Impact of a dedicated emergency surgical unit on early laparoscopic cholecystectomy for acute cholecystitis

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ABSTRACT

INTRODUCTION Emergency general surgery (EGS) accounts for 50% of the surgical workload, and yet outcomes are variable and poorly recorded. The management of acute cholecystitis (AC) at a dedicated emergency surgical unit (ESU) was assessed as a performance target for EGS.

METHODS The outcomes for AC admissions were compared one year before and after inception of the ESU. The impact on cost and compliance with national guidance recommending early laparoscopic cholecystectomy (ELC) within seven days of diagnosis was assessed.

RESULTS The overall ELC rate increased from 26% for the 126 patients admitted in the pre-ESU period to 45% for the 152 patients admitted in the post-ESU period ($p=0.001$). With those unsuitable for ELC excluded, the ELC rate increased from 34% to 82% ($p<0.001$). The proportion of patients precluded from ELC for avoidable reasons, particularly owing to 'surgeon preference/skill', was reduced from 69% to 18% ($p<0.001$). The mean total length of stay (LOS) and postoperative LOS fell by 1.7 days (from 8.3 to 6.6 days, $p=0.040$) and 2 days (from 5.6 to 3.6 days, $p=0.020$) respectively. The higher ELC rate and the reduction in LOS produced additional tariff income (£111,930) and estimated savings in bed day (£90,440) and readmission (£27,252) costs.

CONCLUSIONS A dedicated ESU incorporating national recommendations for EGS improves alignment of best practice with best evidence and can also result in financial rewards for a busy district general hospital.

KEYWORDS

Emergency surgery – Gallstones – Acute cholecystitis – Laparoscopic cholecystectomy – Guidelines

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Emergency patients represent around half of the general surgical workload and account for 80–90% of surgical deaths.¹ Despite this, the provision of emergency general surgery (EGS) care is highly varied and recording of outcomes poor. Centralisation of surgical services, early subspecialisation, an increasing caseload and a climate of financial constraint appear to be responsible.^{1,2} Traditional emergency rotas with consultant surgeons from all specialties sharing may no longer be feasible as modern subspecialist interests may reduce skills and confidence in managing unselected emergency admissions.

The Royal College of Surgeons of England (RCS) and the Association of Surgeons of Great Britain and Ireland (ASGBI) have pressed on the urgent need to examine the provision and outcomes for EGS and explore new service delivery options.¹ Central to their vision is separation of elective and emergency services.³ Accordingly, in December 2013 the provision of EGS care at our trust underwent a fundamental reconfiguration, separating elective from emergency work. A dedicated consultant-led emergency

surgical unit (ESU) was designed, committed to prioritising emergency care, with assigned clinical and managerial leads, and a greater emphasis on regular audit of outcomes and care.

The focus has now moved to measuring the impact of our service. Acute cholecystitis (AC) is responsible for 3% of EGS admissions in England, amounting to over 15,000 cases in 2013–2014.⁴ Early laparoscopic cholecystectomy (ELC) is now accepted as the treatment of choice for AC, superseding the earlier practice of conservative management and delayed cholecystectomy.^{5–7} The consensus on the optimal timing is still lacking, however, with 'early' being defined as ranging from 24 hours to 7 days from diagnosis or onset of symptoms.⁷

Despite positive evidence, the rate of ELC remains low worldwide,^{8–10} mainly on account of financial constraints, logistical difficulties and shortage of expertise.^{6,8,11} Practice of early cholecystectomy in the UK is particularly poor by international standards^{8–10} and possibly reflects the general provision of emergency surgical care.

Management of AC therefore provides a worthy target for EGS service improvement. This view is supported by the National Institute for Health and Care Excellence (NICE), who released guidance in October 2014, recommending that AC should be treated with ELC within seven days of diagnosis.¹¹ Consequently, this study sought to examine the impact of a dedicated ESU on the management of AC by comparing the numbers of ELCs performed prior to and following the inception of the ESU as well as associated cost implications.

