative pain \(^15\), urethral elevation \(^16\) and peri-urethral oedema and/or innervation trauma \(^17\) may hamper optimal emptying of the bladder. Although such prolonged catheterisation appears relatively safe and straightforward, it proved to be unnecessary after vaginal hysterectomy. \(^18\) Furthermore, catheterisation inevitably increases the risk of urinary tract infections and results in longer hospital stay, more discomfort and higher disappointment for patients about the treatment they received. \(^19\), \(^20\) As the majority of patients does not encounter the problem of incomplete voiding the standard postoperative insertion of catheters for longer durations implies that a majority of patients receives suboptimal treatment. Therefore it could be rational to restrict standard catheterisation to the period of impaired
mobility and the possible negative influence of anesthetics on bladder function has not worn out yet. After this period of standard catheterisation a proportion of patients will require additional treatment because of the occurrence of abnormal post void residual volume. When this complication has been diagnosed, again a great variation seems to exist between departments regarding the choice for type of catheterisation and the continuation of catheterisation. Most likely this results from the absence of studies and guidelines regarding this matter.

**Etiology**

Some risk factors have been identified for incomplete voiding after vaginal prolapse surgery. Identification of such risk factors is relevant as it could be used to adjust preventive strategies and treatment regimens. Contrary to vaginal prolapse surgery, more risk factors are known for development of incomplete voiding after incontinence surgery. Some of the identified mechanisms for the development of abnormal post void residual volume after this type of surgery may also account for prolapse surgery. We will explore the aetiology of incomplete voiding after vaginal prolapse surgery by identifying more risk factors for incomplete voiding after vaginal prolapse surgery.

**Detrusor underactivity**

Detrusor underactivity has been defined by the international continence society as a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span. It can be influenced by the following factors.

**Age**

In clinical studies of patients undergoing incontinence surgery a negative effect of age on voiding postoperatively was demonstrated. In other studies age was related to detrusor underactivity and a reduced sensation to bladder filling. On a morphological level these phenomena can be explained by a reduction in axonal content and changes in neurotransmission.

**Influence of anesthetics**

Anaesthetic agents used in general anaesthesia can reduce bladder function by suppression of the pontine micturition center (animal studies). Intrathecally administered local anesthetics block neurons of the sacral spinal cord (S2–S4). The action is by blocking the transmission of the afferent and efferent information of nervous fibers from and to the bladder. The block as a rule wears off within 7-8 hours. To prolong the duration of sensory block with spinal anesthesia
intrathecal opioids can be administered. These agents inhibit bladder contractility and can increase bladder capacity. The duration of this effect on the bladder is dependent on the type of opioid used and the administered dose but will last maximally 24 hours.\textsuperscript{32, 33} For the purpose of analgesia in vaginal prolapse surgery, which are in general relatively short lasting operations, intrathecal opioids are seldomly administered. In the clinical studies in this thesis analgesia was mostly reached using a spinal block without addition of opioids. Therefore, on the role of anesthetics in postoperative incomplete voiding will not be focused in this thesis.

Surgical damage to innervation of the bladder

It has been well established that innervation trauma of the bladder can be a consequence of major pelvic and colorectal surgery.\textsuperscript{34, 35, 36} Although it is likely that dissection and suturing part of the bladder wall in the case of anterior repairs can also result in innervation trauma, it has not been proved. Indirect evidence comes from one study in which a higher stage preoperative anterior wall prolapse was found to be a predictor for the occurrence of abnormal post void residual volumes postoperatively.\textsuperscript{17} This can be explained by a more extensive dissection with higher stage prolapse surgery and innervation damage of the bladder as a consequence.\textsuperscript{17}

Anxiety

We hypothesise that anxiety can be of influence in the development of incomplete voiding after vaginal prolapse surgery. Anxiety is likely to obstruct bladder outflow through an alfa adrenergic stimulation of the bladder outlet\textsuperscript{8, 26, 37} and also by pelvic floor contraction.\textsuperscript{38} The idea that, pre- and postoperatively, anxiety levels rise while patients are faced with hospitalisation, loss of autonomy and (an unusual) request for efficient micturition is supported in literature.\textsuperscript{39-41} The negative effect of posing such conditions to patients was illustrated by the observation in another study that a request for micturition in a hospitalised environment led to an absolute inability to void in 8 of 18 (44\%) otherwise healthy non surgical subjects.\textsuperscript{41}

Pain

Pain is an inevitable consequence of surgery. It is known that it can negatively influence bladder function through central inhibition and is likely to cause bladder outflow obstruction through a disturbed relaxation of the pelvic floor. This has been mentioned as a possible cause of voiding impairment postoperatively.\textsuperscript{8,19, 26, 37} Support for this hypothesis comes from studies in patients undergoing proctological and posterior compartment surgery. Although there is no direct anatomical relationship
between the surgical site and the bladder in such patients, they are however still at risk of developing incomplete voiding.\textsuperscript{15,17}

**Obstruction**

The assumption that postoperative edema, haematoma formation and/or urethral elevation can contribute to a bladder outlet obstruction (BOO) leading to voiding disorder is widespread.\textsuperscript{6,42-44} However, no evidence exists to support this hypothesis. There are no urodynamic studies combining flow parameters with detrusor pressure available to establish the cause of incomplete voiding following vaginal prolapse surgery. A few studies have investigated mixed populations of incontinence and prolapse surgery. In these studies vaginal prolapse surgery shows an increase of incomplete voiding in the first few days which wears off in the longer run while incontinence procedures tend to result in incomplete voiding for longer periods. Therefore, the observed voiding disorder seems to be dominated by direct postoperative effects of the surgery\textsuperscript{24,45} and for longer term voiding disorders incontinence surgery plays a more important role. An explanation could be a more obstructive nature of stress-incontinence surgery.\textsuperscript{16,23,46} This is supported by the finding that the degree to which the bladder neck is elevated and the type of bladder neck suspension are both predictive for incomplete voiding after incontinence surgery.\textsuperscript{16,23}

At the time the studies in this thesis were designed it was common practice to routinely prolong indwelling catheterisation for several days after vaginal prolapse surgery.\textsuperscript{12,13} Further, these catheterisation protocols varied to a great extent which implied suboptimal treatment for many patients. Further, no evidence existed concerning the optimal technique and duration of treatment of incomplete voiding after surgery. Nor was there any insight in patient preferences for treating incomplete voiding and finally, the etiology of incomplete voiding after vaginal prolapse surgery was unknown. This all is important as it could give direction to new preventive strategies.

**Objectives of this thesis**

The following objectives were identified:

1. To determine the preferred practice and practice variation in Dutch hospitals concerning bladder care management after vaginal prolapse surgery.
2. To optimise postoperative bladder care. The first aim is to optimise the duration of the commonly applied standard bladder catheterisation after vaginal prolapse surgery. The second aim is to optimise the actual treatment of an established abnormal PVR and further insight will be provided in the preferences of patients.
3. To understand the underlying mechanisms of abnormal PVR.
Chapter 1

References


Chapter 2

How long should urinary bladder catheterisation be continued after vaginal prolapse surgery?

A Randomised Controlled Trial comparing routine prolonged catheterisation and prolonged catherisation on indication after vaginal prolapse surgery.

RA Hakvoort
R Elberink
A Vollebregt
T van der Ploeg
MH Emanuel

BJOG 2004 111(8), 828-30
Chapter 2

Abstract

Objective: To determine whether prolonged urinary bladder catheterisation after vaginal prolapse surgery is advantageous.

Design: Randomised Controlled Trial.

Setting: A large training hospital in the Netherlands.

Population: Patients undergoing anterior colporraphy.

Main outcome measures: Need for recatheterisation, urinary tract infection, mean duration of catheterisation and hospital stay.

Materials and Methods: One hundred patients were included. Patients were randomised into two groups. In one group (n= 50), a transurethral catheter was in place for four days post-operatively and removed on the fifth post-operative day. In the other group (n= 50), catheterisation was not prolonged and the catheter was removed the morning after surgery. Residual volumes after removal of the catheter were measured by ultrasound scanning. Where residual volumes of >200 mL were found the patient was recatheterised for three more days. Urinary cultures were taken before removal of the catheter. Six patients were excluded: four in the standard prolonged catheterisation group and two in the not prolonged catheterisation group.

Results: Residual volumes exceeding 200 mL and need for recatheterisation occurred in 9% in the standard prolonged catheterisation group versus 40% of patients in the not prolonged catheterisation group (OR 0.15, 95% CI 0.045-0.47). Positive urine cultures were found in 40% of cases in the standard prolonged catheterisation group compared with 4% in the not prolonged catheterisation group (OR 15, 95% CI 3.2-68.6). Mean duration of catheterisation was 5.3 days in the standard prolonged catheterisation group and 2.3 days in the not prolonged catheterisation group (P < 0.001). Mean duration of hospitalisation was 7 days in the standard prolonged catheterisation group and 5.7 days in the not prolonged group (P < 0.001).

Conclusion: The disadvantages of prolonged catheterisation outweigh the advantages, therefore, removal of the catheter on the morning after surgery may be preferable and longer term catheterisation should only be undertaken where there are specific indications.
Introduction

In the Netherlands, it is common to maintain drainage of the bladder with a urethral catheter for longer periods after anterior colporrhaphy. A national questionnaire regarding practice in training hospitals revealed that the mean duration of catheterisation in 24 protocols is 3.7 days. In our hospital, the routine catheterisation period is four days. The reason for this standard procedure is the belief that overfilling of the bladder after prolapse surgery might have a negative influence on surgical outcome. However, there is no evidence in the literature to support this view. In one study of 50 patients, the number of post-operative voiding problems appeared to be equal between two groups of one and three days of prolonged catheterisation, respectively. In our routine practice, the actual proportion of patients requiring prolongation of catheterisation remains unknown. Moreover, bladder catheterisation increases the occurrence of urinary tract infections and is likely to have a negative impact on the wellbeing of patients after surgery and to prolong hospital stay. We therefore examined whether prevention of bladder overfilling can be achieved without prolonged catheterisation. We designed a randomised controlled trial where the standard, prolonged catheterisation was compared with short term catheterisation.

Materials and Methods

In daily practice, 5–10% of patients, treated with our standard prolonged catheterisation, require a second period of catheterisation because of a residual volume of more than 200 mL. We estimated that this number might increase to 30% if the catheter was removed on the morning after surgery. In our power calculation, the two-group equivalence test was therefore used, assuming that the number of patients who would need recurrent catheterisation could increase to 50%. The significance was assumed with a P value of 0.05. Therefore, according to this power calculation, we needed to recruit 100 patients. The study design was approved by the institutional medical ethical committee. Between February 2000 and July 2001, a total of 100 consecutive patients were included after giving informed consent. Prior to surgery, urine samples were taken in the operating theatre for sedimentation. Patients with samples showing signs of a urinary tract infection pre-operatively, defined as having more than 10 white blood cells per high power field and significant microscopic bacteriuria (one per high power field) in the urine sediment, were excluded. All patients had a transurethral Foley catheter (Charrière 14) inserted in the operating theatre immediately after surgery. Prolapse surgery was performed by experienced gynaecologists. At admission to the ward, patients were randomised by the use of closed non-diaphane envelopes, into either standard prolonged catheterisation, or no prolonged catheterisation.
Chapter 2

In the standard prolonged catheterisation group, the catheter was removed on the morning of the fifth post-operative day. In the not prolonged catheterisation group, the catheter was removed on the morning after surgery. Before removal of the catheter, a urine sample was taken for culture. A urinary tract infection was defined as the presence of >10^5 colony forming units/mL in the culture. Urinary bladder volumes after voiding were measured using an ultrasound scanner (type DxU BVI 3000) within 8 hours after removal of the catheter. All patients with imminent overfilling, defined as a post-voiding residual volume of 200 mL or more, had another transurethral catheter inserted for a period of three days (recatheterisation). The above protocol was repeated after removal of this second catheter.

Nominal results were tested using χ² analysis. Differences in mean for two groups with continuous or interval/ratio variables were tested using a Student’s t test.

Results

One hundred patients were included in this study. Age, the type of surgery and mean operating time did not differ significantly between the two groups (Table 1).

Table 1: baseline characteristics

<table>
<thead>
<tr>
<th></th>
<th>Standard prolonged catheterisation (n=46)</th>
<th>Not prolonged catheterisation (n=48)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age at time of surgery</strong></td>
<td>66 (66, 37-87)</td>
<td>67 (67, 36-86)</td>
</tr>
<tr>
<td><strong>No. of interventions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APC</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>APC &amp; vaginal hysterectomy</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>AC</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td><strong>Operating time (min.)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total group</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>APC</td>
<td>54 (50, 30-90)</td>
<td>56 (50, 25-110)</td>
</tr>
<tr>
<td>APC &amp; vaginal hysterectomy</td>
<td>85 (90, 45-105)</td>
<td>91 (90, 60-160)</td>
</tr>
<tr>
<td>AC</td>
<td>43 (35, 30-60)</td>
<td>35 (38, 20-45)</td>
</tr>
</tbody>
</table>

Values within parentheses are median and range.
APC: anterior and posterior colporrhaphy. AC: anterior colporrhaphy.

In the standard prolonged catheterisation group, four patients were excluded: two patients underwent posterior colporrhaphy only and two patients had signs of an underlying urinary tract infection. In the not prolonged catheterisation group, two patients were excluded because of signs of a urinary tract infection (Fig. 1).
A significantly higher number of post-voiding residuals of greater than 200 mL were found in the not prolonged catheterisation group (Table 2) compared with those in the standard prolonged catheterisation group (OR 0.15, 95% CI 0.045–0.47).

**Table 2:** Outcome measures. Values in parentheses are in %.

<table>
<thead>
<tr>
<th></th>
<th>Standard prolonged (n=46)</th>
<th>Not prolonged (n=48)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. patients requiring repeated catheterisation</td>
<td>4 (9%)</td>
<td>19 (40%)</td>
<td>OR 0.145 ^1</td>
</tr>
<tr>
<td>Mean catheterisation days per patient</td>
<td>5.3</td>
<td>2.3</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Urinary tract infections</td>
<td>18 (40%)</td>
<td>2 (4%)</td>
<td>OR 14,786 ^2</td>
</tr>
<tr>
<td>Mean hospital stay in days</td>
<td>7.0</td>
<td>5.7</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

^1 = 95% CI 0.045 – 0.472  
^2 = 95% CI 3.187 – 68.595

Nineteen out of 48 (40%) patients in the not prolonged catheterisation group and 4 out of 46 (9%) in the standard prolonged group required repeat catheterisation. After removal of the second catheter, post-voiding residuals were less than 200 mL in all patients in the standard prolonged catheterisation group. In this group, one patient required catheterisation for a third time, however, this patient was excluded from
analysis because of an underlying urinary tract infection at inclusion. Two patients in the not prolonged catheterisation group had residuals more than 200 mL after re-catheterisation, which was not significant. Despite the higher number of recatheterisations in the not prolonged catheterisation group, the mean duration of catheterisation was still significantly shorter (Student’s t test, P < 0.001).

In the standard prolonged catheterisation group, the occurrence of urinary infections was significantly higher (OR = 15, 95% CI 3.2–68.6). The mean duration of stay was 1.3 days shorter in the not prolonged catheterisation group (Student’s t test, P < 0.001).

**Discussion**

Prolonged catheterisation after vaginal prolapse surgery is believed to prevent voiding problems post-operatively. Catheterisation is therefore routinely prolonged in Dutch training hospitals.

In this study, abandoning prolonged catheterisation led to a tenfold reduction of urinary tract infections. However, a higher number of residual volumes requiring recatheterisation were found in the experimental, short catheterisation group. Although this seems to be an unfavourable outcome, the mean number of catheterisation-days was lower and the majority of patients (60%) in the short duration catheterisation group did not require prolongation of catheterisation. Furthermore, hospital stay was reduced significantly in the experimental, short duration catheterisation group. A further reduction of hospital stay might be expected once the staff becomes more familiar with the new policy. Although not measured in the present study, we would expect patient satisfaction to increase with routine short duration catheterisation post-prolapse surgery. Additionally, this shorter period of catheterisation was preferred by the nursing staff.

Further research work is required to identify specific factors that increase the risk for recatheterisation and whether medication might influence the rate of recatheterisation.
References


A nationwide survey to measure practice variation of catheterisation management in patients undergoing vaginal prolapse surgery

RA Hakvoort
MP Burger
MH Emanuel
JP Roovers

Int Urogynecol J Pelvic Floor Dysfunct 2009 20(7), 813-8
Abstract

Introduction and hypothesis: Urinary catheterisation following vaginal prolapse surgery causes inconvenience for patients, risk of urinary tract infections and potentially longer hospitalisation. Possibly, practice variation exists concerning diagnosis and management of abnormal postvoid-residual volume implying suboptimal treatment for certain subgroups.

Methods: Nationwide questionnaire-based survey.

Results: Postoperatively, 77% performed transurethral indwelling catheterisation, 12% suprapubic and 11% intermittent catheterisation. Catheterisation was applied 3 days (1-7 days) following anterior repair and 1 day (1-3 days) following all other procedures. The median cut-off point for abnormal post-void residual (PVR) was 150 ml (range 50-250 ml). Treatment of abnormal PVR consisted mostly of prolonging transurethral indwelling catheterisation for 2 days (range 1-5 days) (57%), 29% by intermittent and 12% by suprapubic catheterisation. Antibiotics were administered by 21% either routinely or based on symptoms only.

Conclusions: Due to insufficient evidence and suboptimal implementation of available evidence practice variation in catheterisation regimens is high.
Introduction
Urinary catheterisation is a frequently performed procedure in hospitalised patients.\(^1\) Its use is accompanied by an increased risk of urinary tract infections, inconvenience for patients, costs and often prolonged hospitalisation.\(^{1,2}\) Therefore, the judicious use of catheterisation is important. In practice, the initiation is often poorly indicated and continuation of catheterisation is often longer than intended.\(^3\) Reported reasons for this are negligence (i.e. forgetting the presence of a catheter) and convenience for nursing staff.\(^1,3\) The importance of documentation of catheterisation regimens has been emphasised in order to diminish duration of catheterisation.\(^4\) Most gynaecologists routinely catheterise their patients following pelvic organ prolapse (POP) surgery. In this patient category, catheterisation is also frequently prolonged for several days post-operatively. Hilton and colleagues evaluated catheterisation strategies among gynaecologists in the UK and reported that initial catheterisation time varied from 1 to 7 days.\(^5\) The use of these prolonged catheterisation protocols may be prompted by the presence of a vaginal gauze post-operatively but can also be thought to be mandatory as post-operative pain, anaesthesia-related procedures and paraurethral oedema or innervation trauma can prevent optimal emptying of the bladder. Limited evidence or inadequate implementation of available evidence may result in practice variation regarding catheter regimens. Such practice variation is an unwanted feature as it might signify that not all patients receive optimal treatment. We present the data of a nationwide survey assessing the presence and content of catheterisation protocols in patients undergoing vaginal POP surgery. We also evaluated how gynaecologists defined and managed abnormal postvoid residual (PVR) volumes and urinary tract infections, as the last is the most common complication of catheterisation.

Materials and Methods
A survey was performed among all 99 general and academic hospitals in the Netherlands. A mailed questionnaire was sent to the gynecologist responsible for urogynaecology in each hospital. A reminder was sent to non-responders 3 months after the first request.

The questionnaire addressed the following five topics;


Chapter 3

**Topic 3:** Protocolised catheter regimens following different types of vaginal POP surgery.

**Topic 4:** Abnormal post-voiding residual volume: [1] the definition of abnormal PVR (cut-off point of acceptable residual bladder volume and whether this residual volume had to exceed the cut-off point at one or two different occasions), [2] the technique to measure PVR (bladderscan, catheterisation or ultrasound), and [3] management of abnormal PVR.

**Topic 5:** The definition of urinary tract infection and the indications for the administration of antibiotics.

**Statistics**

Descriptive data analysis was performed using SPSS 15.0. (SPSS Statistics UK, SPSS Inc, Chicago, IL, USA).

**Results**

A total of 99 questionnaires were distributed. After two requests, 92 of the 99 hospitals had responded, which represents an overall response rate of 93%. Table 1 shows the characteristics of the responding hospitals.

