Journal of HOSPITAL MEDICINE www.journalofhospitalmedicine.com

ORIGINAL RESEARCH

Performance of Dutch Hospitals in the Management of Splenectomized Patients

Jolanda Lammers, MD, PhD-student[1]
Daphne Veninga, MSc[1]
Peter Speelman, MD, PhD[1]
Joost Hoekstra, MD, PhD[1]
Kiki Lombarts, PhD[2]

[1] Internal Medicine, Academic Medical Center (AMC), University of Amsterdam, Amsterdam Zuid-Oost, The Netherlands.

[2] Department of Quality and Process Innovation Academic Medical Center (AMC), University of Amsterdam, Amsterdam Zuid-Oost, The Netherlands.

Disclosure: This project was funded by ZonMw.

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 are 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 two-fold: (1) Is there an association between hospital teaching status and guideline adherent preventive measures? (2) Which factors contribute to hospital performance?

METHODS: A total of 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: (1) University hospitals in the Netherlands offered higher quality of care than other teaching and nonteaching hospitals. There were only small differences between nonuniversity teaching and nonteaching hospitals. (2) 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 nonuniversity teaching and nonteaching hospitals. The availability of a hospital protocol does not seem to contribute to guideline adherence. ***Journal of Hospital Medicine*** **2010;5:466–470.** © *2010 Society of Hospital Medicine.*

KEYWORDS: hospital, management, performance, post-splenectomy, teaching status.

Patients without a spleen have a diminished host immune defense in response to bacteria.[1] Especially in the first 2 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% to 70%.[2] Importantly, PSS can largely be prevented if protective measures such as immunization and the 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.

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 splenectomized patients in the Netherlands is not optimal (Lammers et al., Management of post-splenectomy patients in the Netherlands, EJCMID, in press, DOI: 10.1007/s10096-009-0870-x).

Several studies demonstrate that performance of hospitals is related to structural characteristics such as teaching status and practice organization.[9–11] A large review showed that teaching hospitals in general offer better care than nonteaching hospitals. Furthermore, major teaching hospitals perform better than minor and nonteaching hospitals.[12,13]

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 splenectomized patients in Dutch hospitals. Our research questions were two-fold: (1) are teaching hospitals delivering better quality of care in the prevention of infections in splenectomized patients than nonteaching hospitals and (2) is there an association between characteristics of practice organization (ie, 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.

2010 Society of Hospital Medicine DOI 10.1002/jhm.690
View this article online at wileyonlinelibrary.com.

Key Recommendations for the Management of Asplenic Patients by the British Committee for Standards in Haematology

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 (ie, dog bites).

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) nonuniversity teaching hospitals and (3) nonteaching hospitals. The teaching status of nonuniversity 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, splenectomized 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 nonrelevant 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 2 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 who 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 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 splenectomized patients (Table 1.) Five hospitals were excluded because they refused cooperation, and were subsequently replaced by comparable hospitals in their category.

2010 Society of Hospital Medicine DOI 10.1002/jhm.690
View this article online at wileyonlinelibrary.com.

Differences Between University and Nonteaching Hospitals

Hospital performance of Dutch university, nonuniversity teaching, and nonteaching hospitals is shown in Table 2. 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 nonuniversity teaching and 66 of 197 (33.5%) in nonteaching hospitals. Vaccination with *N. meningitidis* C occurred in 21 of 33 patients (63.6%) as compared to 82 of 268 patients (30.6%) in nonuniversity teaching and 58 of 197 (29.4%) in nonteaching hospitals. In 53.1% of patients no antibiotics were prescribed in university hospitals, as compared to 72.6% in nonuniversity teaching and 82.5% in nonteaching hospitals. Differences between nonuniversity teaching hospitals and nonteaching 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 GP was minimal.

TABLE 1. Hospital Demographics

	University	Nonuniversity Teaching	Nonteaching
Hospitals, n (number of patients)	2 (40)	15 (287)	11 (209)
Mean number of surgical staff per hospital (range)	20 (18–22)	9.2 (3–16)	5.5 (4–7)
Presence of splenectomy protocol at surgical department, n (%)	2 (100)	14 (93)	7 (64)
Presence of complication registry at surgical department, n (%)	2 (100)	15 (100)	9 (82)

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 nonteaching 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 splenectomized 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

TABLE 2. Guideline Compliance in Relation to Hospital Teaching Status

	Hospital (n = Number of Patients)	University (n = 33)	Nonuniversity Teaching (n = 268)	Nonteaching (n = 197)	*P* Value
Immunizations (%)	Pneumococcal	90	85.5	84.3	0.559
	H. influenzae B	66.7	40.3	33.5	0.001
	Meningococcal C	63.6	30.6	29.4	<0.001
Antibiotics (%)	Prophylaxis*	21.2	14.1	8.6	0.056
	On-demand†	6.3	8.5	9.5	0.812
	Both	18.8	3.6	0	<0.001
	None	53.1	72.6	81.5	0.001
Discharge letters mentioning (%)	Splenectomy	100	98	96.8	0.425
	Immunization‡	83.3	81	80.5	0.609
	Booster immunization	40.6	22.2	22.8	0.113
	Influenza vaccination	25	9.8	14.3	0.021
	On-demand antibiotics	37.5	17.7	23.3	0.015

NOTE: *P* value calculated by means of chi-square testing of 3 categories of hospitals.
* "Prophylaxis": prescription of continuous antibiotic therapy for 2 years after surgery.
† "On-demand": prescription for antibiotics to be used in case of (suspected) infection.
‡ Only when pneumococcal vaccination was given.