Methods

The methodology for patient selection is illustrated in Figure 1. All consecutive patients admitted with suspected gallstone disease between December 2012 and November 2014 were identified through an electronic hospital patient administration system using ICD-10 (International Classification of Diseases, 10th revision) codes for all gallstone related conditions. Cases of AC were confirmed by review of electronic discharge summaries, radiology, blood results and clinical notes. Other biliary conditions (gallstone pancreatitis and biliary colic) were excluded. Relevant OPCS-4 (Office of

Population Censuses and Surveys Classification of Interventions and Procedures, version 4) codes were used to identify those having laparoscopic cholecystectomy (LC). Histopathology records of submitted gallbladder specimens were also searched to identify additional cases that might have escaped detection on the patient administration system.

Depending on the date of admission, all patients with AC belonged either to the pre-ESU (December 2012 – November 2013) group or to the post-ESU (December 2013 – November 2014) group. All outcomes were compared between the two periods. Patients were further grouped by management type as ELC (surgery within 7 days of diagnosis), delayed LC (DLC) (surgery later than 7 days) or no LC (no recorded LC up until end of follow-up review at 21 weeks from end of study period).

AC was diagnosed on presence of right upper quadrant pain and tenderness, raised C-reactive protein and/or leucocytosis, plus radiological evidence of gallstones, thickened gallbladder wall and/or pericholecystic fluid.

Outcome measures

The main outcome was the number of AC cases managed in accordance with NICE guidance (LC within seven days

of diagnosis), plus resultant income gains and cost savings. Secondary outcome measures were reasons for exclusion from ELC, length of stay (LOS) (both total and postoperative), time to operation, complications, conversion and readmission rate.

The total LOS for the DLC group was calculated as the sum of the first admission period and any subsequent admission periods. Readmission was defined as an emergency admission with recurrent symptoms of AC in a patient awaiting DLC after being managed conservatively during the index admission. Bed day cost and tariffs for elective and non-elective cholecystectomy were obtained from the trust's finance manager.

Statistical analysis

SPSS® version 22.0 (IBM, New York, US) was used to produce both descriptive and inferential statistics. Fisher's exact test and t-tests were used as appropriate to compare the pre and post-ESU periods. A *p*-value of <0.05 was considered statistically significant.

Emergency surgical unit

The ESU is staffed by a team of five emergency consultant surgeons trained in upper gastrointestinal, hepatobiliary and colorectal surgery plus an emergency surgery clinical lead. A typical week is split into Monday to Thursday and Friday to Sunday (Table 1). The named consultant of the week or weekend covers the on-call shift between 8am and 5pm, and is responsible for admissions. A second consultant is present between 12pm and handover at 8pm to cover the busy afternoon period, when the morning consultant is supervising trainees in theatre. A third consultant is on call from home overnight. Night cover is shared with ten other non-ESU consultant surgeons at the trust who do not participate in the daytime cover. This allows subspecialist elective commitment to continue uninterrupted, avoiding loss of revenue.

The 1:6 rolling rota design ensures on-site consultant presence at least 12 hours a day with at least twice daily ward rounds 7 days a week. There is currently an additional CEPD (Confidential Enquiry into Perioperative Deaths) emergency theatre list 6 days a week, which is shared with other specialties according to clinical priority, and a 12-bed surgical assessment unit. The second CEPD

list was limited to 3 days a week for the first 18 months of the study. It increased to four days a week in the last six months of the post-ESU period and then six days in the final month.

Although the emergence of the ESU has heightened awareness of ELC for AC, which in turn has facilitated better collaborative working with theatres and radiology, there is not yet a dedicated biliary list and there are no additional radiology inpatient slots. On average, the ESU has 500 acute surgical admissions per month with 60% requiring same admission operative management.

Results

A total of 278 patients with AC were admitted over the study period, representing 27% of all gallstone disease admissions (*n*=1,034). There was an increase in the number of AC admissions from 126 in the pre-ESU period to 152 in the post-ESU period (*p*=0.020). There was no difference in demographics between the two groups (Table 2).

Impact on management

Table 2 shows the management outcomes for the two periods. Overall, more patients were managed operatively in the latter period although this difference was not statistically significant (57% vs 64%, *p*=0.260). However, with those unsuitable for surgical treatment excluded, the difference was significant (69% vs 92%, *p*<0.001).