<table>
<thead>
<tr>
<th>Type of department</th>
<th>Number response</th>
<th>%</th>
<th>Urogynaecologist present</th>
<th>%</th>
<th>Protocol present</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>8</td>
<td>(100)</td>
<td>8</td>
<td>(100)</td>
<td>8</td>
<td>(100)</td>
</tr>
<tr>
<td>Teaching</td>
<td>33</td>
<td>(92)</td>
<td>30</td>
<td>(90)</td>
<td>32</td>
<td>(97)</td>
</tr>
<tr>
<td>Non-teaching</td>
<td>51</td>
<td>(93)</td>
<td>45</td>
<td>(88)</td>
<td>47</td>
<td>(85)</td>
</tr>
<tr>
<td>Total</td>
<td>92</td>
<td>(93)</td>
<td>83</td>
<td>(90)</td>
<td>87</td>
<td>(95)</td>
</tr>
</tbody>
</table>

Total number of university hospitals, teaching hospitals and non-teaching hospitals are respectively 8, 36 and 55

In the majority (90%) of the hospitals, a gynaecologist was employed with a special interest in urogynaecology. Only five hospitals did not have a catheterisation protocol, of which one was a teaching hospital. Table 2 shows the responses to questions related to pre-operative and post-operative management. Before surgery, 69% of the gynaecologists routinely empty the bladder using transurethral catheterisation. Of the respondents, 83% routinely administer antibiotics pre-operatively, 13% do not and the remaining 4% administer antibiotics per-operatively only when the abdominal cavity has been opened. Seventy-five percent of gynaecologists routinely insert a vaginal gauze post-operatively. No respondent removed the gauze later than the morning of the next post-operative day. Most gynaecologists (77%) use a
transurethral indwelling catheter for post-operative bladder drainage, 12% perform suprapubic catheterisation and 11% immediately starts intermittent catheterisation.

**Table 2:** Standard peri-operative protocol

<table>
<thead>
<tr>
<th>Routinely emptying bladder pre-operatively (n=92)</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Always</strong></td>
<td>63</td>
<td>69</td>
</tr>
<tr>
<td><strong>Type of catheter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indwelling catheter</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Intermittent catheter</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td><strong>Never</strong></td>
<td>29</td>
<td>31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard type of postoperative catheterisation (n=92)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Transurethral</td>
<td>71</td>
<td>77</td>
</tr>
<tr>
<td>Suprapubic</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Intermittent</td>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Insertion of a vaginal gauze postoperatively (n=76)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard insertion</strong></td>
<td>57</td>
<td>75</td>
</tr>
<tr>
<td><strong>When indicated:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher amounts of blood loss per-operatively</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>After surgery on more than 1 compartment</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td><strong>Never</strong></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Routine administration of antibiotics pre-operatively (n=92)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
<td>76</td>
<td>83</td>
</tr>
<tr>
<td><strong>No</strong></td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td><strong>No, only when peritoneal cavity has been opened</strong></td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Table 3:** Postoperative standard durations of transurethral indwelling catheterisation

<table>
<thead>
<tr>
<th>Duration of standard initial catheterisation</th>
<th>Different surgical procedures</th>
<th>SSF or other uterus suspension techniques</th>
<th>VH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>AR</td>
<td>PR</td>
<td>APR</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>68</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>31</td>
<td>13</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>46</td>
<td>4</td>
<td>45</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Values are numbers of hospitals*

AR: Anterior repair (with or without mesh)
PR: Posterior repair (with or without mesh)
APR: Anterior and posterior repair (with or without mesh)
SSF: Sacrospinous ligament fixation
VH: Vaginal hysterectomy
Table 3 shows median durations of transurethral indwelling catheterisation following different types of vaginal POP surgery. The median duration of initial catheterisation following anterior repair was 3 days (range 1–7 days). For the combination of anterior and posterior repair, the range was 1–5 days with a median of 3 days. Following posterior repair, this was 1 day (range 0–3 days).

Table 4 shows the responses to questions addressing abnormal PVR and its management. The cut-off value for an abnormal PVR varied from 50 to 250 mL with a median volume of 150 mL. Mostly (83%), this residual volume was measured using a bladder scanning device. In 60% of the hospitals, the residual volume was measured on two different occasions after removal of the catheter before an abnormal PVR was considered. When an abnormal PVR occurred after removal of the initial transurethral catheter, 57% inserted a transurethral catheter for the second time for 2 to 3 days, whereas 29% of the respondents started intermittent catheterisation and 12% chose suprapubic catheterisation. Two percent did not respond to this question.

<table>
<thead>
<tr>
<th>Technique of measurement residual volume</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound</td>
<td>2</td>
<td>(2)</td>
</tr>
<tr>
<td>Bladderscan</td>
<td>76</td>
<td>(83)</td>
</tr>
<tr>
<td>Catheter</td>
<td>14</td>
<td>(15)</td>
</tr>
</tbody>
</table>

**Cut-off point for residual volume (ml)**

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1</td>
<td>(1)</td>
</tr>
<tr>
<td>100</td>
<td>28</td>
<td>(30)</td>
</tr>
<tr>
<td>150</td>
<td>38</td>
<td>(41)</td>
</tr>
<tr>
<td>200</td>
<td>18</td>
<td>(20)</td>
</tr>
<tr>
<td>250</td>
<td>7</td>
<td>(8)</td>
</tr>
</tbody>
</table>

**The number of measurements required before urinary retention is diagnosed**

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 measurement directly after first voiding</td>
<td>37</td>
<td>(40)</td>
</tr>
<tr>
<td>2 measurements after 2 separate voidings</td>
<td>55</td>
<td>(60)</td>
</tr>
</tbody>
</table>

**Type of catheter after diagnosis retention**

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indwelling transurethral</td>
<td>52</td>
<td>(57)</td>
</tr>
<tr>
<td>1 day</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>2 days</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>3 days</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>4 days</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5 days</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sterile intermittent catheterisation</td>
<td>27</td>
<td>(29)</td>
</tr>
<tr>
<td>Suprapubic catheterisation</td>
<td>11</td>
<td>(12)</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>(2)</td>
</tr>
</tbody>
</table>
Practice variation in postoperative bladder care

Table 5 shows the criteria for urinary tract infection and the indications for administration of antibiotics. Twenty-one percent of respondents administered antibiotic treatment without urinary analysis or culture. Of the respondents, 66% depended on urine analysis (dipstick testing) as the minimal requirement to start antibiotic treatment. Seventy-four percent of this group found the presence of nitrite only sufficient to consider an infection present and to initiate antibiotic treatment. Only 13% requested a positive urinary culture before treatment was started. In case urine culture was demanded for, more than 70% used a cut-off point of $>10^5$ colony-forming units to consider the urine culture to be positive.

Table 5: Indication for starting antibiotic treatment and diagnosis of urinary tract infections (n=92)

<table>
<thead>
<tr>
<th>Indication for starting antibiotic treatment</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total of group that starts antibiotic treatment without urinary test</td>
<td>19</td>
<td>21</td>
</tr>
<tr>
<td>Routinely during or after catheterisation</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Symptoms without confirmation of urine analysis or culture</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Total of group that starts antibiotic treatment relying on urine analysis (dipstick testing)</td>
<td>61</td>
<td>66</td>
</tr>
<tr>
<td>Urine analysis results</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Urine analysis results or dipstick testing with complaints</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Total of group that starts antibiotic treatment relying on urinary culture</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Urinary culture results</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Urinary culture with complaints</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Diagnosis of urinary tract infection (dipstick)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrite positive only</td>
<td>68</td>
<td>74</td>
</tr>
<tr>
<td>Leucocyte positive only</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Both nitrite and leucocytes positive</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>Diagnosis of urinary tract infection (urine culture)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$10^3$ colony forming units</td>
<td>14 (15)</td>
<td></td>
</tr>
<tr>
<td>$10^4$ colony forming units</td>
<td>13 (14)</td>
<td></td>
</tr>
<tr>
<td>$10^5$ colony forming units</td>
<td>65 (71)</td>
<td></td>
</tr>
</tbody>
</table>

Diagnostic criteria are given as minimal requirement to start antibiotic treatment

Discussion

A nationwide survey was performed to assess the presence and content of catheterisation protocols after vaginal prolapse surgery and to evaluate how gynaecologists define and manage abnormal PVR as well as urinary tract infections. The proportion of hospitals with a catheterisation protocol was high (95%); however, the content of these protocols varied to a great extent. The duration of initial standard catheterisation, cut-off levels for the definition of abnormal PVR and diagnostic and therapeutic criteria for urinary tract infections varied widely. One issue
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regarding the study design needs to be discussed. The reliability of the study would have improved if a questionnaire was answered by each individual gynaecologist rather than each hospital. However, we believe that the study reflects the routine clinical practice in The Netherlands accurately because of the high percentage of hospitals with a catheterisation protocol and the high response rate obtained in our study. Most gynaecologists routinely administer prophylactic antibiotics before surgery. There is no evidence available to support or reject such regimen with regard to infectious complications post-operatively.6 With respect to the need of post-operative insertion of vaginal gauze for haemostatic reasons, there is no available evidence to support or reject routine insertion after the different types of vaginal surgery. There is limited evidence that 3 h of vaginal packing would be as sufficient for the prevention of post-operative haemorrhage or haematoma as vaginal packing for 24 h.7,8 The most frequently performed type of catheterisation was transurethral indwelling catheterisation. This was, on average, applied 3 days (range 1–7 days) in patients undergoing anterior repair. Based on two randomised trials, this standard duration of 3 days following anterior colporrhaphy appears to be too long as the majority of patients do not encounter voiding problems 1 day after surgery.9,10 Only five hospitals applied an initial catheterisation period of 1 day post-operatively, implicating overtreatment in a significant proportion of patients. After removal of the first catheter, the decision to recatheterise depends on the definition of abnormal PVR. Therefore, a question was included about the used definitions for PVR and the reliability of the methods to measure PVR. Transurethral catheterisation will yield reliable representations of PVR only when the measurement is performed directly after voiding to minimise refilling due to continuing diuresis. Furthermore, there is minimal evidence that Foley catheters do not represent PVR as accurately as shorter catheters.11 Studies evaluating the accuracy of bladder scanning devices for measuring PVR have reported good correlations with catheterised bladder volume 12-14, although some conflicting data are available.15 Together with the non-invasiveness of bladder scanning, it makes this procedure an appropriate method which is reflected by the high percentage of respondents using bladder scanning devices. The wide range (50–250 mL) in cut-off points for considering PVR to be pathological reflects the absence of evidence or guidelines regarding this matter.16 As abnormal PVR is a complication that necessitates additional treatment, the absence of consensus implies that part of the patients receive either undertreatment or overtreatment. The choice for different types of catheterisation when abnormal PVR is diagnosed can depend on evidence, experience with a certain method and patient’s preferences. The group that initially had chosen suprapubic catheterisation continued this treatment for obvious reasons. Suprapubic catheterisation is tolerated better
than transurethral indwelling catheterisation and offers the possibility of clamping and voiding trials while the catheter stays in place.\textsuperscript{17} Furthermore, the risk of urinary tract infection is lower when compared to transurethral indwelling catheterisation.\textsuperscript{18} However, the risk of complications while placing suprapubic catheters justifies a reserved attitude towards this technique.\textsuperscript{19} This is especially the case after vaginal prolapse surgery after which the duration of initial catheterisation can be reduced to 1 day or even less.\textsuperscript{8-10} Possibly, the small proportion of gynaecologists that initially inserts a suprapubic catheter reflects this notion. A significant proportion of gynaecologists that initially applied transurethral indwelling catheterisation (77\%) did the same in case of retention (57\%); however, 17 of the 92 respondents changed to intermittent catheterisation (18\%). This shift towards this treatment can possibly be explained by the advantage of intermittent catheterisation that treatment can be stopped immediately when retention is not present anymore and the finding that, in general, intermittent catheterisation exhibits a lower risk of bacteriuria compared to indwelling transurethral catheterisation.\textsuperscript{17} Intermittent catheterisation, therefore, should be considered more often in the treatment of abnormal PVR. However, randomised studies are needed to determine the required duration of catheterisation and the consecutive risk of urinary tract infection with the two methods. The last topic of our questionnaire addressed definitions and management of urinary tract infection. Based on the data from our study, it appears that patients undergoing catheterisation are exposed to a significant risk of unneeded treatment for urinary tract infection due to suboptimal implementation of evidence regarding the use of antibiotic treatment and diagnostic tests. About one out of five responders routinely administer antibiotics during prolonged catheterisation or based on the presence of symptoms suggestive for urinary tract infection without additional diagnostic testing. Standard antibiotic treatment during or after removal of the catheter is not indicated in urogynaecology patients as many have no bacteriuria or appear to clear bacteriuria without antibiotics.\textsuperscript{9,20} Treatment based on symptoms only seems also unjustified, as large prospective studies found similar incidences of symptoms in groups of patients with urinary tract infections and without urinary tract infections.\textsuperscript{2} Although this study did not concern patients after prolapse surgery, it shows that the presence of the catheter itself can produce similar symptoms. Therefore, starting antibiotic treatment based on symptoms only is questionable. Diagnostic tests applied to screen for the presence of urinary tract infection in Dutch laboratories mostly comprise urine dipstick testing. When indicated, sedimentation is performed or the urine is cultured. The combined observation of both a negative nitrite and negative leucocyte esterase test result when performing dipstick testing has the highest predictive value to exclude the presence of bacteriuria.\textsuperscript{21,22} That our study
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shows that 74% of the responders define the presence of urinary tract infection in case of the presence of nitrite only demonstrates that possibly many patients are treated with antibiotics without proper diagnosis. In conclusion, practice variation of catheterisation regimes following POP surgery probably exists due to limited evidence on this subject and to suboptimal implementation of the evidence that is available. Consequences of this practice variation are unnecessary prolonging of catheterisation, an increase of urinary tract infections related to prolonged catheterisation, overadministration of antibiotics, prolonged hospitalisation and, consequently, increased costs. Well-designed studies are urgently needed to optimise catheterisation management and to develop evidence-based definitions of abnormal PVR and urinary tract infections.
References


Comparing clean intermittent catheterisation and transurethral indwelling catheterisation for incomplete voiding after vaginal prolapse surgery: a multicentre randomised trial

RA Hakvoort
SD Thijs
FW Bouwmeester
AM Broekman
IM Ruhe
MM Vernooij
MP Burger
MH Emanuel
JP Roovers

BJOG 2011 118(9), 1055-60
Abstract

Objective: To compare clean intermittent catheterisation with transurethral indwelling catheterisation for the treatment of abnormal post-void residual bladder volume (PVR) following vaginal prolapse surgery.

Design: Multicentre randomised controlled trial.

Setting: Five teaching hospitals and one non-teaching hospital in the Netherlands.

Population: All patients older than 18 years experiencing abnormal PVR following vaginal prolapse surgery, with or without the use of mesh. Exclusion criteria were: any neurological or anxiety disorder, or the need for combined anti-incontinence surgery.

Methods: All patients were given an indwelling catheter directly after surgery, which was removed on the first postoperative day. Patients with a PVR of more than 150 ml after their first void were randomised for clean intermittent catheterisation (CIC), performed by nursing staff, or for transurethral indwelling catheterisation (TIC) for 3 days.

Main outcome measure: Bacteriuria rate at end of treatment.

Results: A total of 87 patients were included in the study. Compared with the TIC group ($n = 42$), there was a lower risk of developing bacteriuria (14 versus 38%; $P = 0.02$) or urinary tract infection (UTI; 12 versus 33%; $P = 0.03$) in the CIC group ($n = 45$); moreover, a shorter period of catheterisation was required (18 hours CIC versus 72 hours TIC; $P < 0.001$). Patient satisfaction was similar in the two groups, and no adverse events occurred.

Conclusion: Clean intermittent catheterisation is preferable over indwelling catheterisation for 3 days in the treatment of abnormal PVR following vaginal prolapse surgery.
Introduction
Incomplete emptying of the bladder is one of the most common unwanted side effects of vaginal prolapse surgery. The incidence varies widely between studies because of differences in definition, but has been shown to vary from 1.4 to as high as 40%. When the problem is unrecognised or left untreated, bladder overdistension can occur, which can have negative effects on bladder function in the long term. Although the inability to adequately empty the bladder is generally short lasting, there is a huge variation in the management of this complication, and many physicians still tend to initially catheterise for several days. Based on a Cochrane review studying catheter policies after urogenital surgery, and other recent randomised controlled trials studying catheterisation specifically after vaginal prolapse surgery, there is an ongoing trend to further restrict the duration of this standard prolonged catheterisation. However, there is insufficient evidence to tell whether this duration should be 1 day postoperatively or even less. Naturally, patients who experience abnormal post-void residual volumes (PVR) should receive additional treatment. To our knowledge, no evidence exists regarding treatment strategies following vaginal prolapse surgery once abnormal PVR has developed. The absence of such evidence implies that there are risks of practice variation and the unnecessary prolonging of catheterisation, with consequently higher rates of urinary tract infection (UTI). Therefore, a randomised controlled trial was designed in which patients who developed abnormal PVR were randomised between 3-day prolongation of transurethral indwelling catheterisation (TIC) and clean intermittent catheterisation (CIC), performed by nursing staff.

Methods
A randomised controlled trial was performed in five teaching hospitals and one non-teaching hospital in the Netherlands. The allocation ratio was 1:1. Approval was obtained from the institutional review boards of all participating centres. All patients older than 18 years of age with symptomatic pelvic organ prolapse experiencing abnormal PVR following vaginal prolapse surgery, with or without the use of mesh, were eligible. We defined abnormal PVR as a post-voiding residual volume exceeding 150 ml, measured by bladder scanning. Exclusion criteria were: any neurological or anxiety disorder, or the need for combined anti-incontinence surgery. Patients were informed about the study preoperatively and written informed consent was obtained. The prolapse was routinely staged according to the pelvic organ prolapse quantification (POPQ) staging system. Surgery was performed by gynaecologists with a special interest in urogynaecology. Although small variations in surgical technique may have occurred, the surgeons had a similar surgical basis. All patients received prophylactic antibiotics during surgery. A 14 french silicone transurethral
indwelling catheter and a vaginal gauze were inserted directly after surgery. The catheter and gauze were removed on the morning of the first postoperative day. Directly after the first attempt to void the residual volume was measured using a bladder-scanning device (Verathon-Diagnostic Ultrasound DxU BVI 3000 or BVI 6100; BVI, IJsselstein, the Netherlands), and the voided volume was measured in millilitres.

**Catheterisation regimens**

Patients with a PVR ≥150 ml as measured by bladder scan on the first postoperative day were randomised for a 3-day trial of TIC or CIC. In the TIC group a 14 french silicone catheter was inserted by nursing staff. In the CIC group a SpeediCath® (Coloplast, Humlebaek, Denmark) catheter was inserted with a maximum interval of 6 hours. Depending on randomisation, patients were allowed to go home with either an indwelling catheter or, when able to self-catheterise, with instructions to perform clean intermittent self-catheterisation. Information on the study was provided by a research nurse, who also enrolled the participants. Computerised block randomisation was performed by the attending residents or gynaecologists. The attending nurse assigned participants to interventions. Because of the obvious dissimilarity of the intervention, blinding of the next treatment allocation was not possible. In the case of a persistent abnormal PVR after the initial period of 3 days, the surgeon was free to continue treatment by either TIC or CIC.

**Outcome measurements**

The primary outcome measure was bacteriuria. This outcome measure was chosen because this factor was expected to be least influenced by the design of the study, in which one group received an indwelling catheter for 3 days. Significant bacteriuria was defined as >10^5 colony-forming units in a culture. This culture was taken from the first void after PVR had normalised to <150 ml and after either method of catheterisation was finished. Assessments were performed by the microbiology laboratories of the institutions. During the treatment, investigators were not informed about the results of this culture.

Secondary outcome measures included:

1. UTI. Patients meeting the criterion of bacteriuria (culture with more than 10^5 colony forming units) combined with one or more of the following complaints: fever, urinary frequency (more than seven voids a day), dysuria or lower abdominal pain. Patients were asked about the presence of symptoms indicative for the presence of UTI by the principal investigator 1 week after normalisation of abnormal PVR, or
earlier when patients reported the aforementioned symptoms themselves. These complaints were combined with the results of the culture to define UTI.

2. Duration of catheterisation until normalisation of PVR occurred.
3. Number of introductions of the catheter.
4. Duration of hospital stay.
5. Pain scores, difficulty with catheter use and patient satisfaction. These factors were assessed using visual analogue scores. Patients were asked to put an ‘X’ on a 10-cm line, ranging from 0 to 100 between the two extremes, and the distance from the beginning of the line to the ‘X’ was measured. A score of zero corresponded to ‘no difficulty’, whereas a score of 100 corresponded to ‘maximal difficulty’, related to the ease of use of the catheter.

