Pelvic floor symptoms after gynaecological surgery
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Chapter 1

Introduction
Introduction

Hysterectomy and pelvic floor symptoms

Although the frequency with which the operation is performed is declining, hysterectomy still is one of the most commonly performed gynaecological procedures. In 2003, over 600,000 hysterectomies were performed in the United States alone and in the Netherlands approximately 11,000 hysterectomies are performed each year. The most common indications for hysterectomy are: abnormal uterine blood loss, dysmenorrhea, abdominal pain or mechanical obstruction due to an enlarged uterus. Since these are all benign conditions, for which an increasing number of alternative non-surgical treatments are available, it is becoming even more important to evaluate possible negative effects of hysterectomy itself.

Hysterectomy and pelvic floor symptoms

Possible adverse effects of hysterectomy on micturition and defecation have been the subject of numerous studies. The hypothesized etiology for the relationship between hysterectomy and symptoms of micturition and defecation is that direct surgical trauma damages the innervation to the pelvic floor and pelvic organs as well as the fibromuscular support structures.

There are four surgical steps during hysterectomy where nerve damage may occur. First, the main branches of the pelvic plexus, passing beneath the uterine arteries, can be damaged during division of the cardinal ligaments. Second, during dissection of the bladder from the uterus the major part of the vesical innervation, which enters the bladder base before spreading out through the detrusor muscle, may be damaged. Third, the extensive dissection of the paravaginal tissue may disrupt the pelvic neurones passing from the lateral aspect of the vagina. Fourth, removal of the cervix may result in loss of a large segment of the plexus, to which it is intimately related.

This hypothetical base for micturition and defecation symptoms after hysterectomy was supported by a systematic review, performed by Brown et al, who concluded that the odds of developing urinary incontinence after hysterectomy is about 40% higher than for women who have not undergone hysterectomy. This review was mainly based on cross-sectional studies. By using this design, pre-operative differences in micturition symptoms are not taken into account. Prospective studies have, so far, not been able to confirm the increase in micturition symptoms after hysterectomy. An explanation for this discrepancy could be the short follow up period in most previous studies, from 12 till 24 months. Only one long-term follow up study was performed which compared subtotal with total abdominal hysterectomy. The authors reported no increase in micturition symptoms seven to 11 years after subtotal or total abdominal hysterectomy. Up till now no studies are published that confirmed this finding. Furthermore, the long-term effects of vaginal hysterectomy are still unknown.

Long-term follow-up to evaluate micturition and defecation symptoms after hysterectomy is important, as during the first year after surgery, the positive impact of removal of symptoms may compensate for the negative impact of hysterectomy itself. Moreover, similar to childbirth, hysterectomy might be associated with an acute trauma, but with a delay of symptomatic onset as a result of slowly progressive nerve damage. Loss of innervation to the pelvic floor due to stretching of the nerves during the procedure, or damage to the supportive system caused by
traction applied to the tissue during surgery may eventually lead to the onset of micturition and defecation symptoms many years later\textsuperscript{21-24}.

**Surgical route of hysterectomy**

Hysterectomy can be performed by two different surgical routes, vaginally and abdominally. The preferred route of hysterectomy is generally vaginal hysterectomy, since after vaginal hysterectomy the hospital stay is significantly shorter, post-operative complication are less common, the window between surgery and return to daily activities is shorter and the costs are lower\textsuperscript{4, 25}. Only if vaginal hysterectomy is technically not possible, due to the large size or small descent of the uterus, abdominal hysterectomy is performed.

Since vaginal and abdominal hysterectomy are performed by different surgical routes, the risk of damage to innervation and fibromuscular structures might also differ. During vaginal hysterectomy the amount of traction on the pelvic viscera is larger, and due to this traction more nerve damage might occur\textsuperscript{26}. Especially the pudendal nerve, which innervates the urethral sphincter, might be at risk for damage due to overstretching related to downwards traction of the cervix\textsuperscript{21, 26}. This downward traction might also cause more damage to the fibromuscular structures, and increase the risk of hypermobility of the urethra. Furthermore, the level of dissection of the paravaginal tissue may be greater, thereby disrupting the pelvic neurons passing from the lateral aspect of the vagina and along the anterior wall\textsuperscript{10}. Lastly, the innervation of the bladder base might be damaged, as the dissection of the bladder is performed bluntly, and possible less gently, during vaginal hysterectomy, which might result in partial denervation of the detrusor muscle, resulting in post-junctional hypersensitivity of the detrusor muscle\textsuperscript{27, 28}. Therefore, the risk of developing micturition and defecation symptoms after hysterectomy might be increased in case a vaginal approach is selected. Up till now, no prospective studies have been published comparing the long-term effects of vaginal and abdominal hysterectomy on micturition and defecation symptoms.