The overall proportion of cases receiving ELC within 7 days of diagnosis increased significantly from 26% in the pre-ESU period to 45% thereafter (*p*=0.001). A number of patients were deemed unsuitable for ELC owing to unavoidable reasons. After adjusting for this, the ELC rate showed a considerable increase from 34% to 82% (*p*<0.001). This should be regarded as the true ELC rate. The overall DLC rate fell from 31% to 19%.

The proportion of patients precluded from ELC for avoidable reasons decreased from 69% to 18% (*p*<0.001). The most frequently observed avoidable reason ('surgeon preference/skill') decreased significantly (Fig 2).

Time to operation

Overall, patients had their surgery sooner in the post-ESU period (mean time to operation: 62 vs 27 days, *p*=0.002;

Table 1 Emergency surgical unit on-call rota

	8am – 5pm	12pm – 8pm	8pm – 8am
	Morning handover* + on-call round** + surgical admissions + CEPD list	Surgical admissions +/-CEPD list + on-call round** + evening handover*	On-call cover from home
Mon – Thu	ESU consultant 1 (admitting) (1:6)	ESU consultant 2 (1:6)	ESU or non-ESU consultant in rotation (1:16)
Fri – Sun	ESU consultant 3 starts (admitting) (1:6)	Non-ESU consultant (1:10)	Non-ESU consultant (1:10)
*Twice daily consultant-led handovers at 8am and 8pm			
**Twice daily consultant-led on-call rounds after morning handover and before evening handover			
CEPD = Confidential Enquiry into Perioperative Deaths; ESU = emergency surgical unit			

Table 2 Comparison of the pre and post-ESU periods

	Pre-ESU	Post-ESU	p-value
<i>Mean age in years</i>			
Mean age for all AC patients (range)	58 (16–93)	58 (21–94)	0.850*
Mean age for ELC patients (range)	49 (16–87)	53 (22–82)	0.330*
Mean age for DLC patients (range)	58 (23–92)	59 (24–82)	0.780*
Mean age for patients with no LC (range)	63 (19–93)	65 (21–94)	0.750*
<i>Sex</i>			
Sex for all AC patients	M=52, F=74	M=51, F=101	0.180**
Sex for ELC patients	M=13, F=20	M=18, F=50	0.250**
Sex for DLC patients	M=12, F=27	M=27, F=27	0.940**
Sex for patients with no LC	M=9, F=20	M=24, F=31	0.510**
<i>Management outcomes</i>			
Admissions with AC	126	152	0.020**
AC patients having surgery	72 (57%)	97 (64%)	0.260**
AC patients deemed suitable for surgery	104 (83%)	105 (69%)	
Suitable patients treated operatively	72/104 (69%)	97/105 (92%)	<0.001**
Total number of patients receiving ELC overall (apparent ELC rate)	33 (26%)	68 (45%)	0.001**
Total number of patients receiving DLC (apparent DLC rate)	39 (31%)	29 (19%)	
Total number of patients precluded from having ELC	93	84	<0.001**
Owing to avoidable reasons [†]	64 (69%)	15 (18%)	
Owing to unavoidable reasons [†]	29 (31%)	69 (82%)	
AC patients potentially suitable for ELC after excluding those precluded from ELC for unavoidable reasons	126–29 = 97	152–69 = 83	
Suitable patients having ELC (true ELC rate)	33/97 (34%)	68/83 (82%)	<0.001**
<i>Time to operation in days</i>			
Mean time to operation overall (95% CI)	62 (42–82)	27 (16–37)	0.002*
Mean time to ELC from diagnosis (95% CI)	3 (2–3)	2 (2–3)	0.800*
Mean time to DLC from diagnosis (95% CI)	112 (83–141)	83 (53–108)	0.140*
<i>LOS in days</i>			
Mean total LOS overall (95% CI)	8.3 (6.7–9.3)	6.6 (5.7–7.6)	0.040*
Mean total LOS for ELC (95% CI)	7 (5–9)	7 (5–8)	0.820*
Mean total LOS for DLC (95% CI)	11 (8–14)	9 (6–12)	0.480*
Mean postoperative LOS overall (95% CI)	5.6 (3.9–7.4)	3.6 (2.7–4.4)	0.020*
Mean postoperative LOS for ELC (95% CI)	5 (3–6)	4 (3–5)	0.400*
Mean postoperative LOS for DLC (95% CI)	6 (3–10)	3 (2–4)	0.040*
Within-group comparison of mean total LOS for ELC vs DLC	ELC 7 days vs DLC 11 days: p=0.030*	ELC 7 days vs DLC 9 days: p=0.040*	
ESU = emergency surgical unit; AC = acute cholecystitis; ELC = early laparoscopic cholecystectomy; DLC = delayed laparoscopic cholecystectomy; LC = laparoscopic cholecystectomy; CI = confidence interval; LOS = length of stay			
*t-test; **Fisher's exact test; [†] see Fig 2			