Furthermore, patients were asked to answer whether they would choose the same treatment again (yes or no).

Finally, the post-residual volume was categorised: <300 ml; 300–500 ml; and >500 ml. Then an analysis of variants (ANOVA) was performed to test the differences in duration for normalisation of bladder emptying between these categories for statistical significance. Bonferroni’s correction was used to correct for multiple testing.

**Power calculation**
Studies have shown that the risk on bacteriuria increases by approximately 10% for each additional day of indwelling catheterisation.\(^1,3\) The combined effect of the initial catheter, introduced directly after surgery, and the catheter for the treatment of incomplete voiding on the risk of developing bacteruria was estimated to be around 35%.\(^1,3\) A difference in bacteriuria of more than 20% between both interventions was considered to be clinically relevant. To observe a difference of 35 versus 15% with 90% power, and an alpha of 0.05, 42 patients needed to be included per group.

**Statistical analysis**
The data were analysed by intention to treat. To examine differences between groups, we used an unpaired Student’s \(t\)-test for continuous variables and a Fisher’s exact test for dichotomous variables. A Mann–Whitney \(U\)-test was performed to test nonparametric outcomes for statistical significance. In the case of multiple group comparisons, an ANOVA was performed and Bonferroni’s correction was applied for post-hoc tests. Two-sided significance tests were used throughout. \(P < 0.05\) was considered to be statistically significant. Statistics were performed using spss v16.0 (SPSS Statistics UK, SPSS Inc., Chicago, IL, USA).
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Results
From August 2007 until May 2009 a total of 1037 patients underwent vaginal prolapse surgery in the participating centres. Of these patients, 147 (14%) experienced an abnormal PVR, 87 of which were eventually included in the trial (see Figure 1).

Figure 1: Flow diagram of patients through each part of the study (CONSORT).

A total of 45 patients were randomised in the CIC group. In the TIC group, 42 patients were randomised. All patients received the allocated intervention and nobody pulled out of the study. No adverse events occurred. The baseline characteristics of both groups are shown in in Table 1. All these characteristics were similar for both groups. None of the patients used antibiotics preoperatively, nor were there any patients
using medication affecting bladder and bladder outlet, such as anticholinergic or alpha adrenergic agents.

Table 1: Patient characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>CIC (n=45)</th>
<th>TIC (n=42)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>60 (12)</td>
<td>61 (10)</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>26 (1.8)</td>
<td>23 (1.9)</td>
</tr>
<tr>
<td>Parity (median, range)</td>
<td>2 (1 – 5)</td>
<td>3 (1 – 4)</td>
</tr>
<tr>
<td>POP-Q (before surgery)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point Ba</td>
<td>0.5 (1.4)</td>
<td>0.8 (1.3)</td>
</tr>
<tr>
<td>Point Bp</td>
<td>-1.5 (1.8)</td>
<td>-1.5 (1.7)</td>
</tr>
<tr>
<td>Point C</td>
<td>-2.5 (3.2)</td>
<td>-2.0 (3.5)</td>
</tr>
<tr>
<td>Repair anterior compartment performed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior colporrhaphy</td>
<td>42/45 (93)</td>
<td>36/42 (86)</td>
</tr>
<tr>
<td>Mesh</td>
<td>2/45 (4)</td>
<td>3/42 (7)</td>
</tr>
<tr>
<td>Repair posterior compartment performed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posterior colporrhaphy</td>
<td>15/45 (33)</td>
<td>20/42 (48)</td>
</tr>
<tr>
<td>Mesh</td>
<td>1/45 (2)</td>
<td>1/42 (2)</td>
</tr>
<tr>
<td>Repair middle compartment performed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manchester repair</td>
<td>2/45 (4)</td>
<td>5/42 (12)</td>
</tr>
<tr>
<td>Sacrospinous ligament fixation</td>
<td>3/45 (7)</td>
<td>4/42 (10)</td>
</tr>
<tr>
<td>Vaginal hysterectomy</td>
<td>11/45 (24)</td>
<td>8/42 (19)</td>
</tr>
<tr>
<td>Operating time (min)</td>
<td>49 (21)</td>
<td>52 (25)</td>
</tr>
<tr>
<td>Blood loss peroperatively (ml)</td>
<td>143 (96)</td>
<td>136 (81)</td>
</tr>
<tr>
<td>Height of abnormal PVR postoperatively</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>385 (15)</td>
<td>455 (25)</td>
</tr>
<tr>
<td>Median (range 5-95%)</td>
<td>400 (162-647)</td>
<td>400 (167-1000)</td>
</tr>
</tbody>
</table>

CIC Clean intermittent catheterisation
TIC Transurethral indwelling catheterisation
Data are presented as mean (sd) or n (%), unless otherwise indicated

Table 2: Comparison of required duration of catheterisation, bacteriuria, number of catheterisations and hospitalisation

<table>
<thead>
<tr>
<th></th>
<th>CIC (n=45)</th>
<th>TIC (n=42)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteriuria</td>
<td>6 (14)</td>
<td>15 (38)</td>
<td>0.02¹</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>5 (12)</td>
<td>13 (33)</td>
<td>0.03¹</td>
</tr>
<tr>
<td>Duration of catheterization (hours)</td>
<td>18 (5–112)</td>
<td>72 (72–144)</td>
<td>&lt;0.001²</td>
</tr>
<tr>
<td>Number of catheter introductions</td>
<td>3 (1–18)</td>
<td>1 (1–2)</td>
<td>&lt;0.001²</td>
</tr>
<tr>
<td>Duration of hospitalization (days)</td>
<td>2 (1–6)</td>
<td>4 (1–7)</td>
<td>&lt;0.001²</td>
</tr>
</tbody>
</table>

Data are presented as median (range) or n (%)
¹ Mann-Whitney U test, ² Fisher’s exact Test
A significantly lower risk of bacteriuria and UTI was found in the CIC group (14 versus 38%; \( P = 0.02 \)). The risk of UTI was also significantly lower in the CIC group (12 versus 33%; \( P = 0.03 \)). Furthermore, a shorter duration of treatment was found in the CIC group. The normalisation of abnormal PVR occurred 54 hours earlier in the CIC group. The mean length of time to normalise bladder emptying in patients with a PVR of <300 ml was 22 hours shorter (95% CI 2–42 hours; \( P = 0.02 \)), compared with patients with a PVR of 300–500 ml, and 27 hours shorter (95% CI 4–50 hours; \( P = 0.02 \)), compared with patients with a PVR of >500 ml. The difference in time to normalise bladder emptying between patients with a PVR of 300–500 ml and patients with a PVR > 500 ml was 5 hours, and this was not considered to be statistically significant. Table 3 shows that pain scores, ease of use of catheter and extent of patient satisfaction were similar.

### Table 3: Pain score, acceptance and satisfaction with treatment

<table>
<thead>
<tr>
<th></th>
<th>CIC (n=45)</th>
<th>TIC (n=42)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain due to catheterisation*</td>
<td>29 (24)</td>
<td>34 (27)</td>
<td>0.45</td>
</tr>
<tr>
<td>Bother due to catheter use*</td>
<td>28 (25)</td>
<td>36 (32)</td>
<td>0.20</td>
</tr>
<tr>
<td>Extent of satisfaction *</td>
<td>80 (22)</td>
<td>76 (24)</td>
<td>0.41</td>
</tr>
<tr>
<td>Number of patients that would choose the same treatment again (n,%) #</td>
<td>37/38 (97)</td>
<td>33/35 (94)</td>
<td>0.60</td>
</tr>
</tbody>
</table>

*Data are mean scores calculated from a 10 cm visual analogue score 0-100
# In both CIC and TIC group seven patients were lost to follow up.

### Discussion

A randomised controlled trial was performed to compare CIC with TIC for patients who experience abnormal PVR after vaginal prolapse surgery. The main findings of this study were that CIC results in a lower risk of bacteriuria and UTI, as well as a faster normalisation of bladder emptying. The occurrence of a higher risk of bacteriuria and UTI in the TIC group compared with the CIC group was a marked difference. We analysed both bacteriuria and UTI in our study, as we think both outcomes are relevant. One could argue that UTI is a more relevant clinical parameter than bacteriuria, and is therefore preferable. However, although there is consensus about suggestive symptoms, UTI could be considered less suitable as its diagnosis is not clearly defined.\(^{13}\) Moreover, the most frequently applied complaints of urgency, dysuria, frequency or lower abdominal pain appear to be frequently present during and after catheterisation, even in the absence of bacteriuria.\(^{13,14}\) During catheterisation, bacteriuria can develop through two mechanisms: direct inoculation from the insertion of the catheter; and colonisation, through bacteria ascending intraluminally.
and/or extraluminally from the urethral meatus along the catheter. The continuing presence of an indwelling catheter with TIC was followed by a higher risk of bacteriuria, which suggests a significant role for colonisation in the development of bacteriuria. Spontaneous clearance of bacteriuria has been described provided that micturition can occur freely, which thus requires the absence of a catheter. Although the repeated introduction of catheters and bacteria with CIC may also induce bacteriuria, we believe that the action of emptying the bladder is advantageous by preventing the pooling of infected urine.

Furthermore, we found a shorter duration of treatment in the CIC group. The essence of CIC is that the intermittent filling and emptying of the bladder possibly trains the bladder to sensate the difference between a filled and emptied status. Such bladder training could be responsible for the quick resumption of voiding, although studies regarding this mechanism after urogynaecological surgery have shown conflicting results. Alternatively, the shorter required duration of treatment in the CIC group could arise from a problem in the definitions used. In the absence of an exact cut-off value of pathologic PVR, variation may occur regarding the occurrence and treatment results of abnormal PVR. We followed the most recent survey and used a cut-off value of 150 ml. Treatment of residual volumes below 300 ml took significantly less time to normalise than treatment of PVRs above 300 ml. We hypothesise that the treatment time for patients with initially low abnormal volumes, below 300 ml, was shorter because the natural course of these PVRs are favourable, and are possibly even self-limiting. Hypothetically, the cut-off value of abnormal PVR could be between 150 and 300 ml, but this can’t be exactly defined based on our trial results. Patients’ scores for ease of use and satisfaction did not differ, despite the fact that the results clearly indicate the advantages of CIC. One of the reasons for this could be that patients who have actually undergone a certain intervention tend to prefer that particular intervention.

Intermittent self-catheterisation has been shown to be a highly acceptable method for patients, with a high degree of freedom and less embarrassment, as opposed to using a suprapubic catheter (SPC), described in one study. When we take this study into account we could expect that the freedom and mobility with CIC would result in a high satisfaction score. Carrying a leg bag with TIC would be expected to result in more embarrassment and an unpleasant feeling of the catheter. However, conversely it is not unthinkable that the TIC group could still reach a high rate of satisfaction because of the single insertion, as opposed to the bother of repeated insertion by CIC. Another factor might have been that in our CIC group catheterisation was performed by nursing staff. Possibly these patients experienced less autonomy.
and, as a consequence, less satisfaction than they would have in the case of self-catheterisation. In addition, patients were only informed about the protocol of the other option before they decided to participate in the study, but naturally were not informed about the outcomes.

Some issues need to be discussed concerning the study design. We chose to compare CIC with indwelling catheterisation, and to leave SPC out of the comparison for several reasons. The risk of complications while placing SPCs justifies a reserved attitude towards this technique.24 This is especially the case after vaginal prolapse surgery, when the duration of initial catheterisation can be reduced to 1 day or even less.1–3,10 Furthermore, three studies show advantages of CIC over SPC concerning acceptability, duration of treatment and hospitalisation.23,25,26 The length of the prolongation period in the TIC group of 3 days might seem arbitrary. This period was chosen to reflect common practice in the Netherlands.9 Furthermore, the comparison of CIC with an additional period of 3 days of catheterisation (TIC) might have been advantageous for CIC, as the duration of treatment in the TIC group was destined to be 3 days, with the possible consequence of a concurrent rise in the rates of bacteriuria and UTI.10 However, the mean duration for CIC after prolapse surgery in another randomised study was 5 days.26 Therefore, this advantage could not have been anticipated beforehand.

**Conclusion**

This randomised trial compared two of the most frequently applied management strategies for abnormal PVR following prolapse surgery. It was observed that CIC yields a lower risk of bacteriuria and UTI. The study clearly indicates that intermittent catheterisation is a better treatment option than indwelling catheterisation after vaginal prolapse surgery. Future research will be directed towards identifying high- and low-risk subgroups, defining cut-off values and studying patient preferences to further optimise treatment.
Optimising catheterisation strategies for incomplete voiding

References


Chapter 5

Patient preferences for clean intermittent catheterisation and transurethral indwelling catheterisation for treatment of abnormal post void residual bladder volume after vaginal prolapse surgery

RA Hakvoort  
PT Nieuwkerk  
MP Burger  
MH Emanuel  
JP Roovers

BJOG 2011 118(11), 1324-8
Chapter 5

Abstract

Objective: To determine patient preferences for clean intermittent catheterisation (CIC) relative to transurethral indwelling catheterisation (TIC) as the treatment of abnormal post-void residual bladder volume (PVR) following vaginal prolapse surgery.

Design: Scenario-based preference assessment during face-to-face interview.

Setting: Teaching hospital.

Population: A sample of consecutive patients scheduled for vaginal prolapse surgery.

Methods: Preference for CIC relative to TIC was assessed using written treatment scenarios. Initially, treatment duration was set at 3 days and the risk for urinary tract infection (UTI) was 30% for both interventions. Both treatment duration and UTI risk related to TIC were kept constant. Treatment duration and UTI risk after CIC were varied until patients altered their preference. In this way, the duration of catheterisation and level of UTI risk related to CIC at which patients would prefer CIC to TIC could be determined.

Main outcome measures: Patients’ preference for CIC relative to TIC.

Results: When both duration of treatment and UTI risk were identical for both interventions, 64% of patients prefer CIC. Ninety-two percent of patients prefer CIC when CIC lasts 3 days but results in a 15% lower risk of UTI. Assuming that CIC results in a 15% risk of UTI, a total of 98 and 99% of patients prefer CIC to TIC when catheterisation with CIC last 2 and 1 day, respectively.

Conclusions: Most patients with abnormal PVR prefer CIC to TIC. The results of a recent randomised controlled trial showed that CIC resulted in a 2 days shorter catheterisation and more than 20% reduced risk of UTI. These conditions correspond to a preference of 99% of patients for CIC.
Patient preferences for types of catheterisation

Introduction
Pelvic organ prolapse (POP) is a highly prevalent disease.¹ One of the most frequent complications of POP surgery is incomplete emptying of the bladder. On the first postoperative day this risk varies from 1.5 to 40%.²⁻⁵ To prevent bladder over-distention after surgery, most often indwelling catheters are inserted into the bladder during the period in which patients have the highest risk of abnormal post-void residual volume (PVR).⁶ The optimal duration of such indwelling catheterisation is debatable. If catheterisation is too short, the patient may encounter problems in adequately emptying the bladder. If catheterisation lasts too long there is an increased risk of colonisation of the bladder and increased costs arising from a longer period of hospitalisation.³⁻⁴ Whichever method of catheterisation after POP surgery is chosen, some patients will present with an abnormal PVR after the removal of the catheter. The optimal management in these patients has not been defined. One could decide to either replace the transurethral indwelling catheter (TIC) for a given period or start clean intermittent catheterisation (CIC). Intermittent catheterisation has been shown to be well accepted by patients.⁷⁻⁹ Even so, no formal studies have compared and established the preferences for these treatment modalities. As it is generally acknowledged that preference assessment should be incorporated into medical decision making,¹⁰ our objective was to investigate whether patients prefer CIC or TIC for the treatment of abnormal PVR after vaginal prolapse surgery.

Materials and Methods
The patient’s preference for CIC relative to TIC was assessed during a face-to-face interview, using written treatment scenarios.¹²,¹³ This study was performed in the Spaarne Hospital, Hoofddorp, the Netherlands. Approval was obtained from the local medical ethics committee. Patients were eligible if they were 18 years of age or older, were scheduled for vaginal prolapse surgery and had never been catheterised before. Patients were not eligible if they had a neurological or anxiety disorder, or if they underwent vaginal prolapse surgery combined with anti-incontinence surgery. Written informed consent was obtained from each patient. All were interviewed by the same gynaecologist between June 2008 and March 2009.

Written scenarios for both treatments included a description of the procedure of that specific method of catheterisation. The first method was TIC for 3 days, and the second method was CIC. The essential difference between the two interventions was clarified: that is, the difference between the placement of an indwelling catheter for 3 days (TIC) versus the repeated insertion of a catheter (CIC) for the same period of time. In the initial description of both interventions, treatment duration was set at 3 days and the risk of urinary tract infection (UTI) was estimated as 30%. The duration of
3 days was based on a recent survey to evaluate current clinical practice in the Netherlands, which showed that this duration is one of the most popular treatment protocols. The estimation of a 30% risk of UTI was based on studies reporting an increased risk of UTI of 10% per additional day with the placement of an indwelling catheter. After having read both treatment scenarios, patients were asked which mode of intervention they would prefer in the case of abnormal PVR. Furthermore, we asked patients about factors affecting their preference other than the ones that were structurally assessed in the interview (UTI and duration of treatment). We asked five experts in the field of urogynaecology to subclassify these reasons into main categories.

After patients expressed their preference for CIC or TIC based on the initial scenario, the duration of treatment and UTI risk after CIC were systematically varied until patients switched from their initially preferred intervention to the other.

Patients who initially preferred CIC
If CIC was the initially preferred intervention, we quantified at which risk of UTI patients were willing to switch their preference to TIC (assuming that TIC implicated a duration of 3 days and risk of UTI of 30%). For this purpose, we first presented the patients scenarios in which the duration of CIC treatment remained 3 days, whereas the risk of UTI was gradually raised with steps of 5% from 30% to a maximum of 45%. We recorded at what level of UTI risk the patient switched preference to TIC. Subsequently, we recorded at what duration of CIC the patient would switch back from TIC to CIC. Scenarios were presented with a standardised UTI risk at the particular level defined in the previous experiment, whereas the duration of CIC treatment was decreased (in steps of 1 day) from 3 to 1 day. In all of these scenarios, TIC meant a treatment duration of 3 days and a UTI risk of 30%.

Patients who initially preferred TIC
If TIC was the initially preferred intervention, the next step from the initial scenario was to investigate whether these patients would switch from TIC to CIC if CIC resulted in faster recovery to normal PVR bladder volume. The duration of CIC treatment was decreased in steps of 1 day from 3 to 1 day, whereas the UTI risk remained at 30% for both interventions. We recorded at what duration of treatment patients switched preference from TIC to CIC. Subsequently, we measured at which level of UTI risk patients would switch preference from TIC to CIC. To do so, we returned to the initial scenario and first decreased the UTI risk with CIC treatment in steps of 5%, from an initial level of 30 to 15%, whereas the duration of CIC remained at 3 days. Then we increased the UTI risk related to CIC in
steps of 5%, from the initial level of 30 to 45%.
After these steps, preferences were assessed for all 12 remaining combinations in which duration of treatment differed by 1 or 2 days in favour of CIC with a 5, 10 and 15% lower or higher UTI risk with CIC.

Data analysis
Patients’ preference for CIC relative to TIC was the main outcome measure. For each combination of UTI risk and duration of treatment using CIC, we determined whether patients preferred CIC to TIC, or not. A preference for CIC was assigned a score of 1. No preference for CIC was assigned a score of 0. The proportion of patients that preferred CIC as opposed to TIC for each combination of UTI risk and duration of treatment was quantified. To investigate the independent influence of UTI risk and duration of treatment on preference for CIC relative to TIC, we applied a repeated-measures logistic regression analysis by the generalised estimating equations (GEE) method with a logit link, a binomial distribution and unstructured correlation. GEE accounts for the correlation between preferences within a patient across scenarios. We estimated odds ratios and 95% confidence intervals on preferring CIC to TIC at the various risks of UTI after CIC, and duration of treatment for CIC, using GEE. We investigated whether demographic (age and educational level) and clinical characteristics (body mass index, parity, and prolapse severity measurements using the POPQ classification being the most distal portions of anterior wall (Ba), posterior wall (Bp) and position of the cervix (C)) were associated with a preference for CIC using GEE. Data analysis was conducted using spss 16.0.

