Validation of the acute cholecystectomy rate as a quality indicator for emergency general surgery using the SWORD database

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ABSTRACT

INTRODUCTION Despite an increasing emphasis on data-driven quality improvement, few validated quality indicators for emergency surgical services have been published. The aims of this study therefore were: 1) to investigate whether the acute cholecystectomy rate is a valid process indicator; and 2) to use this rate to examine variation in the provision of acute cholecystectomy in England.

MATERIALS AND METHODS The Surgical Workload and Outcomes Research Database (SWORD), derived from the Hospital Episode Statistics database, was interrogated for the 2012–2017 financial years. All adult patients admitted with acute biliary pancreatitis, cholecystitis or biliary colic to hospitals in England were included and the acute cholecystectomy rate in each one examined.

RESULTS A total of 328,789 patients were included, of whom 42,642 (12.9%) underwent an acute cholecystectomy. The acute cholecystectomy rate varied significantly between hospitals, with the overall rate ranging from 1.2% to 36.5%. This variation was consistent across all disease groupings and time periods, and was independent of the annual number of procedures performed by each NHS trust. In 41 (29.9%) trusts, fewer than one in ten patients with acute gallbladder disease underwent cholecystectomy within two weeks.

CONCLUSIONS The acute cholecystectomy rate is easily measurable using routine administrative datasets, modifiable by local services and has a strong evidence base linking it to patient outcomes. We therefore advocate that it is an ideal process indicator that should be used in quality monitoring and improvement. Using it, we identified significant variation in the quality of care for acute biliary disease in England.

KEYWORDS

Cholecystectomy – Quality indicator

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Introduction

Acute biliary disease comprises a significant proportion of the general emergency surgical workload, with approximately 60,000 patients admitted to English NHS hospitals each year.¹ Previous meta-analyses have shown that early cholecystectomy improves outcomes for patients with acute biliary disease, resulting in a reduced total length of stay, faster recovery, reduced morbidity and reduced healthcare costs with no increased risk of complications.² As a result, international guidelines recommend early cholecystectomy for mild and moderate cholecystitis and definitive treatment (either cholecystectomy or endoscopic sphincterotomy)

within two weeks of presentation with mild or moderate acute biliary pancreatitis.^{3,4}

It can be argued therefore that the index procedure for modern emergency hepatopancreaticobiliary (HPB) service delivery is the acute cholecystectomy. However, many hospitals do not offer cholecystectomy in the acute phase and previous studies have shown that concordance with the British Society of Gastroenterology acute pancreatitis guidelines in the UK is low.^{5,6}

This is set against an international background in which there is an increasing emphasis on monitoring, improving and demonstrating the quality of surgical care,^{7,8} with a

variety of quality improvement initiatives, such as national prospective audits and the publication of individual surgeon's outcomes, having been introduced across a range of specialties on both sides of the Atlantic.^{9,10} However, in order to use data to improve care, robust quality indicators must be developed that are realistically measurable in a cost-effective manner, have a direct impact on patient outcomes and experience and are modifiable by clinicians or services. At present, however, no validated quality indicators for benign general surgical disease have been published and few studies exist regarding the management of acute biliary disease in national practice.

The aims of this paper therefore were twofold: first, to examine the provision of acute cholecystectomy in England, and whether it varies nationally. Second, and most importantly, it was to investigate whether the acute cholecystectomy rate is a potential process indicator which can be used to monitor and improve services.

Materials and methods

Setting

The study used the Surgical Workload and Outcomes Research Database (SWORD), which is a quality improvement programme run jointly by the Association of Upper Gastrointestinal Surgeons of Great Britain and Ireland (AUGIS), the Association of Laparoscopic Surgeons of Great Britain and Ireland (ALS) and Methods Analytics Ltd. The aim of SWORD is to provide process and outcomes data on surgical care to support service improvement and surgeon revalidation in a cost-effective manner. Its basis is the NHS England Hospital Episodes Statistics database (copyright © 2013, Reproduced with the permission of the Health and Social Care Information Centre), which is a national database comprising data from all inpatient hospital admissions in England. Data are categorised according to the International Classification of Diseases version 10 (ICD-10) and the OPCS Classification of Interventions and Procedures version 4.7 (OPCS-4.7).^{11,12}

Complete data were available for the five-year period 1 April 2012 to 31 March 2017. It was not possible to go back further than this as, before 1 April 2012, patients with pancreatitis were coded using the three-character code K85x, without breaking it down into aetiology. Patients were included in the study if they were admitted as an emergency to hospital in England with gallbladder pathology or gallstone pancreatitis (defined by the ICD-10 codes K800, K801, K802, K81x, K82x, K850, K851, K858 and K859). They were defined as having had an acute cholecystectomy if they had a procedure with one of the OPCS-4 codes J18.1, J18.2, J18.3, J18.4, J18.5, J18.8 or J18.9 within 14 days of admission. The operation did not necessarily need to be during the same admission as the original emergency presentation, to allow the inclusion of patients who were discharged but brought back to a semi-elective 'urgen' list within that time frame. Patients were excluded from the surgical group if the cholecystectomy code occurred with the OPCS code of another major procedure (such as a liver

or stomach resection). Patients were categorised according to their admission hospital trust, rather than the hospital at which their operation (if applicable) took place. This was to account for trusts in which daycase surgery is carried out on their behalf by another provider (such as an independent sector treatment centre).

