Splenic studies: prevention of pneumococcal disease on organisational, clinical and experimental level

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Chapter 3

Performance of Dutch hospitals in the management of splenectomized patients

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Abstract

Background
After splenectomy, patients are at increased risk of sepsis with considerable mortality. This risk can be reduced by taking preventive measures, such as prescribing immunizations and antibiotic prophylaxis. Studies from various countries show that a substantial percentage of patients is not managed adequately. The aim of the present study was to investigate the quality of care in the prevention of infections after splenectomy in Dutch hospitals.

The research-questions were twofold: (i) Is there an association between hospital teaching status and guideline adherent preventive measures? (ii) Which factors contribute to hospital performance?

Methods
28 Dutch hospitals (30%) participated in the study. A retrospective review of medical records of 536 splenectomy patients was performed. Adherence to prevention guidelines was assessed for all patients, and analyzed according to teaching status and the presence or absence of a post-splenectomy protocol.

Results
(i) University hospitals in the Netherlands offered higher quality of care than other teaching and non-teaching hospitals. There were only small differences between non-university teaching and non-teaching hospitals.
(ii) The presence of a hospital post-splenectomy protocol did not improve vaccination rates. Other aspects of practice organization, such as surgical staff size and keeping a complication registry were only weakly related to performance.

Conclusions
In the Netherlands, university hospitals deliver state-of-the-art care in the prevention of infections in asplenic patients more often than non-university teaching and non-teaching hospitals. The availability of a hospital protocol does not seem to contribute to guideline adherence.
Introduction

Patients without a spleen have a diminished host immune defense in response to bacteria \(^1\). Especially in the first two years after surgery there is a risk for severe infection, mostly with encapsulated bacteria such as *Streptococcus pneumoniae* \(^2\). This syndrome is called post-splenectomy sepsis (PSS), and although the incidence is estimated to be low, it is associated with a high mortality of 50-70% \(^2\). Importantly, PSS can largely be prevented if protective measures such as immunization and prescription of antibiotics are taken. Several relevant organizations and committees have developed guidelines for prevention of infections in this group of patients \(^3\). The recommendations by the British Committee for Standards in Haematology are currently considered to reflect best-practice \(^4,5\) and consist of the key-elements shown in box 1.

1. Splenectomised patients should receive pneumococcal immunization (23-valent polysaccharide vaccine, PPV-23) and lifelong revaccination. They should also receive *Haemophilus influenzae* type B and meningococcal C vaccine. Yearly influenza immunization is recommended.

2. Continuous prophylactic antibiotics are recommended for the first two years after splenectomy. In case of suspected or proven infection during or after these 2 years, patients should be given systemic antibiotics and be admitted to a hospital.

3. All patients should be educated about the risks of infection (PSS) and the risk associated with traveling (such as infection with Plasmodium *falciparum*) and unusual infections (i.e. dog bites).

| Box 1. Key recommendations for the management of asplenic patients by the British Committee for Standards in Haematology. |

Unfortunately, adherence to guidelines is generally considered to be low \(^6\). One of the most consistent findings in health services research is the gap between best practice and actual clinical care \(^7,8\). We have shown earlier that management of splenectomised patients in the Netherlands is not optimal \(^9\).

Several studies demonstrate that performance of hospitals is related to structural characteristics such as teaching status and practice organization \(^10-12\). A large review showed that teaching hospitals in general offer better care than non-teaching hospitals. Furthermore, major teaching hospitals perform better than minor and non-teaching hospitals \(^13,14\). The aim of the present study was to investigate whether or not hospital structural characteristics of care delivery are associated with better compliance with best practice guidelines for preventing infections in splenectomised patients in Dutch hospitals. Our research-questions were twofold: (i) are teaching hospitals delivering better quality of care in the prevention of infections in
splenectomised patients than non-teaching hospitals and (ii) is there an association between characteristics of practice organization (i.e. the size of the surgical staff, the availability of a protocol for post-splenectomy management, and the use of a complication registry by the department of surgery) and quality of care. Quality of care parameters were defined as outcome of adherence to the prevention guidelines of the British Committee for Standards in Haematology.

Methods

Hospital and patient inclusion
This study was approved by the medical ethics committee of the Academic Medical Center, Amsterdam, the Netherlands. After approval, we composed a representative sample out of the total of 93 Dutch hospitals, by including hospitals through a blind drawing. Hospitals were divided into 3 categories: (1) university hospitals, (2) non-university teaching hospitals and (3) non-teaching hospitals. The teaching status of non-university hospitals was based on the (non) presence of an internal or surgical medicine residency training program. After the drawing, each group contained 30% of the total number of Dutch hospitals in its category (source: RIVM, Nationale Atlas Volksgezondheid, 2007).