Table 1: Patient characteristics (n = 85)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>66.1</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.6</td>
</tr>
<tr>
<td>Parity*</td>
<td>2</td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
</tr>
<tr>
<td>Below compulsory- or compulsory school education</td>
<td>33/82 (40%)</td>
</tr>
<tr>
<td>Lower vocational school</td>
<td>22/82 (27%)</td>
</tr>
<tr>
<td>Advanced vocational school or university</td>
<td>27/82 (33%)</td>
</tr>
<tr>
<td>Ba (cm)</td>
<td>0.54</td>
</tr>
<tr>
<td>Bp (cm)</td>
<td>-1.71</td>
</tr>
<tr>
<td>C (cm)</td>
<td>-2.11</td>
</tr>
</tbody>
</table>

1. Data are presented as means (SDs) or number (%), unless otherwise indicated.
2. Ba, Bp and C are quantitative measurements of the degree of prolapse of anterior, posterior and apical compartments.
Chapter 5

Results

A total of 94 consecutive patients were asked to participate in this study, of which 86 (89%) patients agreed to be interviewed. Two patients refused to participate after receiving the written study information, and three patients agreed to participate but had difficulty understanding the questions, and consequently retired from the study. Another three patients were unable to express a preference for one of the interventions, and could therefore not complete the interview.

The characteristics of patients who participated in the preference study are shown in Table 1. The mean age of the interviewed patients was 66 years. The patients predominantly suffered from prolapse of the anterior compartment. The duration of treatment and UTI risk both had a statistically significant effect on patient preference for CIC (Table 2). None of the demographic and clinical characteristics were significantly associated with a preference for CIC (data not shown).

Table 2: Independent effects of duration of hospitalisation and risk of bacteriuria on preference for clean intermittent catheterisation

<table>
<thead>
<tr>
<th>Duration of hospitalisation for CIC</th>
<th>OR (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 days</td>
<td>Reference</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>2 days</td>
<td>1.64 (1.34 - 2.01)</td>
<td></td>
</tr>
<tr>
<td>1 day</td>
<td>3.97 (3.00 - 5.26)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk of bacteriuria after CIC</th>
<th>OR (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>45%</td>
<td>0.05 (0.03 - 0.08)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>40%</td>
<td>0.15 (0.10 - 0.23)</td>
<td></td>
</tr>
<tr>
<td>35%</td>
<td>0.37 (0.27 - 0.51)</td>
<td></td>
</tr>
<tr>
<td>30%</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>1.57 (1.16 - 2.13)</td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>2.51 (1.58 - 4.00)</td>
<td></td>
</tr>
<tr>
<td>15%</td>
<td>4.94 (2.62 - 9.32)</td>
<td></td>
</tr>
</tbody>
</table>

OR= odds ratio  
CI= confidence interval  
CIC= clean intermittent catheterisation  
UTI= urinary tract infection  
TIC= transurethral indwelling catheterisation.

Figure 1 shows the proportion of patients preferring CIC to TIC for each combination of duration and UTI risk of CIC, as compared with a fixed TIC treatment regimen that implies a 30% risk of UTI and 3-day duration of treatment.
In the initial scenario, in which the risk of UTI was set at 30% and the duration of treatment was set at 3 days for both treatments, a total of 64% of the patients would prefer CIC. Reducing the risk of UTI related to CIC and decreasing the duration of treatment after CIC both resulted in an increased proportion of patients preferring CIC to TIC. When CIC and TIC carry a similar risk of UTI and the duration of treatment is 2 days shorter with CIC, the proportion of patients preferring CIC increased from 64 to 90%. If the UTI risk was estimated as 15% lower in the CIC group and the CIC treatment duration was also made 1 or 2 days shorter than for TIC, the proportion of patients preferring CIC increased to 98 and 99%, respectively.

Increasing the risk of UTI for CIC diminished the preference for CIC. Even so, 28 and 36% of patients would prefer CIC in the case of a 15% higher risk of UTI if CIC resulted in 1 or 2 days shorter treatment, respectively.

Of the 86 participants, 74 (86%) provided a reason for their initial preference. The group of experts categorised these reasons, which resulted in four domains: expected discomfort; safety; autonomy; and pain.

Of the 31 patients who preferred TIC, 24 (77%) did so based on expected discomfort.
of repeated catheter introductions with CIC. Other reasons expressed were the expectation that TIC was safer (13%) or less painful (11%). Of the 55 patients who preferred CIC, 45 (82%) patients provided a reason why they preferred CIC. The reasons included: the expectation that CIC would give less discomfort than TIC (n = 24, 53.3%); the expectation that CIC would give more autonomy (n = 15, 33.3%); and the expectation that CIC was associated with less pain (n = 6, 13.3%).

**Discussion**

We investigated whether patients scheduled for vaginal prolapse surgery would prefer either CIC or TIC in the case of abnormal PVR after withdrawal of the postoperatively placed catheter. We did so by scenario-based preference assessment during a face-to-face interview.

The majority of the patients interviewed would prefer CIC if the duration of treatment and the risk of UTI is similar for both interventions. In this situation, most patients made this choice based on the expected level of discomfort of the treatments. When CIC is predicted to last 3 days and has a 15% lower risk of UTI than TIC, the proportion of patients preferring CIC increases to 92%. Assuming that CIC resulted in a 15% lower risk of UTI, and also in a shorter duration of treatment by 1 or 2 days, compared with TIC, 98 and 99%, respectively, of patients preferred CIC to TIC.

All patients in the study were scheduled for vaginal prolapse surgery, and were thus at risk of developing abnormal PVR after surgery. However, they were interviewed before the operation, and thus did not know whether they would suffer from abnormal PVR and how much bother this would cause. It is possible that only patients who have actually experienced a certain disease or treatment can fully understand the burden of the situation and can make choices between the possible interventions. However, based on the fact that most patients successfully completed the interview, we think that the explanation of the condition was well understood.

In the initial scenario the risk of UTI and duration of catheterisation were identical, in order to establish the actual preference for the method of catheterisation itself, and not for the impact of consequences of the intervention, such as duration of catheterisation or risk of UTI. From assessing the factors through open questions it appeared that a few patients had anticipated that CIC could result in a shorter duration of treatment. Furthermore, we did not assess preferences including the possibility that treatment might be continued after 3 days, because the choices for the patients would have become too hypothetical to understand. In our opinion, this simplification of true practice can be justified by the fact that only a minority of patients actually experience abnormal PVR after 3 days.³
Only patients who had never been catheterised before were interviewed, because previous experiences with catheterisation might influence a patient’s preference. Other studies have shown that patients who have actually undergone a certain intervention tend to prefer that particular intervention.\textsuperscript{17–19}

One could argue about whether the duration of TIC, which was set at 3 days, is realistic. This duration was based on a recent survey to evaluate current clinical practice in the Netherlands.\textsuperscript{6}

We cannot compare our results with those of others, as this study is, as far as we are aware, the first to quantify whether patients prefer TIC or CIC. Given the observation that patients prefer CIC when the duration of treatment and risk of UTI are similar for TIC, it is understandable that the preference for CIC increases with a shorter duration of catheterisation and a lower risk of UTI. It appeared that even 36% of patients preferred CIC when it was associated with a higher risk of UTI as long as CIC resulted in the faster recovery of normal bladder function.

Parallel with this preference study we randomly compared both interventions, and observed that CIC reduced the duration of catheterisation on average by 54 hours. The risk of UTI in the CIC group was 14%, versus 38% in the TIC group, which exceeds the maximal difference in UTI risk in the scenarios. The scenario that best represents the results of our randomised controlled trial would imply that 99% of patients prefer CIC to TIC.\textsuperscript{20}

**Conclusion**

We have found that CIC is highly preferred to TIC for the treatment of abnormal PVR after vaginal prolapse surgery. The results of a recent randomised controlled trial showed that CIC resulted in a shorter duration of catheterisation by 2 days and a >20% lower risk of UTI. These conditions correspond with a preference of 99% of patients for CIC.
Chapter 5

References


Chapter 6

Predicting short term urinary retention after vaginal prolapse surgery

RA Hakvoort
MG Dijkgraaf
MP Burger
MH Emanuel
JP Roovers

Neurourol Urodyn 2009 28(3), 225-8
Abstract

Aims: Identification of risk factors for urinary retention after vaginal prolapse surgery.

Methods: The medical records of 345 women undergoing surgical correction for symptomatic pelvic organ prolapse were analysed. Independent risk factors for the development of post-operative urinary retention were identified by performing univariate and multivariate logistic regression analysis. Variables included in the analysis were age, parity, body mass index, previous prolapse surgery, previous hysterectomy, menopausal status, degree of prolapse, type of anesthesia, type and technique of surgery, operation time, intra-operative blood loss, preoperative urinary stress incontinence, and other co-morbidities. Main outcome measure was the occurrence of urinary retention defined as a residual volume after voiding higher than 200 ml as measured by bladder scan.

Results: High grade cystocele (OR 2.5, CI 1.3–4.7), performing levator plication (OR 4.3, CI 2.0–9.3), performing Kelly plication (OR 5.1, CI 1.7–15.5) and amount of intra-operative blood loss (OR 1.4 per 100 ml, CI 1.1–1.8) were identified as independent risk actors for the occurrence of urinary retention after vaginal prolapse surgery.

Conclusions: Urinary retention after vaginal prolapse surgery occurs more frequently in women with larger cystoceles, severe intra-operative blood loss and the application of levator plication and Kelly plication.
Introduction
Women have a lifetime risk of 11% to undergo vaginal prolapse or incontinence surgery. One of the most common complications directly related to prolapse surgery is urinary retention. In most cases, the observed retention is short lasting. However, this complication is still bothersome to the patient. It has been reported that shorter catheterisation time is associated with higher rates of urinary retention postoperatively, whereas longer catheterisation time results in higher urinary tract infection rates and can result in longer hospital stay. Little effort has been made to identify risk factors for urinary retention after prolapse surgery. As far as incontinence surgery is concerned, several demographic factors, voiding parameters, and anatomical factors have been identified for post-operative voiding difficulty. Although some similarity exists between these types of surgery, these factors are largely unknown after vaginal prolapse surgery. When risk factors would be identified for urinary retention after prolapse surgery, pre-operative counselling of the patient about consequences of prolapse surgery could be optimised. Furthermore, the catheterisation regime could be adjusted to an individual risk for post-operative urinary retention. A large retrospective study was performed to identify such risk factors.

Subjects and Methods
This study was performed at the Spaarne Hospital in Hoofddorp, which is a large university affiliated teaching hospital in the Netherlands. Approval was obtained by the institutional review board. All patients who underwent vaginal prolapse surgery between January 2003 and January 2006 and who received initial postoperative transurethral indwelling catheterisation for less than 24 hours were included.

Diagnostic work-up
During the study period, a standard medical and (uro)gynecological history was taken from all patients. Routinely the prolapse was staged according to the Baden and Walker scoring system, which was by that time generally accepted as the standard classification system. Pre-operative flowstudies or urodynamic studies were not routinely performed in the study period. Pre-operative urine analysis and culture were performed to rule out significant bacteriuria (more than $10^5$ colony forming units) or cystitis (bacteriuria with at least one of the following additional complaints; lower abdominal pain, dysuria or fever). All urinary tract infections were treated before surgery.
Intra-operative care
Both general and spinal analgesia were used, based on the preference of the patient and anaesthesiologist. Prophylactic antibiotics were given intravenously to all patients. Post-operatively a transurethral indwelling catheter was placed. In the study period no suprapubic catheterisation or intermittent catheterisation was applied.

Surgical techniques
All procedures were performed or supervised by a team of five gynaecologists with an extensive experience in prolapse surgery. Although small variations in surgical technique may have occurred, the surgeons had a common basis for their surgical principles. In some patients undergoing anterior colporrhaphy, a concomitant Kelly suture was performed only by 2 of the 5 gynecologists, especially in those patients with an effaced urethro-vesical junction. In some patients who underwent posterior colporrhaphy, a levator plication was simultaneously performed according to the surgeons’ preference. During the study period, it was agreed that prolapse surgery and stress-incontinence surgery were not combined if evident or occult stress incontinence was diagnosed in addition to genital prolapse.

Post-operative care
Postoperative care was standardised for all patients. None of the patients received post-operative epidural analgesia. Immediately after surgery patients received a transurethral Foley catheter (Ch.14) and vaginal gauze. Both the vaginal gauze and indwelling catheter were removed on the morning of the first day after surgery. Within 5 - 6 hours after removal of the catheter, post-micturition bladder volume was measured using an ultrasound bladder scanner (Diagnostic Ultrasound DxU BVI 3000®) after a voided volume of at least 150 ml. Patients with a post micturition bladder volume exceeding 200 ml were diagnosed as having urinary retention. In these patients an indwelling catheter was replaced for an additional 72 hours. This was repeated when the bladder retention persisted after this period. When the bladder retention persisted after both periods of 72 hours, patients were taught intermittent self-catheterisation which was discontinued when the residual volume was below 200 ml.

Prognostic factors
The medical files were studied to collect the following variables: age, body mass index, parity, previous prolapse surgery, previous hysterectomy, menopausal status, degree of prolapse according to the Baden and Walker classification system, duration of surgery, amount of blood loss, type of surgery, simultaneously performed levator
plication, simultaneously performed plication of the bulbocavernosus muscles, simultaneously performed Kelly plication and type of anesthesia. The amount of blood loss was expressed per 100 ml and duration of surgery per 10 minutes.

Statistical analysis
The aim of the statistical analysis was to identify independent risk factors for the occurrence of urinary retention following vaginal prolapse surgery. Because of the relatively poor inter-observer agreement of the Baden and Walker vaginal profile and the retrospective nature of the data, grade of prolapse was categorised in low grade (grade 1 and 2) and high grade (grade 3 and 4).

First, the association between each variable and urinary retention was quantified using univariate logistic regression analysis. Subsequently, predictors that were univariately associated with the outcome (odds ratio with a p-value < 0.15) were included in a multivariate logistic regression model using SPSS 12.0. (SPSS Statistics UK, SPSS Inc, Chicago, IL) to identify independent predictors for urinary retention.

Table 1: Characteristics of all patients (n=345)

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>Missing data (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)¹</td>
<td>63.6 (11.3) 0</td>
</tr>
<tr>
<td>Number of delivered children ¹</td>
<td>2.6 (1.1) 3</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)¹</td>
<td>25.8 (3.4) 42</td>
</tr>
<tr>
<td>History of prolapse surgery²</td>
<td>63 (18) 1</td>
</tr>
<tr>
<td>History of hysterectomy²</td>
<td>78 (23) 0</td>
</tr>
<tr>
<td>Post-menopausal²</td>
<td>301 (87) 0</td>
</tr>
<tr>
<td>Urinary incontinence before surgery²</td>
<td>77 (23) 7</td>
</tr>
<tr>
<td>Diabetes mellitus²</td>
<td>22 (6) 0</td>
</tr>
</tbody>
</table>

Finding at pelvic examination*: 
Cystocele grade 3 or 4 ² | 216 (63) 3 |
Rectocele grade 3 or 4 ² | 58 (17) 2 |
Uterine prolapse grade 3 or 4 ² | 66 (19) 1 |

Values are means¹ (standard deviation) or numbers² (percentage).
*Baden & Walker classification

Results
During the study period 383 patients underwent prolapse surgery. Twelve patients were excluded who underwent standard vaginal prolapse surgery but still received initial prolonged catheterisation for more than 24 hr. Other exclusions were 19 patients undergoing colpocleisis and three patients undergoing abdominal sacrocolpopexia.
Four patients undergoing prolapse surgery with concomitant incontinence surgery were not included in order to maintain a pure sample. Of the remaining 345 patients urinary retention occurred in 100 (29%) patients. Catheterisation was prolonged after 72 hr in 30 (8.7%) patients and after 6 days in 4 (1.1%) patients. These last four patients left the hospital after they were taught intermittent self-catheterisation. Two months after surgery, none of the patients had a residual volume exceeding 200 ml. The mean post-void residual in the whole group was 189 ml (range 0–895), in the non-retention group 72 ml (range 0–192 ml) and for the retention group this was 405 (218–895 ml). Patient characteristics are shown in Table 1. Patients (23%) reported urinary incontinence before surgery. Prolapse of the anterior vaginal wall was the predominant reason to perform prolapse surgery as is shown by a prevalence of more than 60% of grade 3 or 4 cystocele before surgery. Surgery related parameters are shown in Table 2.

**Table 2: Surgical parameters (n=345)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Missing data (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of surgery (minutes)</td>
<td>53 (23) 17</td>
</tr>
<tr>
<td>Blood loss (ml)</td>
<td>130 (125) 41</td>
</tr>
<tr>
<td>General anesthesia</td>
<td>77 (22) 1</td>
</tr>
<tr>
<td>Spinal analgesia</td>
<td>267 (78)</td>
</tr>
<tr>
<td>Anterior colporraphy performed</td>
<td>275 (80) 0</td>
</tr>
<tr>
<td>Posterior colporraphy performed</td>
<td>232 (67) 0</td>
</tr>
<tr>
<td>Vaginal hysterectomy performed</td>
<td>56 (16) 0</td>
</tr>
<tr>
<td>Levator plication performed</td>
<td>57 (17) 0</td>
</tr>
<tr>
<td>M bulbocavernous plication performed</td>
<td>163 (47) 0</td>
</tr>
<tr>
<td>Kelly plication performed</td>
<td>29 (8) 1</td>
</tr>
<tr>
<td>Manchester-Fothergill procedure performed</td>
<td>20 (6) 0</td>
</tr>
</tbody>
</table>

Values are means (standard deviation) or numbers (percentage).

The most frequently performed procedure was anterior colporrhaphy with spinal anesthesia. Eight (2.3%) patients experienced post-operative complications; two patients required a second intervention within 1 day after surgery because of persisting post-operative hemorrhage, two patients experienced fever of unknown origin and four patients developed a hematoma of the apex of the vagina after vaginal hysterectomy.