2010 Society of Hospital Medicine DOI 10.1002/jhm.690
View this article online at wileyonlinelibrary.com.

TABLE 3. Guideline Compliance in Relation to the Availability of a Protocol

	Protocol Present	No Protocol	*P* Value
Immunizations (%)			
Pneumococcal	85.3	85.9	0.671
H. influenzae B	40.2	35.3	0.970
Meningococcal C	33.7	25.9	0.188
Antibiotics (%)			
Prophylaxis*	13.8	6.3	<0.001
On-demand†	9.5	5.5	0.001
Both	3.9	0	0.062
None	72	87.7	0.230
Discharge letters mentioning (%)			
Splenectomy	97.7	98.8	0.096
Immunization‡	81.4	78.6	0.321
Booster immunization	25.5	13.8	0.048
Influenza vaccination	14.4	5	0.024
On-demand antibiotics	23.2	12.5	0.213

NOTE: *P* value calculated by means of chi-square testing.

* "Prophylaxis": prescription for continuous antibiotic therapy for 2 years after splenectomy.

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

‡ Only when pneumococcal vaccination was given.

to nonteaching 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 GP. 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 3 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 nonteaching hospitals show small differences, and that nonteaching hospitals even perform better at certain indicators than minor teaching hospitals.[13] We indeed found small differences between nonuniversity teaching hospitals and nonteaching hospitals, where nonuniversity teaching hospitals performed better at prescribing antibiotics, and nonteaching 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.[10,14,15] 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 form 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.[16,9,12] Most prior studies have reported a lower risk-adjusted mortality in major teaching hospitals as compared with minor teaching or nonteaching hospitals.[9,12] 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.[12]

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 hyposplenic 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

2010 Society of Hospital Medicine DOI 10.1002/jhm.690
View this article online at wileyonlinelibrary.com.

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 nonteaching 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.

Acknowledgments

The authors would like to thank all participating hospitals.

Address for correspondence and reprint requests:

Jolanda Lammers, Meibergdreef 9, Amsterdam, Amsterdam Zuid-Oost, The Netherlands; Telephone: 31-20-566-7062; Fax: 31-20-697-7192; E-mail: a.j.lammers@amc.uva.nl

Received 23 September 2009; revision received 31 January 2010; accepted 6 February 2010.

References

1. Mebius RE, Kraal G. Structure and function of the spleen. *Nat Rev Immunol.* 2005;5:606–616.
2. Holdsworth RJ, Irving AD, Cuschieri A. Postsplenectomy sepsis and its mortality rate: actual versus perceived risks. *Br J Surg.* 1991;78:1031–1038.
3. Mourtzoukou EG, Pappas G, Peppas G, Falagas ME. Vaccination of asplenic or hyposplenic adults. *Br J Surg.* 2008;95:273–280.
4. Guidelines for the prevention and treatment of infection in patients with an absent or dysfunctional spleen. Working Party of the British Committee for Standards in Haematology Clinical Haematology Task Force. *BMJ.* 1996;312:430–434.
5. Davies JM, Barnes R, Milligan D. Update of guidelines for the prevention and treatment of infection in patients with an absent or dysfunctional spleen. *Clin Med.* 2002;2:440–443.
6. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA.* 1999;282:1458–1465.
7. Grimshaw J, Eccles M, Tetroe J. Implementing clinical guidelines: current evidence and future implications. *J Contin Educ Health Prof.* 2004;24 Suppl 1:S31-S37.
8. Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. *Lancet.* 2003;362:1225–1230.
9. Allison JJ, Kiefe CI, Weissman NW, et al. Relationship of hospital teaching status with quality of care and mortality for Medicare patients with acute MI. *JAMA.* 2000;284:1256–1262.
10. Chen J, Radford MJ, Wang Y, Marciniak TA, Krumholz HM. Do "America's Best Hospitals" perform better for acute myocardial infarction? *N Engl J Med.* 1999;340:286–292.
11. Lingsma HF, Dippel DW, Hoeks SE, et al. Variation between hospitals in patient outcome after stroke is only partly explained by differences in quality of care: results from the Netherlands Stroke Survey. *J Neurol Neurosurg Psychiatry.* 2008;79:888–894.
12. Polanczyk CA, Lane A, Coburn M, Philbin EF, Dec GW, DiSalvo TG. Hospital outcomes in major teaching, minor teaching, and nonteaching hospitals in New York state. *Am J Med.* 2002;112:255–261.
13. Ayanian JZ, Weissman JS. Teaching hospitals and quality of care: a review of the literature. *Milbank Q.* 2002;80:569–593, v.
14. Thiemann DR, Coresh J, Oetgen WJ, Powe NR. The association between hospital volume and survival after acute myocardial infarction in elderly patients. *N Engl J Med.* 1999;340:1640–1648.
15. Yuan Z, Cooper GS, Einstadter D, Cebul RD, Rimm AA. The association between hospital type and mortality and length of stay: a study of 16.9 million hospitalized Medicare beneficiaries. *Med Care.* 2000;38:231–245.
16. Kupersmith J. Quality of care in teaching hospitals: a literature review. *Acad Med.* 2005;80:458–466.

2010 Society of Hospital Medicine DOI 10.1002/jhm.690
View this article online at wileyonlinelibrary.com.