Subsequently, splenectomised patients were included retrospectively using the Dutch Pathology Registry, since spleens are routinely sent to pathology after removal. In this Registry, a search query *milt* (spleen) was performed, after which all splenectomies performed from 1997 to 2008 were selected and non-relevant hits such as partial splenectomies or spleen biopsies were removed.

Data collection
After hospitals and patients were identified, the medical file and all discharge correspondence were assessed on site. All data were collected separately for each hospital by the same two investigators (DV, JL) using a standardized survey form. To investigate discharge correspondence, discharge letters as well as all other correspondence up to at least 1 year after splenectomy were included, for example from follow-up out-patient visits.

After hospital category was documented, we registered for each hospital the size of the surgical staff at the time of inclusion, the availability of any form of protocol of the surgical department reflecting hospital post-splenectomy policy, and the practice of systematically registering (surgical) complications by the department of surgery. Patient-data included demographics, documentation of vaccine administration and documentation of the prescription of antibiotics.

Furthermore, discharge correspondence was checked for mentioning of each of the following: performed splenectomy, vaccination status, the need for revaccination, prescribed prophylactic antibiotics, the need of urgent use of antibiotics in case of suspected infection and the advice for annual flu-vaccination.
Data analysis

When computing vaccination rates, we included only those patients that survived the first 2 weeks after surgery, since correct vaccination is considered by the British Committee to be given 2 weeks prior to or at least 2 or more weeks after surgery. Pneumococcal vaccination was defined as immunization with either the 23-valent pneumococcal polysaccharides vaccine (PPV-23, Pneumovax), the 7-valent pneumococcal conjugate vaccine (PCV-7, Prevenar), or both. “Prophylactic antibiotics” were defined as a prescription of antibiotics for the first 2 years after splenectomy. “On-demand antibiotics” were defined as a prescription to be given to the patient at discharge, to use in case of suspected infection. When investigating prescription-rates of prophylactic antibiotics, we excluded patients deceased in the first 2 weeks after surgery, regarding their death as a complication of surgery. In case of on-demand antibiotics, patients who died in the hospital before their discharge were excluded as well. When investigating discharge information to the general practitioner (GP), only those patients alive at time of discharge were excluded.

Statistical analysis

First, we have described the study sample using standard descriptive statistics. Second, to explore differences in performance and calculate p-values, we have used a Chi-square test between the 3 categories of hospitals (table 2), between presence or absence of a protocol (table 3) and complication registry. The influence of surgical staff size (divided into 1-8 surgeons or >8 surgeons) was calculated using multivariate logistic regression analysis, where surgical staff size and hospital teaching status were used as covariates in the analysis. All statistical analysis of data was performed in SPSS 16.0.

Results

We included 28 of 93 Dutch hospitals (30%), containing a total of 536 splenectomised patients (see table 1.) Five hospitals were excluded because they refused cooperation, and were subsequently replaced by comparable hospitals in their category.

Differences between university and (non)-teaching hospitals

Hospital performance of Dutch university, non-university teaching and non-teaching hospitals is shown in table 2.
<table>
<thead>
<tr>
<th></th>
<th>University</th>
<th>Non-university Teaching</th>
<th>Non-teaching</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitals [N (number of patients)]</td>
<td>2 (40)</td>
<td>15 (287)</td>
<td>11 (209)</td>
<td></td>
</tr>
<tr>
<td>Mean number of surgical staff per hospital (range)</td>
<td>20 (18-22)</td>
<td>9.2 (3-16)</td>
<td>5.5 (4-7)</td>
<td></td>
</tr>
<tr>
<td>Hospitals with splenectomy protocol at surgical department [N (%)]</td>
<td>2 (100)</td>
<td>14 (93)</td>
<td>7 (64)</td>
<td></td>
</tr>
<tr>
<td>Hospitals with complication registry at surgical department [N (%)]</td>
<td>2 (100)</td>
<td>15 (100)</td>
<td>9 (82)</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Hospital demographics