Statistical analysis

Patients were categorised into three groups. These were the overall group (comprising every patient in the study), the acute pancreatitis group (comprising only those patients presenting with acute pancreatitis; ICD-10 codes K850, K851, K858 and K859) and the acute gallbladder disease group (comprising those patients who presented with cholecystitis or biliary colic; ICD-10 codes K800, K801, K802, K81x and K82x). They were further grouped by UK fiscal year (1 April to 31 March). Statistical analysis was performed using STATA version 10. Data are expressed as mean plus or minus standard deviation unless otherwise stated. Differences in proportions were tested using the chi-squared test.

Variation in the acute cholecystectomy rates among the hospitals was assessed using a funnel plot. This plot tests whether hospital rates differ significantly from the overall national rate.¹³ The hospital rates are plotted on the vertical axis and the number of admissions for gallstone disease per hospital is shown on the horizontal axis. The graph also includes the mean rate for England. The two control limits indicate the ranges within which 95% or 99.8% of the network rates would be expected to fall if differences from the English rate arose from random variation (i.e. chance) alone. The manuscript was prepared according to the STROBE consensus guidelines.¹⁴

Results

Overall, 328,789 patients were admitted with acute gallbladder disease to NHS hospitals in England during the study period. Of these, 42,642 (12.9%) underwent a cholecystectomy within 14 days of admission. This proportion remained constant over the five years (Figure 1). The overall acute cholecystectomy rate for patients with acute

Figure 1 Proportion of patients undergoing acute cholecystectomy, by disease group and year.

Figure 2 Combined acute cholecystectomy rates in English acute NHS trusts following admission with acute gallbladder disease or acute non-alcoholic pancreatitis; data from 2013–2017 fiscal years.

pancreatitis was 6.0% and for patients with acute gallbladder disease (biliary colic or cholecystitis) it was 16.2%. There was a small increase in the acute cholecystectomy rate in the acute pancreatitis group from 4.8% to 7.2% over the study period. The rate in the acute gallbladder disease group remained unchanged.

Figure 3 Acute cholecystectomy rates in English acute NHS trusts following admission with acute non-alcoholic pancreatitis only; data from 2013 – 2017 fiscal years.

Figure 4 Acute cholecystectomy rates in English acute NHS trusts following admission with acute gallbladder disease only; data from 2013–2017 fiscal years.

The acute cholecystectomy rate varied significantly between hospitals (Figures 2–4). Of the 144 acute NHS trusts, 72 (50.0%) had rates below the lower 95% control level and, of these, 68 (47.2%) were below the 99.8% level (i.e. were more than three standard deviations below the national mean). This variation persisted across all disease groupings and time periods. In the overall group in the 2013 fiscal year, 63 trusts (43.8%) were below the 95% confidence limit and 53 (36.8%) were below the 99.8% level, while in the 2017 fiscal year the figures were 63 (43.8%) and 49 (34.0%), respectively (Figures 5–7).

The low rates of early cholecystectomy in the pancreatitis group may be accounted for by an increased use of early endoscopic retrograde cholangiopancreatography, which would also satisfy the British Society of Gastroenterology guideline recommendation but is not currently monitored in the SWORD database. We therefore examined regional variation in the acute gallbladder disease group separately and found a similar extent of regional variation, which again persisted throughout the study period. Looking specifically at the most recent year (the 2017 fiscal year), 57 NHS trusts (39.6%) had significantly lower acute cholecystectomy rates than the national mean (i.e. were below the 95% confidence limit), of which 51 (35.4%) were below the 99.8% limit (Figure 4). In 41 trusts (29.9%), fewer than one in ten patients presenting as emergencies with acute cholecystitis or biliary colic underwent cholecystectomy within two weeks.

Discussion

This study demonstrates three important findings. First, the overall provision of acute cholecystectomy in England is poor, with fewer than one in seven patients admitted with acute gallbladder disease or acute gallstone

Figure 5 Acute cholecystectomy rate in English acute NHS trusts following admission with acute gallbladder disease or acute non-alcoholic pancreatitis in the fiscal year 2012/13.

Figure 7 Acute cholecystectomy rate in English acute NHS trusts following admission with acute gallbladder disease or acute non-alcoholic pancreatitis in the fiscal year 2016/17 combined.

pancreatitis undergoing a cholecystectomy within two weeks of admission. This figure did not improve over the five-year study period. Second, the likelihood of a patient receiving their operation acutely varies significantly depending on the particular hospital they are admitted to. Third and perhaps most important, the study has demonstrated the value of the acute cholecystectomy rate as a potential quality indicator in emergency and HPB surgery.