Table 2). The mean difference in time to operation for both ELC and DLC groups was not statistically significant.

Length of stay

The mean total LOS overall, the mean postoperative LOS overall and the mean postoperative LOS for DLC reduced significantly between the two periods (Table 2). The mean total and postoperative LOS for ELC as well as the mean total LOS for DLC remained unchanged. However, within-group analysis showed a significantly shorter mean total LOS for ELC than for DLC.

Readmissions, complications and conversions

Table 3 gives details of the readmissions, complications and conversions. Fourteen patients awaiting DLC were readmitted in the pre-ESU period compared with only two in the post-ESU period. There were no deaths or major complications reported. There were eight bile leaks. Four of these were managed with endoscopic retrograde cholangiopancreatography and stent insertion, three with washout and drain insertion, and one was treated conservatively. No bile

leak was due to a major duct injury. The conversion rate was higher in the post-ESU period but the overall complication rate remained the same.

Financial impact

The higher ELC rate led to an additional income of £111,930 after the inception of the ESU, based on a higher rate tariff for emergency cholecystectomy. ELC conferred a significant cost saving of £90,440, which was influenced by a reduction in overall LOS. Furthermore, spending on readmission costs was cut by £27,252. The calculations for additional income and costs saved are shown in Table 4.

Discussion

This study demonstrates how a dedicated ESU can offer a higher number of ELC procedures and realise its potential advantages over DLC. These include shorter LOS,^{5,6} reduced repeat admissions and consequent substantial cost savings.^{12–14}

ELC is the optimum treatment for AC.^{5–7,15,16} NICE has recommended LC for AC within seven days of diagnosis as

Table 3 Readmissions for DLC patients, complications and conversions prior to and following the inception of the ESU

	Pre-ESU		Post-ESU	
<i>Readmissions</i>	14		2	
<i>Complications</i>	ELC (n=33)	DLC (n=39)	ELC (n=68)	DLC (n=29)
Bile leak	2	0	5	1
Collection	1	3	0	0
Bleeding	1	0	1	0
Pneumonia	0	0	1	1
Respiratory failure	0	0	0	1
Readmission for pain	0	0	0	1
Atrial fibrillation	0	2	0	0
Other (wound infection, psychiatric issues, acute kidney injury)	0	1	2	0
Subtotal	4 (12%)	6 (15%)	9 (13%)	4 (14%)
Total	10 (14%)		13 (13%)	
<i>Conversions</i>	ELC (n=33)	DLC (n=39)	ELC (n=68)	DLC (n=29)
Number of conversions	0 (0%)	1 (3%)	6 (9%)	1 (3%)
Total	1 (1%)		7 (7%)	

DLC = delayed laparoscopic cholecystectomy; ESU = emergency surgical unit; ELC = early laparoscopic cholecystectomy

a key priority for implementation.¹¹ However, management of AC is highly variable as decision making is often influenced by the individual surgeon's skillset, availability of resources and awareness of national best practice guidance. In the UK, only 11–20% of surgeons offer ELC^{8,17} compared with 33–67% internationally.^{9,10,18,19}

NICE also recognised that success of implementing ELC may rest on providers' willingness to redesign their EGS services.¹¹ This is supported by our almost unique example of a redesigned ESU, which has not only enabled unprecedented compliance with NICE guidance on ELC but has also generated significant income and savings.