<table>
<thead>
<tr>
<th></th>
<th>Hospital (N = number of patients)</th>
<th>University (N = 33)</th>
<th>Non-university teaching (N = 268)</th>
<th>Non-teaching (N = 197)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunizations (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumococcal</td>
<td>90</td>
<td>85.5</td>
<td>84.3</td>
<td></td>
<td>0.559</td>
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<tr>
<td>H. influenzae B</td>
<td>66.7</td>
<td>40.3</td>
<td>33.5</td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>Meningococcal C</td>
<td>63.6</td>
<td>30.6</td>
<td>29.4</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Antibiotics (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prophylaxis ^a</td>
<td>21.2</td>
<td>14.1</td>
<td>8.6</td>
<td></td>
<td>0.056</td>
</tr>
<tr>
<td>On-demand ^b</td>
<td>6.3</td>
<td>8.5</td>
<td>9.5</td>
<td></td>
<td>0.812</td>
</tr>
<tr>
<td>Both</td>
<td>18.8</td>
<td>3.6</td>
<td>0</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>None</td>
<td>53.1</td>
<td>72.6</td>
<td>81.5</td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>Discharge letters mentioning (%)</td>
<td>Splenectomy</td>
<td>100</td>
<td>98</td>
<td>96.8</td>
<td>0.425</td>
</tr>
<tr>
<td>Immunization ^c</td>
<td>83.3</td>
<td>81</td>
<td>80.5</td>
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<td>0.609</td>
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<tr>
<td>Booster immunization</td>
<td>40.6</td>
<td>22.2</td>
<td>22.8</td>
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<td>0.113</td>
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<tr>
<td>Influenza vaccination</td>
<td>25</td>
<td>9.8</td>
<td>14.3</td>
<td></td>
<td>0.021</td>
</tr>
<tr>
<td>On-demand antibiotics</td>
<td>37.5</td>
<td>17.7</td>
<td>23.3</td>
<td></td>
<td>0.015</td>
</tr>
</tbody>
</table>

Table 2. Guideline compliance in relation to hospital teaching status.

^a "Prophylaxis": prescription of continuous antibiotic therapy for 2 years after surgery.
^b "On-demand": prescription for antibiotics to be used in case of (suspected) infection.
^c Only when pneumococcal vaccination was given.
P-value calculated by means of Chi-square testing of 3 categories of hospitals.
Admission to a university hospital is associated with better guideline adherence: 22 of 33 of patients (66.7%) in university hospitals were immunized with *H. influenzae* B as compared to 108 of 268 patients (40.3%) in non-university teaching and 66 of 197 (33.5%) in non-teaching hospitals. Vaccination with *N. meningitidis* C occurred in 21 of 33 patients (63.6%) as compared to 82 of 268 patients (30.6%) in non-university teaching and 58 of 197 (29.4%) in non-teaching hospitals. In 53.1% of patients no antibiotics were prescribed in university hospitals, as compared to 72.6% in non-university teaching and 82.5% in non-teaching hospitals. Differences between non-university teaching hospitals and non-teaching hospitals were small.

**Presence of a post-splenectomy protocol**

The availability of a protocol at the surgical department was not associated with higher vaccination rates (table 3). It did however show a positive relation on the prescription of prophylactic antibiotics. The effect of a protocol on the quality of discharge information to the general practitioner was minimal.

<table>
<thead>
<tr>
<th></th>
<th>Protocol present</th>
<th>No protocol</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immunizations (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumococcal</td>
<td>85.3</td>
<td>85.9</td>
<td>0.671</td>
</tr>
<tr>
<td><em>H. influenzae</em> B</td>
<td>40.2</td>
<td>35.3</td>
<td>0.970</td>
</tr>
<tr>
<td>Meningococcal C</td>
<td>33.7</td>
<td>25.9</td>
<td>0.188</td>
</tr>
<tr>
<td><strong>Antibiotics (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prophylaxis</td>
<td>13.8</td>
<td>6.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>On-demand</td>
<td>9.5</td>
<td>5.5</td>
<td>0.001</td>
</tr>
<tr>
<td>Both</td>
<td>3.9</td>
<td>0</td>
<td>0.062</td>
</tr>
<tr>
<td>None</td>
<td>72</td>
<td>87.7</td>
<td>0.230</td>
</tr>
<tr>
<td><strong>Discharge letters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mentioning (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Splenectomy</td>
<td>97.7</td>
<td>98.8</td>
<td>0.096</td>
</tr>
<tr>
<td>Immunization</td>
<td>81.4</td>
<td>78.6</td>
<td>0.321</td>
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<tr>
<td>Booster immunization</td>
<td>25.5</td>
<td>13.8</td>
<td>0.048</td>
</tr>
<tr>
<td>Influenza vaccination</td>
<td>14.4</td>
<td>5</td>
<td>0.024</td>
</tr>
<tr>
<td>On-demand antibiotics</td>
<td>23.2</td>
<td>12.5</td>
<td>0.213</td>
</tr>
</tbody>
</table>

**Table 3.** Guideline compliance in relation to the availability of a protocol.

a "Prophylaxis"; prescription for continuous antibiotic therapy for 2 years after splenectomy.

b "On-demand"; prescription for antibiotics to be used in case of (suspected) infection.

c Only when pneumococcal vaccination was given.
P-value calculated by means of Chi-square testing.
Size of surgical staff
Performance in relation to the size of surgical staff was determined (data not shown). There were no differences in vaccination rates or quality of discharge information between the groups of different sizes (less or more than 8 surgeons). Larger surgical groups seemed to perform better in prescribing antibiotics, however when adjusting for hospital category in multivariate analysis these differences were not significant.