This study has some strengths and weaknesses. First, the SWORD database does not as yet adjust for patients'

ages and comorbidities. In patients who are old and frail with major comorbidities, cholecystectomy may not be appropriate, certainly in the acute setting. Some of the variation seen between hospitals may therefore be due to differences in case mix. Second, the accuracy of the Hospital Episode Statistics database (and therefore the SWORD database) is dependent on the accuracy of coding, and this is likely to vary between hospitals, with smaller hospitals in particular having been shown to be more affected by data quality issues.¹⁵ We therefore cannot exclude the possibility that some of the variation observed, particularly in the smaller hospitals, was due to coding inaccuracies rather than being a real effect. However, with the increasing use of Hospital Episode Statistics for hospital reimbursement, coding accuracy has been shown to have improved significantly and the procedure and diagnosis codes in particular have been shown to be highly accurate for surgical procedures.¹⁶ Given this documented improvement and the size of the variation observed, it is unlikely that our findings are due simply to differences in case mix and coding accuracy.^{15,16} Furthermore, one of the strengths of the database is the complete national coverage that it allows. This coverage avoids the selection bias inherent in national registries.^{17,18}

International guidelines firmly support early cholecystectomy in cholecystitis and acute pancreatitis due to strong level 1 evidence demonstrating improved outcomes for patients,⁵ in particular lower rates of readmission, recurrent pancreatitis and a lower total length of stay,^{2,19} with no increase in complications or morbidity.² Our findings indicate that compliance with these guidelines in England is poor and that the chance of a patient getting optimal treatment depends in significant part on which hospital they happen to be admitted to.

Figure 6 Acute cholecystectomy rate in English acute NHS trusts following admission with acute gallbladder disease or acute non-alcoholic pancreatitis in the fiscal year 2014/15.

This is consistent with three previous UK studies which have all shown poor compliance with the international guidelines and significant variation.^{20–22} Our study updates and extends these findings with its complete national coverage and the fact that it extends over a full five-year period. Two findings in particular warrant comparison. The first and most concerning is that the rate has barely changed since the start of the previous study in 2000.²⁰ Second, the Scottish study (where the system is organised slightly differently) demonstrated similar findings. This indicates that the same pattern and challenges we demonstrate here are likely to be common to other countries and other systems.²¹

How best to deliver this optimal and efficient care will depend on the resources and geographical characteristics of each individual location. Major HPB cancer centres are better resourced and in England are now required to provide ‘round-the-clock’ seven-day provision of emergency HPB operating and specialist care.²⁵ However, in non-specialist, rural or district general hospital settings, such changes may be more difficult to effect because of a smaller number of adequately trained, high-volume biliary surgeons. Delivering effective patient care to all patients, irrespective of their location, will require services to work together in networks, outside of their traditional ‘silos’.

It is notable, however, that the variation in the acute cholecystectomy rate demonstrated here was independent of hospital cholecystectomy volume, with many low-volume hospitals having an acute cholecystectomy rate significantly higher than the national mean. Conversely, some hospitals doing over 300 cholecystectomies a year had rates below the 99.8% confidence limit and managed to do fewer than 1 in 20 of their patients within 14 days of admission. This suggests that factors other than simply hospital volume are important.

Finally, the increasing national focus on quality improvement will lead to pressure to develop valid indicators,^{8,24,25} but, thus far, no quality indicators for benign emergency surgery have been tested and validated. An ideal quality indicator is measurable, modifiable, has a direct evidence-based effect on patient outcomes and exhibits variance in delivery.^{7,26,28} While they are important, traditional outcomes such as morbidity, mortality or complication rates are problematic in benign surgery as they are very rare events and are multifactorial. They therefore lack sensitivity and may be difficult for individual surgeons or teams to modify.^{7,26,27}

Acute cholecystectomy possesses a clear evidence base linking it to improved patient outcomes. It is modifiable by hospitals and clinical teams and here we have shown that it is both measurable using existing administrative datasets and exhibits significant variation. It therefore satisfies all four required criteria.

One of its particular strengths is its measurability and modifiability – it can be modified by local service improvement and it can be measured using routine administrative data without the need for specific, time-consuming and expensive prospective data collection. We therefore postulate that it is a feasible and valid emergency surgery

process indicator that should be used in service evaluation and improvement. Although we have only tested it on English data, we believe it would be equally valid in other international settings.

Conclusion

Currently, in England, the likelihood of a patient receiving efficient and evidence-based treatment for acute gallstone disease depends in large part on chance and the efficiency of the hospital to which they happen to live near. This is both inequitable for the patient and inefficient for the system as a whole. It is depressing to note that the situation has barely changed in nearly two decades. Given how common the disease is and the morbidity and mortality associated with it (particularly gallstone pancreatitis), the funding and effort that acute biliary service improvement receives nationally is particularly poor.

The acute cholecystectomy rate is the first quality indicator for benign HPB surgery that has been tested in this way and we therefore recommend its use internationally in driving improvement in the quality of emergency surgical services.

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