The overall ELC rate increased from 26% to 45% following the establishment of the ESU. This is more than double the highest reported national figure of 20%¹⁷ and compares favourably with international reports (33–67%).^{9,10,18,19} Furthermore, when patients unsuitable for ELC were excluded from analysis, the ELC rate rose to an impressive 82% in the post-ESU period. This is four times the highest reported national figure¹⁷ and is the highest ELC rate reported even when considering large US centres where private funding incentives are clearly a factor.¹⁹

Despite a significant increase in AC admissions in the second period, a greater number of suitable patients were managed operatively overall (92% vs 69%). The ability to treat increased numbers was due to availability of the necessary surgical expertise seven days a week and a consensus approach to ELC for treating AC, both a direct result of

the ESU. The increase in AC admissions was probably due to a demographic change involving closure of a sister hospital's emergency department, which diverted more patients to our hospital, including those with advancing age and co-morbid conditions. Increased local awareness of the ESU's well publicised acute gallstone disease clinical pathway also contributed to this trend.

The ESU approach to AC provided a substantial 60% increase in tariff income (£295,773 compared with £183,843) by performing a greater number of emergency cholecystectomies. The trust also saved an estimated £90,440 because of the reduction in LOS associated with an increased ELC rate and quicker discharge. Readmissions due to recurrent biliary symptoms reduced dramatically (from 14 pre-ESU to 2 post ESU). A significantly higher number of index admission cholecystectomies meant that fewer patients were waiting for DLC. For delayed cases, the operations were performed on average one month earlier in the post-ESU period (mean time to operation reduced from 112 to 83 days; Table 2). Both these factors seem to be responsible for a reduction in the readmission rate.

Based on an official cost analysis, a third of patients with AC awaiting DLC are readmitted with recurrent symptoms (often up to three times),^{20,21} at a cost of £2,271 per admission.²¹ It can therefore be estimated that £4,542 was spent on readmission costs in the post-ESU period compared with £31,794 in the previous period, amounting to a saving of £27,252.

Table 4 Impact of ESU on income and potential savings			
INCOME CALCULATION:			
Tariff	Procedure	(Fee) x (Local market forces factor)	Final fee
A	DLC	£1,353 x 1.195405	£1,617
B	ELC	£3,062 x 1.195405	£3,660
Procedure	Income pre-ESU	Income post-ESU	
DLC	39 x Tariff A = £63,063	29 x Tariff A = £46,893	
ELC	33 x Tariff B = £120,780	68 x Tariff B = £248,880	
Total	£183,843	£295,773	
Additional tariff income = £295,773 – £183,843 = £111,930			
BED DAY COSTS SAVED:			
Mean LOS pre-ESU	Mean LOS post-ESU	Mean reduction in LOS	
8.3 days	6.6 days	1.7 days	
Average bed day cost saved = 1.7 days x £350 (bed day cost) = £595 per admission			
Total bed day costs saved = £595 x 152 (number of AC admissions after ESU) = £90,440			
READMISSION COSTS SAVED:			
A third of AC patients treated conservatively and awaiting DLC are readmitted with acute biliary symptoms. ^{20,21}			
Official estimated cost per readmission = £2,271 ²¹			
	Pre-ESU	Post-ESU	
Number of readmissions	14	2	
Readmission costs	14 x £2,271 = £31,794	2 x £2,271 = £4,542	
Total readmission costs saved = £31,794 – £4,542 = £27,252			
ESU = emergency surgical unit; DLC = delayed laparoscopic cholecystectomy; ELC = early laparoscopic cholecystectomy; LOS = length of stay; AC = acute cholecystitis			

The reasons for some cases being precluded from ELC were also examined. It was noteworthy that avoidable reasons fell from 69% to 18% in the post-ESU period, the main reduction being for 'surgeon preference/skill', which is often cited as a major barrier to an ELC service.^{8,12,17} The provision of six widely experienced surgeons with two covering the busy afternoon periods as well as extra theatre capacity throughout the week removed this barrier. Unavoidable reasons included the patient being medically

unfit, patient choice, presentation after seven days and bile duct pathology. These reasons applied to a higher proportion of patients deemed unsuitable for ELC in the post-ESU period (82%) than in the pre-ESU period (31%) despite no difference in demographics.