Complication registry
Complications were systematically registered by all but 2 surgical departments in non-teaching hospitals, composing a cohort of 27 patients. Although numbers are low, it demonstrates that in the absence of a registry the guideline adherence for this group of patients was similar, and only prophylactic antibiotics were significantly less prescribed: 62 of 473 patients (13.1%) in the presence of a registry, as compared to 0 of 27 patients in absence of a registry (p-value = 0.044) (data not shown). The precise role of the registry herein remains unclear, since both hospitals also lacked a hospital post-splenectomy protocol.

Discussion

Main findings
The aim of the present study was to investigate quality of care for splenectomised patients in Dutch hospitals with different teaching status. In general, beneficial effects of teaching status only extended to university hospitals in the Netherlands. Other teaching hospitals performed similarly to non-teaching hospitals in the Netherlands. Hospitals in which the surgical department developed a local protocol with recommendations for managing patients after splenectomy did not achieve higher vaccination rates. There was however an improvement in prescription of antibiotics and in the quality of discharge correspondence from the hospital to the general practitioner. Surgical staff size was not related to hospital performance.

Explanation of results
In the Netherlands, all categories of hospitals provided over 80% of their post-splenectomy patients with pneumococcal immunization, reflecting that Dutch physicians in general are aware of the need for pneumococcal protection after splenectomy. However, university hospitals had better performance results regarding immunizing patients with all three recommended vaccines, as well as prescribing prophylactic antibiotics in combination with a prescription for on-demand antibiotics. Collectively, university hospitals offered their patients a more complete post-splenectomy treatment.
It has been described elsewhere that minor teaching and non-teaching hospitals show small differences, and that non-teaching hospitals even perform better at certain indicators than do minor teaching hospitals. We indeed found small differences between non-university teaching hospitals and non-teaching hospitals, where non-university teaching hospitals performed better at prescribing antibiotics, and non-teaching hospitals did better at giving recommendations to the GP on booster immunization and use of on-demand antibiotics.

Hospital characteristics have been shown to have important effects on hospital outcomes. We hypothesized this would also be the case regarding the adherence to post-splenectomy management recommendations. In particular, we were expecting to find that the availability of a protocol at the department of surgery would be associated with better compliance with all key recommendations in the British Standards. However, vaccination rates did not differ from departments without a protocol. The items that were generally most eligible for improvement seemed to benefit most from the presence of a protocol.

Neither the presence of a protocol nor the size of the surgical staff were related to better performance in university hospitals. We can therefore only speculate about the explanation for the differences found between university and other hospitals. Organizational differences may not be disregarded; it has been described elsewhere that better quality and processes of care are delivered in major teaching hospitals. Most prior studies have reported a lower risk-adjusted mortality in major teaching hospitals as compared with minor teaching or non-teaching hospitals. It is also possible that residency and fellowship programs contribute to better compliance of guidelines and have a favorable impact on the delivery of patient care in teaching hospitals.

**Limitations**

In absence of a Dutch guideline we chose to investigate adherence to the recommendations by the British Committee for Standards in Haematology, assuming that Dutch professionals have some knowledge of these recommendations. Although these recommendations are internationally considered to reflect current best practice and patients should therefore be managed according to at least comparable standards, the extent of familiarity and use of the British standards by Dutch physicians remains to be investigated in the future. Furthermore, we investigated the availability of a locally designed protocol on the management of post-splenectomy patients by the surgical department. Checking the contents of each of these local protocols was not part of our study and thus we can not exclude that these protocols are lacking certain recommendations. It also remains unclear how hospitals have implemented their protocols.
Implications for future research and policy

In the Netherlands, hospitals could offer better quality of care for hypo- and asplenic patients in the prevention of infections by increasing immunization rates. Furthermore, although academic centers performed better than the other hospital categories, only a minority of patients were given or advised to receive on-demand antibiotics. Here lies a tremendous opportunity to improve patient care in the prevention of severe infections.

Potential barriers that exist for delivering optimal care to these patients remain to be investigated. Furthermore, although teaching status is related to performance, the explanation for this difference remains unclear. The results of this study suggest that there is a relation between characteristics of practice organization and performance, but these characteristics should be further elucidated.

Conclusion

University hospitals offer higher guideline adherence in preventing infections after splenectomy than other teaching and non-teaching hospitals. For all Dutch hospitals there is room for improving the quality of post-splenectomy patient care. The results of this study suggest that the difference in performance may be related to several characteristics of hospital practice organization. Future research should further investigate these hospital characteristics and their influence on performance.
References