Table 3 shows the results of the uni- and multivariate logistic regression analysis. In the multivariate analysis higher amounts of blood loss per 100 ml (OR 1.4, CI 1.1–1.8), grade 3 cystocele (OR 2.5, CI 1.3–4.7), performing levator plication (OR 4.3, CI 2.0–9.3) and performing Kelly plication (OR 5.1 CI 1.7–15.5) were identified as independent predictors for the occurrence of post-operative urinary retention.
Table 3: Univariate and multivariate analysis of the association of patient characteristics, pelvic examination and surgical parameters with presence of urinary retention after vaginal prolapse surgery

<table>
<thead>
<tr>
<th></th>
<th>Univariate analysis</th>
<th>Multivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>(95 % CI)</td>
</tr>
<tr>
<td><strong>Medical history</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (per 5 year)</td>
<td>1.0</td>
<td>(0.9 – 1.1)</td>
</tr>
<tr>
<td>BMI (per kg/m²)</td>
<td>1.0</td>
<td>(1.0 – 1.1)</td>
</tr>
<tr>
<td>Parity (per child)</td>
<td>0.9</td>
<td>(0.7 – 1.1)</td>
</tr>
<tr>
<td>History of prolapse surgery (yes vs no)</td>
<td>0.8</td>
<td>(0.4 – 1.5)</td>
</tr>
<tr>
<td>History of hysterectomy (yes vs no)</td>
<td>1.0</td>
<td>(0.6 – 1.8)</td>
</tr>
<tr>
<td>Post-menopausal (yes vs no)</td>
<td>1.0</td>
<td>(0.5 – 1.9)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.7</td>
<td>(0.3 – 2.0)</td>
</tr>
<tr>
<td>Presence of stress-incontinence</td>
<td>1.2</td>
<td>(0.7 – 1.9)</td>
</tr>
<tr>
<td><strong>Pelvic examination before surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystocele (high grade vs low grade)</td>
<td>1.8</td>
<td>(1.1 – 3.1)</td>
</tr>
<tr>
<td>Rectocele (high grade vs low grade)</td>
<td>1.7</td>
<td>(0.9 – 3.0)</td>
</tr>
<tr>
<td>Uterine prolapse (high grade vs low grade)</td>
<td>0.5</td>
<td>(0.2 – 1.0)</td>
</tr>
<tr>
<td><strong>Surgical parameters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of surgery (per 10 min)</td>
<td>1.3</td>
<td>(1.2 – 1.5)</td>
</tr>
<tr>
<td>Blood loss (per 100 ml)</td>
<td>1.7</td>
<td>(1.3 – 2.1)</td>
</tr>
<tr>
<td>Anterior colporraphy (yes vs no)</td>
<td>1.6</td>
<td>(0.9 – 3.1)</td>
</tr>
<tr>
<td>Posterior colporraphy (yes vs no)</td>
<td>2.9</td>
<td>(1.6 – 5.1)</td>
</tr>
<tr>
<td>Vaginal hysterectomy (yes vs no)</td>
<td>0.5</td>
<td>(0.2 – 1.0)</td>
</tr>
<tr>
<td>Levator plication (yes vs no)</td>
<td>9.9</td>
<td>(5.2 – 19.0)</td>
</tr>
<tr>
<td>M bulbocavernous plication (yes vs no)</td>
<td>1.6</td>
<td>(1.0 – 2.6)</td>
</tr>
<tr>
<td>Kelly plication (yes vs no)</td>
<td>11.8</td>
<td>(4.7 – 30.2)</td>
</tr>
<tr>
<td>Manchester-Fothergill procedure (yes vs no)</td>
<td>0.8</td>
<td>(0.3 – 2.3)</td>
</tr>
<tr>
<td>Anesthesia (spinal vs general)</td>
<td>0.8</td>
<td>(0.5 – 1.4)</td>
</tr>
</tbody>
</table>

OR = odds ratio
CI = confidence interval

Discussion
In this study high grade cystocele, higher intra-operative blood loss, Kelly plication and levator plication appeared to be independent predictors for the occurrence of urinary retention after prolapse surgery. The retrospective study design may have limited the reliability of these findings as a prospective study would allow more accurate and complete data collection. However, in the study period the studied prognostic factors were consistently documented in all patients. Pre-operative voiding parameters like the post-micturition residual bladder volume could not be included in this study, as
they were not routinely documented during the study period. However, we think that this has not limited the value of our study as there is no evidence that pre-operative voiding parameters predict postoperative urinary retention.\textsuperscript{11,12} The large study sample allowed us to correct for multiple prognostic variables and increased the reliability of the calculated odds ratios. The study was further strengthened by the uniform catheterisation policy during the study period as reflected by the small number of patients that received initial catheterisation longer than 24 hr. A true cut-off level for urinary retention has not been defined by the International Continence Society. Variations in this definition directly affects observed incidences of urinary retention. To avoid potential over-treatment of patients with clinically irrelevant urinary retention, the cut-off value in the study center was set at 200 ml residual volume. In contrast with prolapse surgery, several studies have been undertaken to identify predictors for urinary retention after incontinence surgery. One study failed to identify predictors whereas other studies showed increasing age, lower BMI, previous incontinence surgery and post-operative urinary tract infection to be related to urinary retention.\textsuperscript{5,13–15} Although realising the difference between prolapse- and stress incontinence surgery we could not confirm the prognostic value of these variables in this study. Other factors related to the development of urinary retention following stress incontinence surgery have been pre-operative peak flow rate, decreased detrusor pressure, straining during voiding and the degree to which the bladder neck is elevated during surgery.\textsuperscript{13,16–18} The finding that Kelly plication was an independent predictor could be a consequence of such an elevation of the bladder neck. With respect to the treatment of stress-incontinence the long-term effects of Kelly plication are poor.\textsuperscript{19} Now that suburethral tapes are available and have been proven to have a long standing excellent effect we have further abandoned Kelly plication. High degree cystoceles were independently of influence.

With the correction of high grade cystoceles it is likely that the bladder neck is elevated to a greater extent in this way introducing an obstructive factor. Urinary retention may also result from edema formation that is expected to be more severe and thus more obstructive in patients with larger cystoceles requiring more extensive surgical correction. Although it is known that patients with high degree cystoceles also show decreased flow rates pre-operatively\textsuperscript{20} the role of this factor is unclear after anterior colporrhaphy has been performed. The reason why an increased amount of blood loss is associated with urinary retention following prolapse surgery can only be hypothesised. First, more blood loss may result in hematoma formation acting as a non-functional, obstructive sub-urethral mass. Second, more blood loss may be related to more extensive damage to the innervation of the detrusor muscle when surgery gets
more complicated. Blood loss is often accompanied by an increased operating time. The fact that blood loss was an independent predictor supports our hypotheses of a role for hematoma formation or surgical damage to the innervation of the bladder in the occurrence of urinary retention. Levator plication appeared to be strongly related to postoperative urinary retention. As it does not involve manipulation of the bladder or urethra, levator plication probably impairs lower urinary tract function indirectly. We hypothesise that performing levator plication causes more postoperative pain resulting in disabled relaxation of the pelvic floor muscles with urinary retention as the clinical result. No definitive evidence of the beneficial effect of levator plication in addition to posterior colporrhaphy exists. However, levator plication has been associated with post-operative dyspareunia. The finding that levator plication also appears to increase the risk of post-operative urinary retention provides another argument for a reserved attitude with respect to the use of this technique. This study was undertaken to identify independent risk factors for the development of urinary retention. The results are helpful in counseling the patient about the individual risk on post-operative bladder dysfunction in cases of high grade cystocele. It could even be used to adjust the catheterisation regimen in case of high grade cystocele or higher amounts of blood loss. The identified risk factors raise the hypothesis that both a disturbed pelvic floor relaxation due to post-operative pain, intrinsic damage to the innervation of the bladder and obstruction of the bladder outlet can contribute to the development of urinary retention following vaginal prolapse surgery. These hypotheses will be tested in future prospective studies.

**Conclusion**

In this study several predictors were found for the occurrence of urinary retention after vaginal prolapse surgery. The results raise the hypothesis that the causes of urinary retention after vaginal prolapse surgery are multifactorial.
Chapter 6

References


A prospective study to identify risk factors for the occurrence of abnormal post void residual bladder volume (PVR) following vaginal prolapse surgery

RA Hakvoort
MM Lakeman
A Vollebregt
MY Bongers
FW Bouwmeester
IM Ruhe
MP Burger
JP Roovers

Submitted BJOG
Abstract

Objective: To identify independent risk factors for the occurrence of abnormal post void residual bladder volume (PVR) following vaginal prolapse surgery.

Design: Prospective observational cohort study.

Setting: Five teaching hospitals and one non teaching hospital in the Netherlands.

Population: Women undergoing vaginal surgical correction for symptomatic pelvic organ prolapse.

Methods: Several patient characteristics, surgery related parameters including postoperative pain, situationally induced anxiety level and background level of anxiety were collected. Abnormal PVR was defined as a residual volume after voiding higher than 150 ml measured by a bladderscanning device. To identify independent risk factors for the development of abnormal post void residual volumes (PVR) potential variables were tested for statistical significance by performing univariable and multivariable logistic regression analysis with stepwise backward selection.

Main outcome measure: Abnormal PVR defined as a residual volume after voiding higher than 150 ml.

Results: A number of 342 patients were included of which 87 women developed abnormal PVR. Factors that were univariably associated with the development of abnormal PVR at a significance level of \( p=0.15 \) were included in a multivariable logistic regression analysis with stepwise backward selection to construct the final model with predictors for abnormal PVR. In the multivariable analysis with stepwise backward selection the strongest predictors were parity (OR 1.34, 95% CI 0.9-1.9), UDI pain domainscore (OR 1.11 95% CI 1.0 -1.3), situationally induced anxiety level (OR 1.39, 1.0 - 1.9) and point Ba (OR 1.25 95% CI 1.0-1.5). Of these factors situationally induced anxiety level and point Ba remained as the only two statistically significant predictors.

Conclusion: Abnormal PVR following vaginal prolapse surgery occurs more frequently in women with a higher preoperative stage anterior wall prolapse and higher level of anxiety after surgery.
Identifying patients at risk for incomplete voiding

Introduction
Vaginal prolapse surgery is intended to restore normal pelvic floor function by correcting anatomical abnormalities. One of the most common complications directly related to prolapse surgery is the occurrence of abnormal post void residual bladder volumes (PVR). In most cases, treatment comprises bladder drainage for an additional period of several days. Although this treatment may seem straightforward it inevitably increases risk of urinary tract infections, bothers patients and prolongs hospital stay in many. Efforts to identify risk factors for the occurrence of abnormal PVR could ultimately reduce the risk of this adverse event and improve counselling about the patient’s individual risk of developing abnormal PVR. Possible mechanisms which increase the risk of developing abnormal PVR include obstructive effects through the elevation of the bladder neck and urethra occurring during anterior compartment surgery, haematoma and oedema formation and damage to innervation of the bladder. The finding however that patients undergoing posterior repair and levator myorrhaphy also run the risk of abnormal PVR has raised the hypothesis that also postoperative pain can adversely affect pelvic floor relaxation with bladder outlet obstruction as a result. However, pain has never been prospectively studied as a risk factor for incomplete voiding. Another hypothetical mechanism is that not only pain but also anxiety can inhibit pelvic floor relaxation and bladder function. This hypothesis is based on the documented pathway that higher anxiety levels induce sympathetic nerve activation resulting in inhibition of detrusor contractility and obstruction of bladder outflow. The influence that psychological factors can have on voiding was illustrated by the observation that a request for voiding in a clinical environment resulted in an inability to void in a large proportion of patients. However, anxiety as a possible risk factor for abnormal PVR has never been prospectively studied. Studying the role of post-operative pain and anxiety is especially relevant as these factors can potentially be influenced. We performed a prospective multi-centre study to identify risk factors for abnormal PVR after vaginal prolapse surgery and to evaluate whether post-operative pain and anxiety were among these risk factors.

Methods
A prospective observational cohort study was performed in five teaching hospitals and one non teaching hospital in the Netherlands. Approval was obtained by the institutional review boards of all participating centres. In the period from August 2007 till May 2009 patients scheduled for vaginal prolapse surgery could participate in this study. Written informed consent was obtained from all participating patients. All patients aged 18 years and older undergoing vaginal prolapse surgery with or without
the use of mesh were eligible. Exclusion criteria were: any diagnosed neurological or anxiety disorder under professional treatment or an indication for concomitant incontinence surgery.

**Assessment of possible predictors for abnormal PVR**

At their first visit at the outpatient clinic, patients were informed about the study. After written informed consent was obtained, participants completed a standardised urogynecologic interview and completed the Dutch validated version of the urogenital distress inventory (UDI).\textsuperscript{14,15} Patients were asked to complete this questionnaire at home at least one day before surgery to determine the role of the severity of preoperative urogenital dysfunction in the occurrence of postoperative abnormal PVR. Routinely, prolapse was staged according by using the POPQ staging system.\textsuperscript{16} Routine urodynamic investigation was not performed. Pre-operative urine analysis and culture were performed to rule out significant bacteriuria (defined as more than $10^5$ colony forming units) and cystitis (defined as bacteriuria with at least one of the following additional complaints; lower abdominal pain, dysuria or fever). All urinary tract infections were treated with antibiotics before surgery. To determine anxiety levels, patients were asked to complete the validated Dutch version of the Spielberger State-Trait Anxiety Inventory (STAI) before and after surgery.\textsuperscript{17,18} The aim of the STAI is to quantify the level of anxiety experienced at any point in time by using the state questionnaire. The inherent anxiety normally felt by the subject is measured by using the trait questionnaire. The state and trait subscales, with 20 items each in a 4-point response format, range from 20-80 with higher scores indicating higher anxiety levels. Patients were asked to complete the trait form of the STAI questionnaire to measure the general baseline anxiety level at least 1 day before surgery. To determine the postoperative situational anxiety level, patients were asked to complete the state form 2 hours after removal of the catheter and before their first attempt for micturition. At the same time (2 hours after removal of the catheter and before the first attempt for micturition) post-operative pain was scored on a visual analogue scale. Patients were asked to put an “X” on a ten cm line ranging from 0-100 between the two extremes and the distance from the beginning of the line to the “X” was measured. Postoperative pain management between centers agreed in paracetamol given maximally 4 times daily in doses of 1 gram as the first step. After this step the second step included a maximum of 3 doses of non steroidal anti inflammatory drugs. The third step was the use of morfinomimetics. Regarding the last two steps variations in the protocol were accepted in the design of the study.
Peri-operative care
Either general anesthesia or spinal analgesia was applied, based on the preference of the patient and anaesthesiologist. Single-shot intravenous antibiotics were standardly given to all patients before surgery. After completion of surgery a transurethral indwelling catheter was placed which was removed on the morning of the first postoperative day.

Surgical techniques
All procedures were performed or supervised by gynaecologists with a special interest in urogynaecology. Although small variations in surgical technique may have occurred, the surgeons had a common basis for their surgical principles. In primary prolapse surgery, prolapse of the anterior vaginal wall was corrected by anterior colporrhaphy, surgery of the posterior vaginal wall by posterior colporrhaphy and prolapse of the uterus by sacrospinous ligament fixation, manchester repair or by vaginal hysterectomy with McCall suspension. For recurrent prolapse a mesh was used in case of anterior or posterior vaginal wall prolapse.

Post-operative care
Postoperative care was standardised for all patients. None of the patients received post-operative epidural analgesia. A vaginal gauze was inserted directly after surgery. The catheter and gauze were removed on the morning of the first postoperative day. Directly after the first attempt to void, residual volume was measured in ml using a bladder scanning device (Diagnostic Ultrasound DxU BVI 3000 or BVI 6100®, Ijsselstein, the Netherlands). Also the voided volume was measured and required to be more than 100 mL to be considered representative enough to subsequently measure PVR. Patients with a PVR exceeding 150 ml were diagnosed as having an abnormal PVR. These patients were asked to participate in a trial comparing intermittent catheterisation and indwelling catheterisation.

Prognostic factors
The aim of the analysis was to identify independent risk factors for the occurrence of abnormal PVR following vaginal prolapse surgery. The following patient characteristics and variables were collected preoperatively to determine their influence on the risk of abnormal PVR: age, body mass index, parity, UDI domain scores for overactive bladder, pre-operative urinary stress incontinence, obstructive micturition and prolapse complaints measured before surgery as well as postoperative pain score and anxiety levels. Another postoperative variable included in the analysis was type of surgery.
Statistical analysis

First, the data were checked for linearity using histograms and normality plots. After this, the association between each variable and abnormal PVR was quantified using univariable logistic regression analysis. Subsequently, predictors that were univariably associated with the outcome (univariable p-value < 0.15) were included in a multivariable logistic regression model with stepwise backward selection using SPSS 18.0 (SPSS Statistics UK, SPSS Inc, Chicago, IL). To analyse if incomplete data could have affected the results of our study a missing value analysis was performed. Calibration of the model was performed using the Hosmer-Lemeshow test.

Results

From August 2007 till May 2009 a total of 1037 patients underwent vaginal prolapse surgery in the participating centers. (See figure 1. STROBE Flowchart). Of these patients, 532 patients were invited to participate in this prospective study. Of the 419 patients who met the inclusion criteria and were willing to participate, 342 patients had a complete data set and could be included in the analysis, 87 of them experienced an abnormal PVR. Between centers no differences were found in occurrence of abnormal PVR and participation rates.

Figure 1: Patient flow through the study (STROBE)
Patient characteristics, pre-operative questionnaire results and performed procedures are shown in table 1.

**Table 1**: Patient characteristics of the included patients (n=342)

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>Age per year</th>
<th>BMI per kg/m²</th>
<th>Parity, n (median, range)</th>
<th>POP-Q (median, range)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>61.7 (10.5)</td>
<td>25.7 (3.8)</td>
<td>2 (0-5)</td>
<td>Ba: 0 (-3-5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bp: -2 (-3-5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>C: -3 (-9-8)</td>
</tr>
</tbody>
</table>

| Questionnaire results                    |              |                |                           |                       |
|                                          |              |                |                           |                       |
| Preoperative baseline anxiety level      | 38.3 (8.8)   |                |                           |                       |
| Postoperative situational anxiety level | 34.3 (9.0)   |                |                           |                       |
| Pain score                               | 20.1 (19.9)  |                |                           |                       |
| UDI overactive bladder domain score      | 29.6 (23.6)  |                |                           |                       |
| UDI incontinence domain score            | 24.4 (23.6)  |                |                           |                       |
| UDI obstructive domain score             | 21.2 (25.1)  |                |                           |                       |
| UDI pain domain score                    | 22.8 (23.7)  |                |                           |                       |
| UDI prolapse domain score                | 42.5 (30.6)  |                |                           |                       |

| Performed procedures #                   |              |                |                           |                       |
|                                          |              |                |                           |                       |
| Anterior colporrhaphy                    | 272 (79)     |                |                           |                       |
| Posterior colporraphy                    | 133 (39)     |                |                           |                       |
| Vaginal hysterectomy                     | 86 (25)      |                |                           |                       |
| Sacrospinous ligament fixation           | 27 (8)       |                |                           |                       |
| Manchester Fothergill                    | 24 (7)       |                |                           |                       |
| Polypropylene mesh                       | 24 (7)       |                |                           |                       |
| Kelly sutures                            | 14 (4)       |                |                           |                       |

Values are mean (SD) unless stated otherwise

# patients can have undergone more than one procedure

BMI = body mass index

UDI = urinary distress inventory

On all mentioned variables in table 1, univariable logistic regression analysis was performed, to define factors that were univariably associated with the development of abnormal PVR at a significance level of p=0.15. These factors are shown in table 2 and were included in a multivariable logistic regression analysis with stepwise backward selection to construct the final model with predictors for abnormal PVR. The results of the multivariable logistic regression analysis are also shown in table 2.
Table 2: Outcomes of univariable analysis using logistic regression and multivariable analysis using logistic regression with stepwise backward selection for the association of patient characteristics and (peri) operative parameters with the development of post-operative abnormal PVR.

<table>
<thead>
<tr>
<th></th>
<th>Univariable analysis</th>
<th>Multivariable analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>P</td>
</tr>
<tr>
<td>Parity, n (median, range)</td>
<td>1.3 1.0-1.8</td>
<td>0.06</td>
</tr>
<tr>
<td>Ba</td>
<td>1.2 1.1-1.5</td>
<td>0.01</td>
</tr>
<tr>
<td>Pain score (per 10 points)</td>
<td>1.2 1.0-1.3</td>
<td>0.01</td>
</tr>
<tr>
<td>Postoperative situational anxiety level (per 10 points)</td>
<td>1.4 1.1-1.9</td>
<td>0.01</td>
</tr>
<tr>
<td>Preoperative baseline anxiety level (per 10 points)</td>
<td>1.3 0.9-1.7</td>
<td>0.11</td>
</tr>
<tr>
<td>UDI pain domain score (per 10 points)</td>
<td>1.1 1.0-1.2</td>
<td>0.11</td>
</tr>
<tr>
<td>UDI prolapse domain score (per 10 points)</td>
<td>1.1 1.0-1.2</td>
<td>0.06</td>
</tr>
<tr>
<td>Anterior colporrhaphy</td>
<td>2.3 1.1-4.7</td>
<td>0.02</td>
</tr>
<tr>
<td>Kelly sutures</td>
<td>4.2 1.4-12.4</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Factors included in the final model were: parity, UDI pain domain score, situationally induced anxiety level and point Ba. Of these factors situationally induced anxiety level and point Ba remained as the only two statistically significant predictors. The calibration of the model was good (Hosmer-Lemeshow test p=0.63). A missing value analysis showed that the missing data of the factors which were associated with abnormal PVR was missing completely at random.

Discussion

Our objective was to identify independent risk factors for the occurrence of abnormal post void residual bladder volume (PVR) following vaginal prolapse surgery. For this purpose demographic and peri-operative parameters of patients (n=342) undergoing vaginal prolapse surgery were prospectively collected and analysed. The stage of anterior vaginal wall prolapse and postoperative situational anxiety level were identified as the two independent predictor for developing abnormal PVR. Before interpreting these results some issues need to be discussed. First, the preoperative timing of the UDI questionnaire and baseline anxiety (trait) was done at least one day before surgery to reduce the possible influence of anxiety due to the coming operation. We can not exclude the possibility that this measurement still could have been influenced by anxiety due to the coming operation and therefore should have been timed earlier.
Second, voiding parameters like the pre-operative post-micturition residual bladder volume could not be included in this study as this was not a routine measurement in the participating centres. Knowing that, before surgery, prolapse and voiding dysfunction are related it is possible that a proportion of patients could have suffered from incomplete bladder emptying preoperatively. Although obtaining information about voiding efficiency and flow preoperatively would have been preferable we think that this has not limited the value of our study as the problem of high residual volumes pre-operatively is likely to resolve following vaginal prolapse surgery and pre-operative flow studies have not been found to have a significant predictive value for postoperative occurrence of incomplete voiding.

Last, there is no consensus about the true cut-off level for the diagnosis of incomplete voiding. Variations in this definition of PVR directly affect the observed prevalence and this could also have had its effect on our study. Although variation exists between definitions and some centres also use percentages of voided volume, in this study a cut off of 150 ml was used as this is the most popular cut off level. Therefore, we think the results of this study are applicable to daily clinical practice.