**Adjustments to the surgical technique**

Since the main hypothesis for the development of micturition and defecation symptoms after hysterectomy is damage to the innervation of the pelvic floor, it is highly relevant to investigate how the surgical technique can be adjusted in such a way that innervation trauma is limited. One of the main steps causing innervation damage during hysterectomy is thought to be the division of the uterosacral and cardinal ligaments\textsuperscript{29}. A quantitative analysis of free nerve endings has shown that the risk of nerve trauma increases with more lateral clamping of the uterosacral and cardinal ligaments during hysterectomy\textsuperscript{29}. So, by dividing the uterosacral and cardinal ligaments less lateral from the uterus and reducing the amount of traction during hysterectomy, the risk of post-operative micturition and defecation symptoms could be reduced. We hypothesize that the use of electrosurgical bipolar vessel sealing techniques, instead of the normal conventional clamping and suturing, could help to achieve these goals. By using this technique only one clamp has to be entered through the vagina to secure the vessels and cut the tissue, instead of one clamp and one scissor. This might allow the surgeon to cut the surrounding tissues closer to the uterus. Furthermore, since no sutures are needed, less traction might be applied to the
tissue to enable adequate visualization. Another advantage of this decrease in traction might be a reduction in post-operative pain. Also, the operation duration might be shortened due to a limitation in surgical steps. Previous studies have proven this technique to be safe and effective, but the possible advantages of this technique on post-operative micturition and defecation symptoms has never been evaluated before.

In summary, the aims of this part of the thesis are:
1. To evaluate the long term effect of vaginal and abdominal hysterectomy on micturition and defecation symptoms.
2. To evaluate whether adjustment of surgical technique can reduce morbidity related to hysterectomy.

**Gynaecological surgery and sexual function**

The impact of gynaecological surgery on sexual function has been the subject of numerous review articles and peer-reviewed research over the past twenty years\(^{30-38}\). Gynaecological surgery might have a positive impact on sexual function due to disappearance of symptoms for which surgery was indicated and also correction of anatomical abnormalities, as in the case of prolapse surgery, may positively influence sexual function\(^{39, 40}\).

Hypothetical concerns about adverse effects of gynaecological surgery on sexual function include anatomical considerations (damage to the innervation and vascularisation to the small pelvis), removal of the cervix, which may be involved in the sexual response, and loss of female identity in case the uterus is removed\(^{35, 41, 42}\).

Previous studies evaluating sexual function after surgery used mostly questionnaires to evaluate sexual function before and after surgery. By doing this, mainly a woman’s subjective awareness of sexual function is evaluated. However, apart from these subjective symptoms, also autonomic genital response mechanisms are important in the development of sexual complaints. Genital response, i.e. vaginal vasocongestion\(^{43-45}\), might be damaged by the surgical trauma itself. Hence, there is a need for objective outcome measurements to quantify sexual function, to better understand how this function is affected by prolapse surgery.

**Definition of sexual function**

In earlier days female sexual response was regarded as a linear progression from an initial awareness of sexual desire to one of arousal with a focus on genital swelling and lubrication, to orgasmic release and resolution\(^{46}\). Nowadays, we realize that female sexual function is far more complex and is depending on multiple factors which can be divided into several dimensions being interpersonal-, physical-, social- and psychological- factors\(^{43}\). When one of these dimensions is affected, sexual dysfunction may develop.

Sexual dysfunction refers to one or more sexual symptoms experienced by an individual or a couple during any stage of sexual activity, combined with personal sexual distress\(^{43}\). The World Health
Organization defined Sexual dysfunction as “the various ways in which an individual is unable to participate in a sexual relationship as he or she would wish”. Within our definition of sexual function we therefore not only incorporate the ability of a woman to have intercourse, but also the possibility of having a pleasurable sexual experience.

Psychological mechanisms of sexual function
As mentioned before, sexual function is of a multidimensional nature, in which various psychological aspects are important. Basson et al described these aspects in a review as “interpersonal and contextual factors” and “personal psychological factors”.

Of the interpersonal and contextual factors the emotional relationship with the partner and general emotional well-being were the two strongest predictors of absence of sexual distress. Of the personal psychological factors low self image, mood instability and tendency towards worry and anxiety were most important.

Patients with gynecological conditions are known to encounter sexual dysfunction more frequently, presumably due to worry and anxiety related to the gynecological condition. This has been confirmed by the finding from previous studies that post-operative sexual function was more related to patient’s perception of their symptoms and body image than to actual topographical changes.

As the intention of gynecological surgery is to resolve gynaecological symptoms, for example pelvic organ prolapse, urinary incontinence or abnormal uterine blood loss, an improvement in sexual function can be expected after surgery.

Physiological mechanisms of sexual function
During sexual stimulation increased vaginal blood supply causes clitoris engorgement and subsequent lubrication. The same occurs for the vagina, which becomes engorged during sexual stimulation and forms a plasma transudate that is critical during the sexual arousal phase.

The autonomic innervation responsible for this response to sexual stimuli originates from the pelvic plexus and travels within the uterosacral and cardinal ligaments.

Hysterectomy may damage vaginal innervation due to dissection of the uterosacral and cardinal ligaments. Also removal of the cervix, which is closely related with autonomic innervation, is a part of hysterectomy that can be held responsible for damage to the pelvic innervation.