The ESU agreed AC management protocol and consultant-led approach is reflected in the reduction of almost two days in overall and postoperative LOS. These findings are mirrored in the literature.^{6,15,22} An increased ELC rate,

a shorter time to surgery and early discharge are likely to be contributing factors. The latter can be attributed to greater senior involvement by way of daily ward rounds and unrestricted availability through mobile phone communication ensuring consultant-led decisions at all times.

Follow-up data collection was continued for 21 weeks after the end of the study period to adequately capture the vast majority of delayed cholecystectomies. This was shown to be valuable by final data on time to surgery for DLC (pre-ESU mean: 16 weeks, maximum: 20 weeks; post-ESU mean: 12 weeks, maximum: 15 weeks), meaning that any DLC cases missed would be too few in number to have a considerable impact on the results. Since the main aim of the study was to compare the number of 'early' operations before and after the inception of the ESU, a small theoretical loss of DLC numbers is not considered a weakness.

The post-ESU conversion rate for ELC was 7% in the present study, which is significantly lower than the 20.3% reported in a meta-analysis from 2013.⁵ The complication rate was similar for ELC and DLC, which is consistent with the literature, demonstrating equal morbidity and mortality for the two approaches.^{6,18,22}

A multidisciplinary approach to the management of AC, centred on a well staffed and experienced ESU, has aided in changing the perception of LC as a low priority semielective procedure among radiology, anaesthetic and theatre staff.¹⁷ This has helped to streamline patient flow. This is further evidenced by a comparative audit published in 2015 highlighting our 100% compliance with the British Society of Gastroenterology guidelines for early definitive management of gallstone pancreatitis (GSP).²³ For this reason, GSP patients were not included in this study. Patients with biliary colic were also excluded as unlike AC and GSP, there is no national guidance on ELC for this group and in the absence of a dedicated biliary list, we do not perform ELC routinely for biliary colic on the CEPD list unless clinical priority is not being compromised.

A systematic review from 2015 of globally reported data looking at the impact of dedicated emergency services on patient outcomes and cost benefits adds further support to our findings.²⁴ The individual factors identified in the review as a basis for a future worldwide model for high quality delivery of EGS care already form the basis of the ESU.

Regardless of the reported achievements, the ESU team has identified several avenues for further improvement and negotiations are already underway. Increased capacity for urgent ultrasonography and magnetic resonance cholangiopancreatography will remove the single biggest limiting factor to providing an even better ELC service. The additional CEPD list capacity secured mainly by ESU efforts is currently shared with other surgical specialties. Future availability of a dedicated biliary list will resolve delays in time to operation, increase throughput, allow even more AC cases to be performed as ELC and allow inclusion of severe biliary colic cases also. Increased elective operating capacity will reduce time to operation for DLC cases, which in turn will further reduce the number of readmissions with recurrent symptoms.

Despite a robust methodology for data collection, the retrospective design is a limitation of this study. In the coming years, our performance will be audited prospectively.

Conclusions

Increasing capacity and improving service provision for emergency LC for AC through the establishment of a dedicated ESU offers substantial cost savings and improves compliance with NICE guidance. The RCS and the ASGBI have emphasised the need to contribute to the growing evidence base of positive outcome measures to help improve patient care and support commissioning in the field of emergency surgery.¹ This paper adds to the current body of work by presenting potential cost savings and positive clinical outcomes for emergency surgery, which so far have been poorly reported in the literature.