In the univariable analysis anterior colporrhaphy and point Ba were both found to increase the risk of abnormal PVR. In the multivariable analysis point Ba remained as an independent predictor. The finding of higher point Ba values as a risk factor might be explained by impairment of preoperative sensibility and contractility due to the higher prolapse stage, which persists postoperatively. However, unfortunately in this study no preoperative urodynamic assessment was done. Therefore we are not able to support or reject this proposed mechanism.

It can also be deduced that that performing anterior colporrhaphy only leads to impaired voiding when it is performed on patients with higher prolapse stage. An explanation can be a higher extent of dissection and consequently disruption of innervation when prolapse stage gets higher.

Pain and anxiety belong to another category of causes that are not directly associated nor anatomically related with the bladder. These factors can possibly obstruct bladder outflow through a disturbed relaxation of the pelvic floor, central inhibition of the bladder and/or alpha adrenergic stimulation of the bladder outlet respectively. Although the cause and effect relation of these factors and the occurrence of abnormal PVR might seem well established this is the first study to include these factors prospectively in a large cohort of patients undergoing vaginal prolapse surgery. Evidence to support the role of pain came from earlier studies in which it was observed that patients undergoing posterior repairs also were at increased risk of developing abnormal PVR. As the bladder and its innervation are obviously not directly damaged during posterior compartment surgery, the hypothesis was raised...
that a non anatomical factor like pain could be of influence.\textsuperscript{10,11,26} Postoperative pain initially did show an effect in the univariable analysis. However, pain did not turn out to be a significant independent determinant in the multivariable analysis.

The second independent predictor in the multivariable analysis was postoperative situational anxiety level. We suspect that postoperative anxiety levels are likely to rise because patients are hospitalised, are faced with a request for efficient micturition with the threat of additional catheterisation as a consequence of incomplete voiding and possibly the feeling of loss of autonomy.\textsuperscript{27} The possible negative effect of posing such preconditions to patients was illustrated by the observation that a request for micturition in a hospitalised environment led to an absolute inability to void in 8 of 18 (44\%) otherwise healthy non surgical subjects in another study.\textsuperscript{13} In the same study it was shown that voiding and the inability to void correlated well with the activation of different pontine regions.\textsuperscript{13}

More support for the relationship between anxiety and voiding impairment came from three earlier randomised studies which all showed a reduction of the postoperative incidence of abnormal PVR after urogynaecological surgery with the administration of alpha blocking agents.\textsuperscript{28,29,30} However, this is the first study that demonstrates a direct causal relation between anxiety and incomplete voiding. The finding of a higher anxiety level in patients developing abnormal PVR can have several possible reasons like the actual physical stress caused by the operation, being hospitalised and experiencing loss of autonomy. Therefore, future research will not only evaluate whether drug therapy intended to reduce anxiety results in improved bladder emptying but also whether stress reduction on the day of catheter removal results in a lower incidence of abnormal PVR.

\section*{Conclusion}

The occurrence of abnormal PVR after vaginal prolapse surgery is both related to anxiety after surgery and the pre-operative stage of anterior vaginal wall prolapse. This finding provides a new insight in the etiology of abnormal PVR and is helpful in developing new strategies to prevent abnormal PVR.
References


Anterior colporrhaphy does not induce bladder outlet obstruction

MM Lakeman
RA Hakvoort
EP van de Weijer
MH Emanuel
JP Roovers

Int Urogynecol J 2012 Feb 8
Abstract

Introduction and hypothesis: We aimed to evaluate if anterior colporrhaphy causes incomplete voiding due to bladder outlet obstruction.

Methods: Women scheduled for anterior colporrhaphy were asked to undergo multichannel urodynamic investigation before surgery and the first postoperative day. Bladder outlet obstruction was assessed using the Blaivas–Groutz voiding nomogram. Maximum flow rate, detrusor pressure and residual volume were compared between pre- and postoperative measurements and between women with and without an abnormal post-void residual volume (PVR; volume exceeding 150 ml).

Results: Seventeen women participated. One woman who was unobstructed before surgery was obstructed after surgery. Overall, detrusor pressure and maximum flow rate before and after surgery did not differ. After surgery, six women had an abnormal PVR, one was unable to void, four were mildly obstructed and one moderately obstructed.

Conclusion: Urodynamic investigation the first day after anterior colporrhaphy did not show that anterior colporrhaphy induces bladder outlet obstruction. The explanation for postoperative urinary retention can therefore also lie in nonanatomical causes such as postoperative pain and psychological factors.
Introduction
Vaginal prolapse surgery is intended to restore normal pelvic floor function by correcting anatomical abnormalities. One of the most common complications directly related to prolapse surgery is the occurrence of incomplete emptying of the bladder.\(^1\) Whereas the optimal management is assessed in several studies, the underlying pathophysiology of voiding difficulties after vaginal prolapse surgery is poorly understood.\(^2\)

Several hypotheses can be raised like impairment of bladder function and pelvic floor relaxation due to postoperative pain and anxiety.\(^3\) Other frequently raised hypotheses have been urethral obstruction by oedema or hematoma formation and surgical damage to the innervation of the bladder.\(^4\) As incomplete voiding is generally short lasting, it is questionable whether innervation damage plays an important role and thus obstruction related to oedema formation is a more acceptable explanation.\(^5\)

Until now, no studies have been undertaken to objectify the occurrence of bladder outlet obstruction following anterior colporrhaphy. Previous studies have indicated that a combination of clinical parameters and urodynamic findings is the best way to define bladder outlet obstruction.\(^6\) During urodynamics, flow rate and detrusor pressure are measured simultaneously and together they provide insight in whether obstruction is present as indicated by a relatively low flow rate related to the measured detrusor pressure.\(^3\,4,6,7\) Therefore, urodynamic studies were performed on patients before and after surgery in a prospective observational study to assess if anterior colporrhaphy is a risk factor for postoperative bladder outlet obstruction.

Materials and methods
A prospective study was performed in the Spaarne Hospital, Hoofddorp, the Netherlands. Women aged 18 years and older and who were scheduled for anterior colporrhaphy were informed about the study and asked to participate. Anterior repair could be combined with posterior repair and/or vaginal hysterectomy, sacrospinous ligament fixation or Manchester repair. Patients who were diagnosed with any neurological or anxiety disorder for which they underwent professional treatment and patients undergoing concomitant incontinence surgery were excluded. The study was approved by the regional medical ethics committee (VU Academic Medical Centre, Amsterdam) and by the institutional medical ethical committee. After informed urodynamic investigation within 2 weeks before surgery and between 12 and 24 h after surgery. During the study period, the participants completed a standardised urogynaecologic interview. Baseline characteristics and procedures performed were collected from all women.
Chapter 8

Urodynamic investigations
Before urodynamics, urine analysis and culture were performed to rule out significant bacteriuria (defined as more than $10^5$ colony-forming units) and cystitis (defined as bacteriuria with at least one of the following additional complaints: lower abdominal pain, dysuria or fever). In case of urinary tract infection, patients were excluded to minimise the chance of urodynamic artefacts and interference by urinary tract infection. Prior to the pressure flow studies, patients were asked to empty their bladders; after which, the bladder was drained by a hydrophilic-coated transurethral catheterisation (SpeediCath®, Amersfoort, the Netherlands).

Subsequently, pressure flow studies were performed using a MMS UD 2000 device (Medical Measurement Systems MMS, Enschede, Netherlands) with a water-filled MediPlus 5716 double-lumen cystometry catheter and a water-filled MediPlus 5415 rectal pressure balloon catheter.

Filling of the bladder occurred with saline at body temperature with a speed of 50 ml/min up to the moment patients experienced a strong desire to void or either filling continued up to a maximum volume equalling the functional bladder capacity which was defined as the largest voided volume in a 24-h voiding a sitting position with the 7F catheter in place. The post-void residual volume (PVR) was calculated by bladder catheterisation. Patients with a post-void bladder volume exceeding 150 ml were diagnosed as having an abnormal PVR.

Surgery
Anterior colporrhaphy was performed using a midline incision of the vaginal epithelium, and the bladder was sharply dissected from the vaginal wall. The pubocervical fascia was plicated in the midline with absorbable Vicryl® 2–0 interrupted sutures (Ethicon Inc, Somerville, NJ, USA). The surplus of vaginal epithelium was removed, and the epithelium was closed with running absorbable interlocking Vicryl 2–0. All procedures were performed in the same hospital and were performed by two gynaecologists with a special interest in urogynaecology. All procedures were performed under spinal analgesia. Patients received postoperative prophylaxis for deep vein thrombosis and a single dose of intravenous prophylactic antibiotics during surgery. A 14 French Foley indwelling catheter with a 5-ml balloon was used to drain the bladder after surgery. This catheter was removed within 24 h on the morning of the first day after surgery.

Postoperative care
Postoperative care was standardised for all patients. A vaginal gauze was inserted directly after surgery. The catheter and gauze were removed on the morning of
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the first postoperative day. After the first attempt to void, patients underwent catheterisation of the bladder and subsequently pressure flow studies were performed (see “Urodynamic investigations” section). Patients with a PVR above 150 ml received additional transurethral indwelling catheterisation for the duration of 3 days.

Outcome measurements
The primary outcome was the presence and extent of obstruction before and after surgery as defined by the Blaivas and Groutz nomogram.\(^6\)\(^8\) In this nomogram, the maximum flow rate (Qmax) is plotted in relation to the maximum detrusor pressure (Pdetmax) (obtained from the pressure flow study). Four categories of obstruction have been defined: no, mild, moderate and severe obstruction. The boundaries of the four categories are as follows:

Between no obstruction and mild obstruction: a line with slope 1.0 and intercept 7 cm H2O
Between mild and moderate obstruction a horizontal line at Pdetmax of 57 cm H2O
Between moderate and severe obstruction a horizontal line at Pdetmax of 107 cm H2O

Secondary outcomes were differences in maximum flow rate, maximum detrusor pressure, maximum detrusor pressure during maximum flow rate and residual volume pre and postoperatively in the total group and between women with and without abnormal PVR. A subanalysis was performed in women with abnormal PVR to compare the pre and postoperative measurements.

Statistical analysis
Data were analysed in SPSS version 18.0. Continuous variables were analysed using the Wilcoxon’s test for dependent data (i.e. differences between pre- and postoperative measurements) and a Mann–Whitney test for independent data. For categorical variables, Fisher exact or chi-square test was used.
Results

During the study period, 17 women underwent urodynamic investigation before and after anterior colporrhaphy was performed. Baseline characteristics and concomitantly performed procedures are summarised in Table 1.

Table 1: Patient characteristics, performed procedures and operative characteristics of the women who underwent pre- and postoperative pressure flow studies (n=17).

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>Median (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>61.2 (38.3-76.8)</td>
</tr>
<tr>
<td>Parity (n)</td>
<td>3 (2-8)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.7 (22.4-32.2)</td>
</tr>
<tr>
<td>Previous gynaecological procedures</td>
<td></td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>2 (12)</td>
</tr>
<tr>
<td>POP-Q</td>
<td></td>
</tr>
<tr>
<td>Ba</td>
<td>0 (-0.5-1.5)</td>
</tr>
<tr>
<td>Bp</td>
<td>-2.6 (-3.0-0.0)</td>
</tr>
<tr>
<td>C</td>
<td>-2.4 (-5.0-0.0)</td>
</tr>
<tr>
<td>Performed procedure</td>
<td></td>
</tr>
<tr>
<td>Anterior colporrhaphy (AC)</td>
<td>11 (65)</td>
</tr>
<tr>
<td>AC + Sacro-spinous ligament fixation</td>
<td>1 (6)</td>
</tr>
<tr>
<td>AC + posterior colporrhaphy (PC)</td>
<td>3 (18)</td>
</tr>
<tr>
<td>AC + Manchester fothergill</td>
<td>1 (6)</td>
</tr>
<tr>
<td>AC + Manchester fothergill +PC</td>
<td>1 (6)</td>
</tr>
<tr>
<td>Operative characteristics</td>
<td></td>
</tr>
<tr>
<td>Duration of surgery (minutes)</td>
<td>32.0 (25.0-78.0)</td>
</tr>
<tr>
<td>Surgical complications</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Post-operative complications</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Values are numbers (%) or median (range)

Figure 1 shows the Blaivas and Groutz nomogram before and after surgery. The presence and degree of pre- and postoperative bladder outlet obstruction are summarised in Table 2. Overall, before surgery, five women were unobstructed, one of them had de novo mild bladder outlet obstruction; she underwent anterior colporrhaphy and had a residual volume after voiding of 121 ml. Twelve women were obstructed preoperatively, two of them were no longer obstructed after surgery. From the ten women who had pre and postoperative bladder outlet obstruction, one woman increased in degree of obstruction from mild to moderate. She underwent anterior and posterior colporrhaphy and had a residual volume of 441 ml.
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**Figure 1:** Blaivas and Groutz nomogram. Distribution of the maximum flow rate by maximum detrusor pressure before and after vaginal prolapse surgery was performed.

**Table 2:** Classification of obstruction according to the Blaivas and Groutz nomogram before and after surgery was performed.

<table>
<thead>
<tr>
<th>Pre-operative situation</th>
<th>Post-operative situation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No obstruction</td>
</tr>
<tr>
<td>No obstruction</td>
<td>5 (29%)</td>
</tr>
<tr>
<td>Mild obstruction</td>
<td>6 (35%)</td>
</tr>
<tr>
<td>Moderate obstruction</td>
<td>6* (35%)</td>
</tr>
<tr>
<td>Severe obstruction</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
</tr>
</tbody>
</table>

*1 patient was not able to void postoperatively.
Table 3 shows the urodynamic findings before and after surgery. No statistical significant differences were found between the pre- and postoperative measurements. Postoperatively, six women had an abnormal PVR (range, 172–487 ml).

**Table 3**: Comparison of the median maximum flow rate (Qmax), maximum detrusor pressure (Pdet max), maximum detrusor pressure during maximum flow rate (Pdet Q max), residual volume and flow time as obtained by pressure flow studies before and after surgery.

<table>
<thead>
<tr>
<th></th>
<th>Before surgery n=17</th>
<th>After surgery n=16 †</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voided volume (in mL)</td>
<td>364.0 (3.0 - 712.0)</td>
<td>338.0 (7.0 - 588.0)</td>
<td>0.38</td>
</tr>
<tr>
<td>Q max (in mL/sec)</td>
<td>20.0 (5.0 - 55.0)</td>
<td>17.0 (0.0 - 73.0)</td>
<td>0.36</td>
</tr>
<tr>
<td>P det Q max (in cmH2O)</td>
<td>22.0 (0.0 - 73.0)</td>
<td>26.0 (0.0 - 69.0)</td>
<td>0.80</td>
</tr>
<tr>
<td>P det max (in cm H2O)</td>
<td>44.0 (13.0 - 102.0)</td>
<td>37.5 (17.0 - 96.0)</td>
<td>0.53</td>
</tr>
<tr>
<td>Residual volume (in mL)</td>
<td>10.0 (0.0 - 707.0)</td>
<td>66.0 (0.0 - 487.0)</td>
<td>0.78</td>
</tr>
<tr>
<td>Flow time (in sec)</td>
<td>49.5 (28.0 - 222.0)</td>
<td>58.0 (9.0 - 255.0)</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Values are median (range)
† One patient was unable to void during pressure flow studies after surgery
* Calculated using wilcoxon paired t-test

All of these six patients received a transurethral indwelling catheter which was removed after 3 days. All patients showed a residual volume under our definition of abnormal residual volume of 150 ml after removal of this catheter. Of the six women with an abnormal PVR, one could not void at all, four women were classified as mildly obstructed and one woman as moderately obstructed according to the Blaivas and Groutz nomogram. One of these six women also had an abnormal PVR before surgery, the others not. Two of the six women underwent anterior and posterior colporrhaphy, the others anterior colporrhaphy only.

**Table 4**: Comparison of post-operative urodynamic findings between women with and without abnormal PVR.

<table>
<thead>
<tr>
<th></th>
<th>Normal PVR n=11</th>
<th>Abnormal PVR n=6 †</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voided volume</td>
<td>406.0 (116.0 - 588.0)</td>
<td>98.0 (7.0 - 206.0)</td>
<td>0.01</td>
</tr>
<tr>
<td>Q max (in mL/sec)</td>
<td>19.0 (11.0 - 73.0)</td>
<td>6.0 (2.0 - 11.0)</td>
<td>0.00</td>
</tr>
<tr>
<td>P det Q max (in cmH2O)</td>
<td>32.0 (10.0 - 45.0)</td>
<td>14.0 (0.0 - 69.0)</td>
<td>0.32</td>
</tr>
<tr>
<td>P det max (in cm H2O)</td>
<td>34.0 (17.0 - 96.0)</td>
<td>39.0 (37.0 - 85.0)</td>
<td>0.15</td>
</tr>
<tr>
<td>Residual volume (in mL)</td>
<td>0.0 (0.0 - 141.0)</td>
<td>392.0 (305.0 - 707)</td>
<td>0.00</td>
</tr>
<tr>
<td>Flow time (in sec)</td>
<td>54.0 (35.0 - 108.0)</td>
<td>82.0 (9.0 - 255.0)</td>
<td>0.74</td>
</tr>
</tbody>
</table>

† One patient was unable to void during pressure flow studies after surgery
* As calculated using non parametric Mann-Whitney test
Does vaginal prolapse surgery induce bladder outlet obstruction?

Table 4 shows the postoperative urodynamic findings in these women compared to women with a normal PVR. Women with abnormal PVR had a statistically significant lower maximum flow rate. No difference was found in maximum detrusor pressure. When performing a subanalysis comparing urodynamics before and after surgery among women with abnormal PVR, no statistically significant differences were found in maximum detrusor pressure, maximum detrusor pressure at maximum flow and maximum flow rate (data not shown).

Discussion

Our study was intended to explore if anterior colporrhaphy causes bladder outlet obstruction. Using urodynamic investigations shortly before surgery and on the first day after surgery, we could not reveal any difference in the presence of bladder outlet obstruction, the degree of obstruction, detrusor pressure and maximum flow rate. De novo obstruction after anterior colporrhaphy was only found in one woman, questioning the contribution of bladder outlet obstruction to the development of incomplete voiding following anterior colporrhaphy.

Before further interpreting the data, some issues need to be discussed. First is the relatively low number of patients included. For the diagnosis of obstruction, generally a Qmax <12 ml/s is required. In the preoperative situation, median maximum flow rate was 20 ml/s; therefore, we needed to be able show an 8-ml/s difference to be able to show if prolapse surgery caused bladder outlet obstruction. According to a post hoc analysis, this study would have 80% power to pick up a mean difference in maximum flow rate of >7.7 ml/s between pre- and postoperative situation. Therefore, we are confident that we were able to pick up relevant differences with this small sample size. Furthermore, since no previous studies are performed evaluating bladder outlet obstruction, the first intention of our study was to explore if we could find any evidence that the inability to void on the first postoperative day was caused by bladder outlet obstruction possibly caused by oedema or hematoma formation. Even with our limited sample size, we could not reveal any indication that this was the case; therefore, we think it is unethical to expose more women to this investigation. Second, one can argue about the timing of removal of the catheter and the consequent assessment of voiding parameters by postoperative pressure flow study. We decided to remove the catheter within the first day after surgery because several studies have shown benefits regarding UTI risk and catheterisation duration of this regimen. This is therefore the timing at which incomplete voiding is most commonly identified and therefore the most clinically relevant timing when intending to study if bladder outlet obstruction plays a role in the development of this complication.

All included women underwent anterior colporrhaphy. Concomitant surgery included
suspension techniques for uterine descent (two patients), posterior colporrhaphy (three patients) and a combination of both in one patient. Suspension techniques and elevation of the apical portion of the vagina have been reported to be a risk factor for abnormal PVR.\textsuperscript{12} The most likely explanation for this finding is extra elevation of the bladder outlet and therefore obstruction.

From our data, we could not confirm that obstruction according to the Blaivas and Groutz nomogram increased in the three patients with concomitant uterine suspension. Two studies have shown a risk increase with the performance of posterior compartment surgery. As this type of surgery has no anatomical relationship with the bladder, it has been hypothesised that pain and a disturbed relaxation of the pelvic floor might be a contributing factor in these cases.\textsuperscript{13,14} In our study in one of the three patients with concomitant posterior repair obstruction according to the Blaivas and Groutz nomogram increased from mild to moderate, one patient could not void after surgery and the last patient remained unaltered. This does not exclude that posterior colporrhaphy might increase the risk of abnormal PVR due to the previously mentioned hypothesis. However, due to the small numbers, no definite conclusions can be drawn.