The impact of prolapse surgery on vaginal innervation and vasocongestion may differ from the effects of hysterectomy. First, the extensive dissection of the vaginal epithelium and fascia, that is performed during colporraphy, may result in damage of the free nerve endings located in and near the vaginal epithelium and around the small blood vessels. Also the peripheral vessels, which are important for vaginal lubrication, may be affected by this dissection.

Second, during sacro-spinous ligament fixation, the pudendal nerve might be at risk for damage due to indirect surgical trauma, as the pudendal nerve is closely related to the sacro-spinous ligament. Last, traction to the apical compartment during vaginal surgery may result in damage to vaginal innervation or congestion.
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**Previous methods to evaluate vaginal vasocongestion and innervation**

Vaginal photoplethysmography has been the most commonly used method to evaluate vaginal vasocongestion\(^6^0\). The method was developed by Palti and Bercovici in 1967\(^6^1\), improved by Sintchak and Geer in 1975\(^6^2\), and further improved by Hoon et al in 1976\(^6^3\). The modern day version consists of a tampon-size acrylic device that contains an orange-red light source (3 mm) and an optical sensor. A signal conditioning amplifier separates the VPA from the direct current component. The light source illuminates the entire microcirculation of the vaginal wall. As vasocongestion occurs, more light is reflected from the vaginal tissue and the output phototransistor changes to indicate this. When the signal is connected to an AC amplifier, the vaginal pulse amplitude (VPA) is measured\(^6^4\). VPA is thought to represent the pulse wave in the peripheral vascular vessels within the vagina\(^6^5\). Although it is an indirect measure of vaginal blood flow, VPA has been found to be a sensitive and reliable measure in assessing the increase in blood flow during genital arousal\(^6^6\). However, its correlation with sexual function is still a matter of debate\(^6^6\).

To evaluate vaginal innervation several tools have been developed. Vardi et al performed measurements with the Genitosensory Analyzer (medoc Advanced Systems) which is comprised of thermal and vibratory components\(^6^7\). Vaginal and clitoral warm, cold, and vibratory sensory thresholds were measured in 89 healthy paid volunteers by slowly increasing a stimulus until the participant reports that they are aware of it\(^6^7\). The vibratory probes have no single contact surface but vibrate throughout, so no differences in innervation between different areas of the vagina can be measured. Yang et al reported a technique to measure sensory evoked potentials (SEP) of the dorsal nerve of the clitoris and the perineal nerve\(^6^8\). The dorsal nerve of the clitoris was stimulated through self-adhesive disk electrodes on either side of the clitoris. Perineal nerve SEPs were evoked through a vaginal probe. Cortical responses were measured through cup electrodes affixed to the scalp\(^6^8\). By using this method only the distal part of the vagina at the introitus is stimulated and not the proximal part. Whether the proximal part is important for sexual function still needs to be explored. During gynaecological surgery innervation of the proximal part of the vagina may also be affected as during most gynaecological procedures an incision is made in the proximal part of the vaginal wall. Therefore the impact of gynaecological surgery to these areas of the vaginal wall also needs to be explored. Furthermore, using the method from Yang et al, stimuli were delivered at a three times sensory threshold; women were only asked to localize the site of the stimuli\(^6^8\). By doing this, the method doesn’t allow for measurement of differences in sensibility pre- and post surgery.

Weijmar Schultz and co-authors also published a technique to measure vaginal sensibility\(^6^9\). To stimulate the vaginal wall, they used a trofidur cylindrical tube on which two conical stainless steel tips (with a diameter of 4 mm) were positioned 1 cm from the tip of the tube to serve as stimulating electrode and indifferent electrode. The researchers stimulated 12 different locations, 2 to 4 cm from the vaginal introitus, under nonerotic conditions. Unfortunately, they did not report on the inter- and intra-observer reproducibility of the technique. Furthermore it is not well known, with this cylindrical tube, which part of the vaginal wall is stimulated. This reduces its ability to compare pre- and post-surgical innervation and to localize the area of damage.
To better understand the relationship between pelvic surgery and sexual function there is a need for objective outcome measures. Since none of the mentioned tools are suitable, the first step in the process would be to develop and validate a suitable method to measure vaginal wall sensibility, which can be used to compare pre- and post operative vaginal wall sensibility and is able to discriminate between different vaginal area’s as different types of surgery might affect different vaginal regions. Second, the relationship between alterations in vaginal physiology and sexual function needs to be confirmed. This may lead to improved understanding of sexual function after pelvic surgery, it may improve counselling to patients and, perhaps, ultimately, improve surgical techniques in the future.

In summary, the aims of this part of the thesis are:

1. To develop and validate a reproducible technique to objectively quantify vaginal wall sensibility
2. To evaluate the effects of hysterectomy and prolapse surgery on vaginal wall sensibility, vaginal vasocongestion and sexual function.
Introduction

References

Introduction