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References

1. Royal College of Surgeons of England, Association of Surgeons of Great Britain and Ireland. *Emergency General Surgery*. London: RCS; 2013.
2. Royal College of Surgeons of England. *Reshaping Surgical Services: Principles for Change*. London: RCS; 2013.
3. Royal College of Surgeons of England. *Separating Emergency and Elective Surgical Care*. London: RCS; 2007.
4. Hospital Episode Statistics, Admitted Patient Care, England – 2013–14. Health and Social Care Information Centre. <http://www.hscic.gov.uk/catalogue/PUB16719> (cited November 2015).
5. Gurusamy KS, Davidson C, Gluud C, Davidson BR. Early versus delayed laparoscopic cholecystectomy for people with acute cholecystitis. *Cochrane Database Syst Rev* 2013; **6**: CD005440.
6. Gutt CN, Encke J, Königer J *et al*. Acute cholecystitis: early versus delayed cholecystectomy, a multicenter randomized trial (ACDC study, NCT00447304). *Ann Surg* 2013; **258**: 385–393.
7. Zhou MW, Gu XD, Xiang JB, Chen ZY. Comparison of clinical safety and outcomes of early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a meta-analysis. *ScientificWorldJournal* 2014; 274516.
8. Cameron IC, Chadwick C, Phillips J, Johnson AG. Management of acute cholecystitis in UK hospitals: time for a change. *Postgrad Med J* 2004; **80**: 292–294.
9. Feliu X, Targarona EM, García-Agustí A *et al*. The development of laparoscopic surgery in Spain. *Dig Surg* 2004; **21**: 421–425.
10. Yamashita Y, Takada T, Hirata K. A survey of the timing and approach to the surgical management of patients with acute cholecystitis in Japanese hospitals. *J Hepatobiliary Pancreat Surg* 2006; **13**: 409–415.
11. National Institute for Health and Care Excellence. *Gallstone Disease: Diagnosis and Initial Management*. London: NICE; 2014.
12. Agrawal S, Battula N, Barraclough L *et al*. Early laparoscopic cholecystectomy service provision is feasible and safe in the current UK National Health Service. *Ann R Coll Surg Engl* 2009; **91**: 660–664.
13. Macafee DA, Humes DJ, Bouliotis G *et al*. Prospective randomized trial using cost-utility analysis of early versus delayed laparoscopic cholecystectomy for acute gallbladder disease. *Br J Surg* 2009; **96**: 1,031–1,040.
14. Garner JP, Sood SK, Robinson J *et al*. The cost of ignoring acute cholecystectomy. *Ann R Coll Surg Engl* 2009; **91**: 39–42.
15. Papi C, Catarci M, D'Ambrosio L *et al*. Timing of cholecystectomy for acute calculous cholecystitis: a meta-analysis. *Am J Gastroenterol* 2004; **99**: 147–155.

16. Lau H, Lo CY, Patil NG, Yuen WK. Early versus delayed-interval laparoscopic cholecystectomy for acute cholecystitis: a metaanalysis. *Surg Endosc* 2006; **20**: 82–87.
17. Senapati PS, Bhattacharya D, Harinath G, Ammori BJ. A survey of the timing and approach to the surgical management of cholelithiasis in patients with acute biliary pancreatitis and acute cholecystitis in the UK. *Ann R Coll Surg Engl* 2003; **85**: 306–312.
18. de Mestral C, Laupacis A, Rotstein OD *et al*. Early cholecystectomy for acute cholecystitis: a population-based retrospective cohort study of variation in practice. *CMAJ Open* 2013; **1**: E62–E67.
19. Zafar SN, Obirieze A, Adesibikan B *et al*. Optimal time for early laparoscopic cholecystectomy for acute cholecystitis. *JAMA Surg* 2015; **150**: 129–136.
20. Ghani AK, Rosin RD. Progress of symptoms and quality of life of patients waiting for laparoscopic cholecystectomy. *Br J Surg* 2004; **91**(Suppl 1): S67.
21. NHS Institute for Innovation and Improvement. *Focus on: Cholecystectomy – A Guide for Commissioners*. Coventry: NHS Institute for Innovation and Improvement; 2006.
22. Gul R, Dar RA, Sheikh RA *et al*. Comparison of early and delayed laparoscopic cholecystectomy for acute cholecystitis: experience from a single center. *N Am J Med Sci* 2013; **5**: 414–418.
23. Bokhari S, Kulendran M, Liasis L *et al*. Implementation of a novel emergency surgical unit significantly improves the management of gallstone pancreatitis. *Ann R Coll Surg Engl* 2015; **97**: 308–314.
24. Chana P, Burns EM, Arora S *et al*. A systematic review of the impact of dedicated emergency surgical services on patient outcomes. *Ann Surg* 2015 Apr 24. [Epub ahead of print.]