We chose to use pressure flow studies to assess bladder outlet obstruction since this is the best defined way to assess obstruction.\textsuperscript{4} One might argue that video urodynamics has the advantage of also localising a possible obstruction; however, other studies have shown that using cutoff points in pressure flow studies compares favourably to video urodynamics.\textsuperscript{4,15} Imaging techniques such as MRI have the advantage of visualisation of the obstruction; however, these techniques cannot be combined with flow studies and are therefore not able to assess the functional component which is most relevant when assessing causes of abnormal PVR.\textsuperscript{5}

Our main outcome was the presence and extent of obstruction as defined by the Blaivas and Groutz nomogram.\textsuperscript{6} The original Blaivas and Groutz nomogram uses maximum flow rate obtained by free flow because in their series a significantly higher flow rate was observed in the same patient without the presence of a catheter.\textsuperscript{6} We chose not to analyse maximum flow rate as obtained by free flow as such measurement implicates that the measured values of maximum flow rate and detrusor pressure are based on two separate and potentially different voids as one originates from a void with a catheter and one without. Furthermore, we wanted to minimise the burden for the patients. However, by measuring maximum flow rate with the catheter present, it is possible that we subsequently obtained a relatively low maximum flow rate which might explain part of the high rate of obstruction we found before and after surgery using the Blaivas and Groutz nomogram. Recently, Massolt et al. also suggested that the Blaivas and Groutz nomogram might overestimate the proportion of patients with bladder outlet obstruction.\textsuperscript{8} When using other cutoff points, we would probably have found
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less obstructed women. However, when using these cutoff point studies, one has to realise that only patients with clinically predefined anatomical obstruction were included in these studies, whereas women with functional bladder neck obstruction, e.g. from surgery, were not included in any of these studies. Therefore, the Blaivas and Groutz nomogram might still be the most informative since it graphically shows the difference in flow rates and detrusor pressure which also enables us to see smaller differences between the pre- and postoperative situation. The main goal of this study was to investigate if anterior colporrhaphy causes bladder outlet obstruction which is hypothesised to be due to urethral elevation or either by suburethral hematoma and/or oedema formation. Using the Blaivas and Groutz nomogram, only one woman appeared to develop obstruction postoperatively, and she was only mildly obstructed after surgery. Also, when looking at the detrusor pressure, no evidence for obstruction could be found since we did not see a rise in detrusor pressure during maximum flow rate. This does not exclude that oedema formation or elevation of the bladder neck might be present; however, our data show that if oedema formation is present, it does not seem to introduce obstruction to the bladder outlet more than the situation before surgery. In addition, damage to the innervation of the bladder is previously hypothesised as a possible cause for incomplete voiding after prolapse surgery. This would result in a decrease in maximum detrusor pressure and detrusor pressure during maximum flow rate. In women with abnormal PVR, we did observe a trend towards a lower detrusor pressure during maximum flow rate and observed a decreased flow rate. This might indicate that innervation damage may play a role in the development of abnormal PVR. However, an argument against this hypothesis is that within the group of women with abnormal PVR, we could not show a decrease in detrusor pressure during maximum flow rate when comparing detrusor pressure pre- and postoperatively.

Considering the limited evidence that has been provided to support the role of innervation damage on incomplete bladder emptying, and because of the lack of evidence for obstruction as a causal factor for incomplete bladder emptying, we think the underlying pathophysiology of voiding difficulties after prolapse surgery should not only be sought in mechanical causes. It is possible that other factors like pain and postoperative anxiety will contribute to this complication. Support for a possible role of postoperative anxiety came from three earlier randomised studies which all showed a reduction of the postoperative incidence of abnormal PVR after urogynaecological surgery with the administration of alpha blocking agents. Further, previous studies have also shown that bladder function impairment could also be explained by psychological inhibition due to the clinical environment in which patients are requested to void postoperatively. Therefore, we think that future
research should focus more on the origin and treatment of these non-mechanical causes as with the present study and current literature most evidence points towards that direction.

**Concluding message**

Urodynamic investigation on the first day after anterior colporrhaphy shows that anterior colporrhaphy carries a low risk of inducing bladder outlet obstruction. The explanation for postoperative development of abnormal PVR should therefore not only be sought in the effects of surgery on the bladder neck and urethra but also involves other non-anatomical explanations such as anxiety, pain and other psychological factors. These possible candidates should be evaluated in order to decrease the prevalence of abnormal PVR and optimise its treatment.

**References**


Does vaginal prolapse surgery induce bladder outlet obstruction?


Chapter 9

General discussion
Chapter 9

This thesis reports on the etiology, prevention and management of incomplete voiding after vaginal prolapse surgery.

I Objectives of this thesis

The first objective was to determine the preferred practice and practice variation in Dutch hospitals concerning bladder care management after vaginal prolapse surgery. A survey was performed among Dutch gynaecologists with a special interest in urogynaecology.

The second objective was to optimise postoperative bladder care. Firstly, a randomised controlled trial was performed to compare a duration of standard postoperative catheterisation of 5 days (which was then the most frequently applied duration) to removal within 24 hours. Secondly, based on the results of the survey, the two most popular treatment protocols for the treatment of incomplete voiding, transurethral catheterisation for 3 days and intermittent catheterisation were compared in a multi-center randomised controlled trial (RCT) to establish what the most optimal technique of catheterisation is for management of patients with an abnormal postvoiding residual volume. In addition to the last RCT a preference study was performed to evaluate why patients choose for one or the other treatment.

The third objective was to understand the development of abnormal PVR. Risk factors for the development of abnormal PVR postoperatively were identified through logistic regression analysis on one retrospective and one prospective cohort. In the prospective study, anxiety and pain scores were included to determine their possible effect on the development of abnormal post void residual volume. An additional urodynamic study was performed to investigate the potential role of bladder outlet obstruction after prolapse surgery as an aetiological factor of incomplete voiding after vaginal prolapse surgery.

II Main conclusions

First objective: determining preferred practice and practice variation
At the time the studies in this thesis were designed it was common practice to prolong initial catheterisation for several days after vaginal prolapse surgery. Duration of this type of catheterisation frequently lasted up to 5 and sometimes 7 days. A randomised controlled trial comparing removal on the fifth day with removal within the first day showed clear benefits of removal within the first postoperative day. After this RCT a survey was performed to evaluate the effect of this RCT on the content of protocols in the Netherlands. The survey showed that initial catheterisation was mostly performed with a transurethral indwelling catheter. The duration of this initial catheterisation ranged from 1 to 7 days. Interestingly, the median duration went
down to 3 days. This might represent an adjustment to our trial results. Other findings were that there was no consensus about the minimal residual volume considered to be pathological (median 150 ml, range of 50-250 ml). Furthermore, there was a considerable practice variation regarding the use of antibiotics. These were given either standardly or based on urinary tract infection symptoms alone by 21% of responding gynaecologists. Lastly, there was a great variation in the management of abnormal PVR. The two most popular catheterisation regimens for abnormal PVR were indwelling catheters for 2 to 3 days and intermittent catheterisation. The large practice variation regarding these issues could be explained by limited evidence and inadequate implementation of available evidence on this subject.

Second objective: optimising postoperative bladder care

In the first RCT patients were randomised between a 5 day regime of catheterisation or a regime in which catheterisation was ceased within 24 hours postoperatively. This study revealed that a standard regimen to prevent abnormal PVR after vaginal prolapse surgery (duration of indwelling catheterisation of 5 days) could be safely reduced to a maximum of 1 day. It was observed that shorter catheterisation lowers the risk of urinary tract infections and gives a higher risk of re-catheterisation. However, the total days catheterisation lasted was still lower in the short catheterisation arm. After the removal of the initially placed catheter some patients develop an abnormal post void residual volume. It was observed, in the second RCT, that intermittent catheterisation showed a significant reduction in bacteriuria, a lower number of urinary tract infections and a quicker resumption to adequate bladder emptying when compared to transurethral indwelling catheterisation for 3 days. After disclosure of the results of this RCT 98% patients expressed a preference for intermittent catheterisation. It is likely that the finding of a higher bacteriuria and urinary tract infection rate in the indwelling group can be explained by the continuous presence and bacterial colonisation of the indwelling catheter as opposed to the in/out regime with intermittent catheterisation (IC). Although the repeated introduction of catheters during IC may also introduce bacteria, the difference in urinary tract infection rate can be explained by earlier observations by others that clearance of bacteria occurs during micturition in the absence of a (long term) catheter. The most likely explanation of the better results of intermittent catheterisation (as opposed to the continuous drainage with transurethral catheterisation) is that the bladder intermittently fills and empties and that this trains the bladder to sensate the difference between a filled and an emptied status.
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Third objective: understanding development and etiology of abnormal PVR
From the multivariable analysis of a retrospective cohort it was observed that abnormal PVR after vaginal prolapse surgery occurs more often in women with larger cystoceles, with larger amounts of intra-operative blood loss and/or after surgery with levator plication or suburethral (Kelly) plication.\(^8\)

A subsequent urodynamic study revealed that after anterior repair the risk of de novo bladder outlet obstruction was low. Therefore, abnormal postvoiding bladder residual volume after vaginal prolapse surgery apparently does not result from bladder outlet obstruction.\(^9\)

Lastly, in an attempt to further identify risk factors for abnormal PVR and to establish whether the magnitude of anxiety and pain levels could be of influence for developing abnormal PVR a prospective cohort was studied. In this cohort, multivariate analysis revealed that patient anxiety level and higher degree of anterior wall prolapse were independent variables related to the development of abnormal post void residual volumes.\(^10\)

Implications and future perspectives

First objective: determining preferred practice and practice variation
From our survey it is clear that clinical practice regarding bladder care varies to a great extent. From several studies including ours it can be concluded that transurethral indwelling catheterisation is a safe technique with low morbidity, provided that the duration is shortened to a maximum of 24 hours postoperative. Further, for patients with an abnormal PVR, clean intermittent catheterisation is preferable as compared to transurethral indwelling catheterisation. The observed practice variation implies that some patients are exposed to an unnecessary higher risk to develop catheter induced urinary tract infections and longer hospitalisation. Reasons for this non-compliance with the evidence may be unawareness, underestimation and/or ignorance of the risks of catheterisation. Although we did observe effects on protocols after publication of trial results and noticed more attention for this subject nationally, not all hospital departments implemented this evidence in their protocols. In order to serve patients needs and demands, an effort for further optimisation of postoperative bladder care through clinical trials and further implementation of these trials should be aimed at. We think that continuing attention to this subject and the development of national (and international) multidisciplinary guidelines could serve this purpose.

Second objective: optimising postoperative bladder care
The duration of the initial placement of a catheter directly postoperatively should be reduced in order to reduce morbidity. Early removal of the initially placed
catheter results in a reduction of total duration of catheterisation and in a reduction of the occurrence of urinary tract infections. This outweights the higher risk of re-catheterisations.\textsuperscript{1} We believe that transurethral indwelling catheterisation is mandatory in the period that a vaginal gauze is left in place. However, an early removal of the vaginal gauze could be feasible and, in this way, facilitate earlier removal of the catheter.

Further studies should therefore focus at the actual need for a vaginal gauze, exploring the possibility of even earlier removal of the catheter and to investigate the potential benefits of IC over transurethral indwelling catheterisation directly postoperative.

In case of incomplete voiding, intermittent catheterisation should be the treatment of choice.\textsuperscript{3} More studies are needed to determine the acceptance of patients for intermittent catheterisation. In such studies special attention should focus at the willingness and ability of patients to either receiving IC by nurses or performing self catheterisation and at the time efficiency for nursing staff and costs.

Such studies, incorporation in guidelines, continuing attention to the subject by oral presentations and clinical lessons are mandatory to increase awareness of gynaecologists and to improve postoperative care.

**Third objective: understanding development of abnormal PVR**

The results of the multivariate analysis in our retrospective cohort revealed that patients undergoing suburethral suturing (Kelly) have a higher risk to develop abnormal post void residual volume.\textsuperscript{8} We hypothesised that this could be due to more pain with an inhibiting effect on bladder emptying and also due to elevation and possible obstruction of the bladder outlet. Elevation and edema formation causing obstruction of the bladder outlet have often been related to the development of abnormal post void residual volume after anterior compartment surgery.\textsuperscript{11-14} Therefore, patients undergoing vaginal prolapse surgery were urodynamically evaluated in a prospective study. The results showed that bladder outlet obstruction is not a likely explanation for incomplete voiding after vaginal prolapse surgery. This means that our surgery technique should not be altered to prevent abnormal post void residual volume.

Lastly, our retrospective multivariate analysis revealed that the development of abnormal post void residual volume is multi-factorial. Both surgical and non-surgical factors can contribute to the development of abnormal PVR. To gain more insight in non-surgical explanations of development of abnormal post void residual volume anxiety level scores and pain scores were included in another (prospective) multivariable analysis. Again an effect was found of high stage anterior wall prolapse which could point to innervation damage as an explanation. Also, anxiety level was
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found to have an influence on the development of abnormal post void residual volume, however more studies are needed to confirm this finding and to further quantify which levels of anxiety predispose for abnormal post void residual volume. Ultimately, intervention strategies to reduce anxiety in patients with higher anxiety scores should be evaluated in RCT’s as prevention and treatment of abnormal PVR.

**Concluding message**

Incomplete voiding after vaginal prolapse surgery is a common, but underevaluated, clinical condition. The large practice variation in diagnosis and treatment of voiding problems after vaginal prolapse surgery underlines the need for this thesis. The studies performed show that initial catheterisation should be shortened after vaginal prolapse surgery and in the event of an occurring abnormal PVR clean intermittent catheterisation should be initiated. From the studies several new research questions can be raised to further optimise postoperative care following vaginal prolapse surgery. To increase awareness of physicians and to implement the evidence, the existing and future evidence should be incorporated in national and international clinical guidelines.
References


Chapter 10

Summary
This thesis reports on the etiology, prevention and management of abnormal post void residual volumes (PVR) following vaginal prolapse surgery.

In **chapter 1** the introduction, an overview is given of the possible etiology and treatment of the clinical condition of incomplete voiding. The research questions are raised which are dealt with in the thesis.

In **chapter 2** the results of a randomised controlled trial comparing preventive catheterisation after vaginal prolapse surgery for a duration of less than 1 day is compared to 5 days. The study was undertaken to determine whether patients undergoing vaginal prolapse surgery need a prolonged period of preventive catheterisation. The period of 5 days was chosen as a comparison because this was common practice at that time. A significant higher rate of abnormal PVR was found in the 1 day catheterisation group (OR 0.15, limits 0.045-0.47). 40% of patients in the 1 day group and 9% in the standard prolonged group of 5 days required repeated catheterisation due to incomplete voiding. Despite the higher number of recatheterisations in 1 day group the mean duration of catheterisation was still significantly shorter than in the 5 day group (p<0.001). In the 5 day group the occurrence of urinary infections was significantly higher (chi-square analysis, OR 15, limits 3.2-68.6) than in the 1 day group. The mean hospital stay was 1.3 day shorter in the not prolonged catheterisation group (p<0.001).

Although a significant proportion of patients experience abnormal PVR there is a major benefit of 1 day catheterisation regarding urinary tract infection risk. A majority of 60% does not require additional catheterisation in the group where catheterisation was ceased within 1 day. It is advised to remove indwelling catheters on the morning of the first postoperative day.

In **chapter 3** the results of a dutch nationwide survey to measure practice variation concerning catheterisation is presented. The main reason for this study was that a considerable practice variation was suspected concerning diagnosis and management of abnormal postvoid-residual volume. As bladder catheterisation following vaginal prolapse surgery causes inconvenience for patients, raises the risk of urinary tract infections and potentially lengthens hospitalisation this implies suboptimal treatment for certain subgroups. A self developed questionnaire was sent to each hospital addressing the gynaecologist with a special interest in urogynaecology at that specific institution. The response rate was 93%. Postoperatively, 77% performed transurethral indwelling catheterisation, 12% suprapubic and 11% intermittent catheterisation. Catheterisation was applied 3 days (1-7 days) following anterior repair and 1 day (1-3 days) following all other procedures. The median cut-off point for abnormal post-void residual (PVR) was 150 ml (range 50-250 ml). Treatment of abnormal PVR consisted mostly of prolonging transurethral indwelling
catheterisation for 2 days (range 1-5 days) (57%), 29% by intermittent and 12% by suprapubic catheterisation. Antibiotics were administered by 21% either routinely or based on symptoms only. It was concluded that due to insufficient evidence and suboptimal implementation of available evidence concerning bladder care practice variation is high.

In **chapter 4** the results are presented of a randomised study comparing indwelling catheterisation for 3 days with intermittent catheterisation for the treatment of abnormal PVR after vaginal prolapse surgery. These methods were the most frequently applied treatments for abnormal PVR but no evidence existed which one was the most preferable.

All patients were given an indwelling catheter directly after surgery which was removed on the first postoperative day. Patients with a PVR of more than 150 mL after their first void were randomised for either clean intermittent catheterisation performed by nursing staff (CIC) or for transurethral indwelling catheterisation (TIC) for three days.

A total of 87 patients were included in the study. In the CIC group (n=45) a lower risk of developing bacteriuria (14% vs 38%, P=0.02) and UTI (12% vs 33%, P=0.02) was found together with a shorter required duration of catheterisation compared to the TIC group (n=42) (18 hours CIC versus 72 hours TIC, P< 0.001). Patient satisfaction was similar. No adverse events occurred. It was concluded that clean intermittent catheterisation is preferable above indwelling catheterisation for three days in the treatment of abnormal PVR following vaginal prolapse surgery.

**Chapter 5** describes patient preferences for intermittent catheterisation and indwelling catheterisation. Preferences were assessed using written treatment scenarios. In the initial scenario, treatment duration was set at 3 days and the risk for urinary tract (UTI) at 30% for both interventions. Treatment duration and UTI risk after CIC were varied until patients switched preference, with the aim to determine what role duration of catheterisation and UTI risk play in the preference of patients for either of the two treatments. Treatment duration and UTI risk related to TIC were kept constant throughout the interview. When duration of treatment and risk of UTI would be identical for both interventions 64% percent of patients would prefer CIC above TIC. When CIC would last 3 days and would result in a 15% lower UTI risk than TIC, 92% of the patients would prefer CIC. Assuming that CIC resulted in a 15% lower UTI risk, respectively 98% and 99% of the patients preferred CIC over TIC when catheterisation with CIC would last one respectively two days shorter than TIC.

**Chapter 6** presents the results of a logistic regression model which was performed to identify risk factors for abnormal PVR. Identifying risk factors for abnormal PVR is important because it can improve pre-operative counselling and ultimately
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the catheterisation regime can be adjusted to an individual risk for post-operative abnormal PVR. The medical records of 345 women undergoing surgical correction for symptomatic pelvic organ prolapse were analysed. Independent risk factors for the development of post-operative abnormal PVR were identified by performing univariate and multivariate logistic regression analysis. Several patient, demographic and surgical parameters were collected to determine risk factors for incomplete voiding. High grade cystocele (OR 2.5, CI 1.3 - 4.7), performing levator plication (OR 4.3, CI 2.0 – 9.3), performing Kelly plication (OR 5.1, CI 1.7 -15.5) and amount of intra-operative blood loss (OR 1.4 per 100 ml, CI 1.1-1.8) were identified as independent risk factors for the occurrence of abnormal PVR after vaginal prolapse surgery. From the finding that Kelly plication was of influence it was concluded that possibly the causes of abnormal PVR are an elevation of the bladder neck with an obstructive effect on the bladder outlet. From the finding that higher stage prolapse proved to be a risk factor, an influence of innervation damage due to extra dissection with higher stages was suspected. Further, levator plication was thought to exert its effect through pain leading to a disabled relaxation of the pelvic floor and consequently a negative effect on micturition.

In chapter 7 the results are shown of a second logistic regression model of a prospective cohort of patients having underwent vaginal prolapse surgery. A total of 342 patients were included. In the multivariable analysis with stepwise backward selection the strongest predictors were parity (OR 1.34, 95% CI 0.9-1.9), UDI pain domainscore (OR 1.11 95% CI 1.0 -1.3), situationally induced anxiety level (OR 1.39, 1.0 - 1.9) and point Ba (OR 1.25 95% CI 1.0-1.5). Of these factors situationally induced anxiety level and point Ba remained as the only two statistically significant predictors. It was concluded that incomplete voiding can be related to an obstruction of bladder outflow through a disturbed relaxation of the pelvic floor, central inhibition of the bladder and/or alpha adrenergic stimulation of the bladder outlet respectively but also to innervation damage through surgery.

In chapter 8 pre operative and postoperative urodynamic data are presented to determine the effect prolapse surgery has on bladder function and bladder outflow resistance patients undergoing vaginal prolapse surgery. The data were plotted in the Blaivas/Groutz nomogram as a reference to subclassify patients into categories varying from non-obstructed to obstructed (Blaivas). It appeared that vaginal prolapse surgery does not cause a significant obstruction as postoperative patients fell into the categories non obstructed to mildly obstructed.

In chapter 9 the discussion section the results of these studies are placed in a broader perspective and recommendations are given for clinical practice.
Chapter 11

Samenvatting
Vaginale prolaps is een veel voorkomende aandoening waarvoor ongeveer 1 op de 10 vrouwen in haar leven geopereerd wordt. Een vaginale verzakkingsoperatie beoogt de prolaps op te heffen en zoveel mogelijk de normale bekkenbodemfunctie te herstellen. Na een dergelijke operatie blijkt ongeveer 1 op de 5 vrouwen na het verwijderen van de kathteter niet in staat de blaas compleet te legen. Hiermee is dit onvolledig legen van de blaas een van de meest frequent optredende complicaties na een dergelijke operatie. Er bestaat enige consensus in de literatuur dat deze onvolledige mictie als pathologisch moet worden aangemerkt vanaf 150 ml residu volume. Wanneer deze retentie over de blaas capaciteit heen gaat en on(der) behandeld blijft kan de blaas overrekt raken met, soms blijvende, negatieve gevolgen voor de functie van de blaasspier. Deze complicatie kan voorkomen worden door het preventief inbrengen van een blaaskatheter. Decennia lang hebben gynaecologen na vaginale prolapschirurgie daarom standaard meerdere dagen de blaas gekatheteriseerd. Veelgenoemde redenen voor deze standaard interventie zijn de aanwezigheid van een vaginale tampon, de negatieve effecten van anesthetica op blaasfunctie maar ook de postoperatief afgenomen mobiliteit en daardoor bemoeilijkte toiletgang van patiënten. Andere mogelijke factoren die de blaasfunctie kunnen belemmeren zijn postoperatieve pijn, peri-urethraal oedeem en elevatie van de urethra na voorwandplastiek of schade aan de innervatie van de blaas door vrij prepareren en doorsteken van de blaas.

De indicatie voor deze preventieve behandeling staat ter discussie aangezien het een preventieve behandeling betreft voor een complicatie die in de meerderheid van de gevallen niet op gaat treden maar ook omdat het mechanisme niet goed bekend is. Alhoewel deze preventieve behandeling eenvoudig en veilig lijkt leidt het onherroepelijk tot een verhoogde kans op urineweginfecties, hinder voor patiënten en verlenging van ziekenhuisverblijf met bijkomende kosten. Om deze redenen is het belangrijk om te weten of deze preventieve behandeling daadwerkkelijk nodig is, hoe er beter geanticipeerd kan worden op een urineretentie en hoe de behandeling van een eenmaal vastgestelde retentie geoptimaliseerd kan worden. Daarbij is er geen inzicht in de oorzaken van urineretentie noch is er inzicht in de patiëntenvoorkeur ten aanzien van de verschillende soorten behandelings die er zijn.

Tot op heden is er weinig literatuur over de noodzaak en optimale duur van preventieve blaaskatheterisatie bedoeld om een retentie te voorkomen. Het is verder onduidelijk wat de meest optimale techniek van katheteriseren is wanneer een retentie eenmaal is vastgesteld. Ten slotte zijn er geen oorzaken bekend van deze complicatie. In dit proefschrift worden bovengenoemde punten derhalve geëvalueerd.

Hoofdstuk 1, de introductie, geeft een overzicht van het probleem incomplete blaaslediging. Met name de ideeën die bestaan over de mogelijke oorzaken en de
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behandeling worden belicht. Aan het eind worden vragen geformuleerd die in de daarop volgende studies beantwoord worden.

**Hoofdstuk 2** beschrijft de resultaten van een gerandomiseerde studie waarin honderd patiënten die vaginale prolapschirurgie ondergingen werden geïncludeerd. Patiënten werden gerandomiseerd ofwel voor 5 dagen (op dat moment de gebruikelijke preventieve katheterisatieduur) ofwel voor 1 dag katheterisatie. Een significant lager aantal patiënten met afwijkend residu werd gezien in de 5 dagen katheteriseren groep vergeleken met de 1 dag katheteriseren groep (OR 0.15, 95% betrouwbaarheidsinterval 0.045-0.47). Na het verwijderen van deze katheter moet een eventuele gediagnosticeerde retentie behandeld worden met aanvullende katheterisatie.

Negentien van de 48 patiënten (40%) in de 1 dag groep kregen volgens protocol een tweede katheter versus 4 van de 46 (9%) in de groep 5 dagen katheteriseren. Ondanks het hogere aantal herhaalde katheterisaties in de 1 dag groep was het gemiddeld aantal katheterisatiedagen per patiënt toch significant lager (2.3 dagen versus 5.3 dagen, p < 0.001, Student’s t-test). Daarbij was in de 5 dagen groep het gemiddeld aantal urineweginfecties significant hoger (OR 15.0, 95% betrouwbaarheidsinterval 3.2-68.6). De gemiddelde opnameduur was 1.3 dagen korter in de groep met verkorte duur. In deze studie werd dus wel een verhoogd aantal abnormale residuen gevonden bij het eerder verwijderen van de katheter, echter het totaal aantal katheterisatiedagen bleek lager te zijn voor de 1 dag groep, de meerderheid was in staat om normaal uit te plassen en de opnameduur alsmede urineweginfecties lieten een significante daling zien in de groep met verkorte duur. Er werd geconcludeerd dat 1 dag preventief katheteriseren de voorkeur had boven 5 dagen katheteriseren.

**Hoofdstuk 3** laat de resultaten zien van een enquête die onderzocht wat de gewoonten waren van gynaecologen ten aanzien van postoperatieve zorg na vaginale prolapschirurgie. Postoperatief bleek bij preventieve katheterisatie 77% van de respondenten gebruik te maken van een transurethrale verblijfskatheter, 12% van een suprapubische katheter en 11% stelde intermitterende katheterisatie in als behandeling. De duur van de eerste (standaard) katheterisatie bleek gemiddeld 3 dagen te zijn na operaties aan het voorste compartiment met een variatie van 1 tot 7 dagen en gemiddeld 1 dag na operaties aan het achterste en middelste compartiment met een variatie van 0 tot 4 dagen. Het meest gebruikte afkappunt voor het definiëren van een abnormaal residu urine dat in de blaas overblijft was 150 ml met een variatie van 50-250 ml. De behandeling van eenmaal vastgestelde retentie bleek in 57% van de gevallen plaats te vinden met een transurethrale verblijfskatheter (gemiddeld 2,25 dagen met een variatie van 1-5 dagen), 29% door intermitterende katheterisatie en
dezelfde 12% die aanvankelijk bij preventieve katheterisatie koos voor suprapubische katheterisatie bleek suprapubische katheterisatie voort te zetten. Antibiotica werden in 21% van de protocollen routinematig toegediend of gegeven op basis van symptomen alleen. Er werd in deze studie vastgesteld wat de meest gebruikte protocollen zijn voor katheterisatie na vaginale prolapschirurgie. De meest gebruikte protocollen konden worden vergeleken in een nieuwe RCT. Er werd geconcludeerd dat er veel variatie bestond tussen protocollen en dat de voornaamste redenen hiervoor onvoldoende literatuur of het niet toepassen van wel bekende literatuur leken te zijn.6 Hoofdstuk 4 toont de resultaten van een gerandomiseerde studie die werd uitgevoerd in meerdere centra waarbij patiënten werden gerandomiseerd tussen de meest voorkomende behandelingen in Nederland zoals die naar voren kwamen uit de eerdere enquête; 3 dagen verblijfskatheter en intermitterend katheteriseren. De primaire uitkomstmaat was het optreden van bacteriurie na behandeling. Hieruit bleek dat zowel het optreden van bacteriurie (14% vs 38%, P = 0.02) als de duur van behandeling (18 uur bij intermitterend katheteriseren versus 72 uur bij verblijfskatheter, P < 0.001) significant korter waren bij de toepassing van intermitterend katheteriseren. Deze kortere behandelduur bleek bovendien te resulteren in een korte ziekenhuisverblijf (2 versus 4 dagen, p < 0.001. Als meest logische verklaring voor de hogere infectiekans bij de verblijfskathetertgroep is de aanwezigheid van een vreemd lichaam voor een langere duur waardoor kolonisatie van bacteriën optreedt. In het geval van intermitterend katheteriseren is er bij elke poging tot mictie een kans op uitwassen van bacteriën. De kortere behandelduur bij de intermitterende katheterisatie werd verklaard door de afwisselende vulling en lediging van de blaas bij intermitterend katheteriseren die waarschijnlijk het dichtst bij de fysiologische normale situatie komt.7 In hoofdstuk 5 wordt geëvalueerd voor welke van de twee behandelingen (3 dagen verblijfskatheter of intermitterend katheteriseren) de patiëntenvoorkeur het grootst is. Hierbij werden patiënten een aantal scenario’s voorgelegd over de twee behandelingen. In de uitgangssituatie werd bij beide typen katheterisatie de duur van de behandeling op 3 dagen gesteld en de kans op urineweginfectie ten gevolge van de behandeling op 30%. Patiënten werd gevraagd om een voorkeur uit te spreken voor een van de twee behandelingen bij deze situatie. Hierna werd systematisch in stappen van 5 % de kansen op een urineweginfectie en de duur van de behandeling verlaagd bij behandeling met intermitterend katheteriseren. De duur van behandeling werd bij een verblijfskatheter op een benodigde 3 dagen gehouden met een constant risico op urineweginfecties van 30%. Op deze manier kon de patiëntenvoorkeur voor de verschillende katheterisatie regimes vastgesteld worden.
Ook kon de invloed van het risico op urineweginfecties en duur van behandeling worden bepaald op de totstandkoming van deze keuze. Hieruit kwam een logisch verloop van preferenties. Patiënten bleken te kiezen voor voordeel in infectiekans en duur van behandeling. Hieruit bleek dat een meerderheid van 98% van de patiënten intermitterend katheteriseren zou verkiesgen boven een verblijfskatheter als de resultaten uit de genoemde RCT in hoofdstuk 3 gelden.\(^8\)

**Hoofdstuk 6** beschrijft een analyse van een groep patiënten die eerder vaginale prolapscirurgie ondergingen. Van verschillende factoren zoals lengte, gewicht, graad van verzekking, type en techniek van de ingreep en duur van de ingreep werd nagegaan of deze van invloed waren op het risico een retentie te ontwikkelen. De volgende factoren bleken van invloed: hoge graad cystocele (OR 2.5, CI 1.3-4.7), het toepassen van bekkenbodemspierhechtingen (levatorhechtingen) (OR 4.3, CI 2.0-9.3), hechtingen onder de urethra om urine incontinentie tegen te gaan (Kelly hechtingen) (OR 5.1, CI 1.7-15.5) en toenemende hoeveelheid bloedverlies tijdens de operatie van invloed bleken (OR 1.4 per 100 ml, CI 1.1-1.8). Omdat spierhechtingen van de levatorspier geen directe anatomische relatie hebben met de blaas werd geconcludeerd dat blijkbaar niet-anatomische factoren een rol spelen. Pijn, en daardoor een onvoldoende ontspanning van de bekkenbodem, zou hier een rol kunnen spelen. De bevinding dat bloedverlies van invloed was, zou kunnen liggen in de mogelijkheid dat meer doorstekingen noodzakelijk zijn bij meer bloedverlies en daardoor innervatieschade kan optreden aan de blaas. De invloed van Kelly hechtingen werd geïnterpreteerd als een teken dat de retentie mede verklaard zou kunnen worden door elevatie van de blaashals met een obstructie als gevolg. Er werd geconcludeerd dat het optreden van urineretentie waarschijnlijk een multifactoriële origine heeft.\(^9\)

**Hoofdstuk 7** beschrijft een analyse van een cohort van 342 patiënten die vaginale prolapscirurgie ondergingen. Net als in hoofdstuk 6 was het doel om vast te stellen welk type patiënt een hoger risico heeft om een retentie te ontwikkelen. De opzet van deze studie was prospectief. In een groep van 342 patiënten ontwikkelden 87 patiënten een retentie. Een van de hypotheses was dat angst een belangrijke invloed zou kunnen hebben op mictie postoperatief. Het is bekend dat de blaasopslag en evacuatie door respectievelijk het sympathisch- en de para-sympathisch zenuwstelsel gereguleerd worden. In het algemeen kan gesteld worden dat angst en nervositeit de sympathetic activeren met een inhibitie van de blaasspier (m.detrusor) en een alfa adrenerge stimulatie van de blaashals en urethra met een obstructie als gevolg. In het cohort werd, naast de invloed van verschillende patiëntkarakteristieken en operatieve variabelen, ook onderzocht de invloed van angstniveau is zoals dat ervaren wordt in het normale dagelijks leven (Trait anxiety level) en het angstniveau zoals dat ervaren wordt na een stressvolle gebeurtenis (in dit geval hospitalisatie en operatie). Deze
angst meting wordt aangemerkt als State anxiety. Bij een univariabele analyse werden een aantal variabelen geïdentificeerd die van invloed konden zijn op het ontwikkelen van een dergelijke retentie. Na verdere selectie in de daaropvolgende multivariabele analyse bleek de hoogte van het preoperative stadium van voorwandprolaps en postoperatief angstniveau van de patiënt inderdaad de enige significante voorspellende factoren te zijn.

Er werd geconcludeerd dat angst een negatieve invloed heeft op postoperatieve mictie en dat dit mogelijk komt door de operatie en hospitalisatie. Er werd een aanbeveling gedaan voor toekomstige studies. Deze zouden zich moeten richten op stress reductie.

In Hoofdstuk 8 worden de resultaten gerapporteerd van een studie waarin 17 patiënten voor, en 1 dag na het ondergaan van vaginale prolapschirurgie een urodynamisch onderzoek ondergaan. Een veelgehoorde hypothese voor het ontstaan van urineretentie is een obstructie door een elevatie van de blaashals en urethra, hematoom vorming en oedeemvorming. Het doel van deze studie was om te onderzoeken of de optredende retentie inderdaad toe te schrijven zou kunnen zijn aan een eventuele obstructie door de gevolgen van de recente plastiek. Er werden in deze studie geen verschillen gevonden met betrekking tot detrusor druk en maximale flow tussen de pre- en postoperatieve situatie. Wanneer deze uitslagen ingebracht werden in en veel toegepast nomogram voor obstructie (nomogram volgens Blaivas en Groutz) mocht geconcludeerd worden dat prolapschirurgie geen belangrijke obstructie veroorzaakt van het blaasuitstroomgebied. Deze studie bevestigde de uitkomsten dat de optredende retentie niet alleen chirurgisch gerelateerd was.10

In hoofdstuk 9, de discussie worden de resultaten van de genoemde studies in een breder perspectief geplaatst en er worden aanbevelingen gedaan voor de praktijk.
**Conclusies**
De meerderheid van patiënten die vaginale prolapschirurgie ondergaan hebben zal geen last hebben van urineretentie en bovendien blijkt dat een korte duur van katheterisatie van minder dan 24 uur, ondanks een initieel hoger aantal patiënten met een retentie, een voordeel biedt ten opzichte van de totale benodigde katheterisatieduur en infecties. Er wordt voorgesteld dit type katheterisatie beperkt wordt tot de directe postoperatieve periode waarin de mobiliteit van patiënten beperkt is en de gevoeligheid van de blaas voor vulling mogelijk verminderd is. De behandeling van een retentie, na het verwijderen van de initieel ingebrachte katheter, blijkt beter te kunnen worden behandeld door intermitterend katheteriseren dan met, de thans meest gebruikte methode, een verblijfskatheter voor 2-3 dagen. Er bleek een forse reductie op te treden in bacteriurie, urineweginfecties, katheterisatieduur en hospitalisatie bij intermitterende katheterisatie wanneer dit werd vergeleken met een verblijfskatheter voor 3 dagen. Vanwege deze voordelen wordt geconcludeerd dat intermitterende katheterisatie te verkiezen is boven een verblijfskatheter. De overgrote meerderheid van patiënten blijkt bij deze voordelen intermitterend katheteriseren boven een verblijfskatheter te prefereren. De voorkeur voor deze behandeling blijkt bij patiënten met name te berusten op de lagere infectiekans en duur van de behandeling. Naar aanleiding van de bevinding dat met name angst een rol speelt in de origine van de retentie en een obstructie niet oorzakelijk bleek zouden toekomstige studies zich kunnen richten op psychologisch welbevinden van de patiënt tijdens hospitalisatie en angstreductie. Effecten van eerdere terugkeer naar een normale huiselijke omgeving door kortere hospitalisatie, het verminderen van psychologische focus op het voorkomen van deze complicatie door verwijderen van de katheter voor de nachtrust, en het vergroten van autonomie door aanleren van zelfkatheterisatie zouden gemeten moeten worden. Optimalisatie van deze factoren zou effect kunnen hebben in het voorkomen van de retentie maar ook de duur van de vervolgbaehandeling.
Chapter 11

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Robert Alexander Hakvoort was born on the 31st of March 1972 in Vorden (The Netherlands) as the youngest son of Maria Antonia Johanna Hakvoort-Aarnink and Gerardus Antonius Johannes Hakvoort. He graduated from high school in 1991 (Baudartius college, Zutphen) after which, by drawing lots, he was excluded several times from medical school. In these years he worked and he studied chemical technology at Wageningen University. He received a bachelor's degree in this field after which he was finally admitted to medical school at the Vrije Universiteit in Amsterdam in 1993. In his internship obstetrics and gynaecology in the Spaarne Hospital in Haarlem he became interested in this field. After receiving his medical degree in 2000 he worked as a house officer in obstetrics and gynaecology in the Spaarne Hospital for 2 years. Here he finalised his first randomised trial about incomplete voiding after vaginal prolapse surgery. This manuscript is now part of this thesis. In 2002 he started his training in obstetrics and gynaecology at the Medical Center Alkmaar and subsequently at the Academic Medical Center in Amsterdam. In this period he became president of the Dutch society of trainees in obstetrics and gynaecology and member of the board of the Dutch society of obstetrics and gynaecology. In 2006, he returned to the Spaarne Hospital in Hoofddorp to complete his training. Here, he initiated more studies about incomplete voiding after vaginal prolapse surgery. Since 2007 he is working in the Spaarne Hospital as a staff consultant gynaecologist. In this period he became member of the organising committee of the Dutch gynaecological surgery congress (COBRA), member of the public relations committee of the international urogynaecology association (IUGA) and secretary of the Dutch society of obstetrics and gynaecology. In 2011 he was registered as a subspecialist urogynaecology. The author lives in Haarlem, the Netherlands, with his wife Kirsten Stuurman, his daughter Guusje and his two sons Reinier and Gijs.
Stellingen

1. Preventieve katheterisatie na vaginale prolapschirurgie kan bekort worden tot maximaal 24 uur.
2. Bij gebleken incomplete mictie na vaginale prolapschirurgie verdient intermitterend katheteriseren de voorkeur boven een verblijfskatheter.
3. De bijdrage van obstructie van het uitstroomgebied van de blaas aan het optreden van incomplete mictie na vaginale prolapschirurgie is minimaal.
4. Onrust van de patiënt speelt een belangrijke rol bij het ontstaan van incomplete mictie na vaginale prolapschirurgie.
5. De aanzienlijke praktijkvariatie in postoperatief katheterisatiebeleid impliceert dat een deel van de patiënten suboptimaal geholpen wordt.
6. Bekkenbodempathologie is alledaags: Van gedonder bij de buren heb je zelf ook last.
7. Het proces van instellen van volumenormen voor ingrepen zou moeten beginnen met definiëren wat basiszorg is.
8. Promoveren naast gezin en voltijds werken is net als man zijn en gynaecoloog; je blijft uitleggen waarom.
9. A-j niet noar buutn goat kom i-j ok nans.
10. Als je lang genoeg normaal blijft wordt je vanzelf bijzonder.