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META-ANALYSIS

Effect of institutional volume on laparoscopic cholecystectomy outcomes: Systematic review and meta-analysis

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Abstract

AIM: To determine whether institutional laparoscopy cholecystectomy (LC) volume affects rates of mortality, conversion to open surgery, bile leakage and bile duct injury (BDI).

METHODS: Eligible studies were prospective or retrospective cohort studies that provided data on outcomes from consecutive LC procedures in single institutions. Relevant outcomes were mortality, conversion to open surgery, bile leakage and BDI. We performed a Medline search and extracted data. A regression analysis using generalized estimating equations were used to determine the influence of annual institutional LC caseload on outcomes. A sensitivity analysis was performed including only those studies that were published after 1995.

RESULTS: Seventy-three cohorts (127404 LC procedures) were included. Average complication rates were 0.06% for mortality, 3.23% for conversion, 0.44% for bile leakage and 0.28% for bile duct injury. Annual institutional caseload did not influence rates of mortality (P = 0.142), bile leakage (P = 0.111) or bile duct injury (P = 0.198) although increasing caseload was associated with reduced incidence of conversion (P = 0.019). Results from the sensitivity analyses were similar.

CONCLUSION: Institutional volume is a determinant of LC complications. It is unclear whether volume is directly linked to complication rates or whether it is an index for protocolised care.

Key words: Abdominal; Cholecystectomy; Quality control; Systematic review; Meta-analysis

Core tip: We performed a meta-analysis to determine whether institutional laparoscopy cholecystectomy (LC) volume affects rates of mortality, conversion to open surgery, bile leakage and bile duct injury. Annual institutional caseload did not influence rates of mortality (P = 0.142), bile leakage (P = 0.111) or bile duct injury (P = 0.198) although increasing caseload was associated with reduced incidence of conversion (P = 0.019). Our results suggest that institutional LC volume may be a determinant of LC complications. It is unclear whether institutional LC volume is directly linked to complication rates or whether its influence is a surrogate for improved quality of care.

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INTRODUCTION

Laparoscopic cholecystectomy (LC) is one of the most commonly performed operations-close to 400000 procedures are performed annually in non-federal community hospitals in the United States[1] and around 50000 procedures are performed annually in the United Kingdom[2]. LC is preferred over open cholecystectomy as it leads to a shorter hospital stay and a quicker recovery[3]. However, there are risks of serious complications with LC such as biliary leaks (0.4%-1%)[2,4], bile duct injury (BDI) (0.2%-0.3%)[3,5] and mortality (0.1%-0.4%)[3,5]. Conversion rates vary from about 15%-5%[5].

An expanding body of evidence suggests that outcomes in a variety of conditions are improved when patients are managed in high-volume centres or by high-volume healthcare providers[6]. High-volume centres dramatically improve the management of pancreatic cancer (≥ 20 cases per year), oesophageal cancer (≥ 30 cases per year), paediatric cardiac conditions (≥ 300 cases per year), unruptured abdominal aortic aneurysms (AAA) (≥ 36 cases per year) and acquired immune deficiency syndrome (≥ 100 cases per year)[6]. Similarly, high-volume surgeons or physicians dramatically improve the management of pancreatic cancer (10-42 cases per year), ruptured AAAs (≥ 10 cases per year), paediatric cardiac conditions (≥ 75 cases per year), colorectal cancer (≥ 22 cases per year), carotid endarterectomy (≥ 30 cases per year) and coronary artery bypass grafting (≥ 150 cases per year)[6]. In contrast, no proven volume-outcome relationships exist for conditions such as diabetes, cystic fibrosis, rheumatoid arthritis, appendicitis and hernias[7,8].

Recently, data have emerged confirming that high-volume surgeons improve outcomes following LC[2,4,5,9-12]. Giger *et al*[5] found improved results with surgeons who performed > 100 LCs per year, Nuzzo *et al*[10] found improved results with surgical teams who performed > 450 LCs in three years, Csikesz *et al*[11] found improved results with surgeons who performed > 15 LCs per year and McMahon *et al*[12] found improved results for surgeons who had performed more than 200 cases. Andrews *et al*[2] and Hobbs *et al*[4] did not specify thresholds although they identified significantly reduced complications with increasing surgeon volume. However, it is unclear whether a volume-outcome relationship exists for LC at institutional level. If such an institutional relationship can be proven and understood, the creation of high-volume LC centres may become a priority. Therefore we performed a systematic review and meta-analysis focusing on institutional volume/outcome relationships for LC. The aim was to determine whether institutional LC volume affects rates of mortality, conversion to open surgery, bile leakage and bile duct injury.

MATERIALS AND METHODS

This systematic review was performed in accordance with the PRISMA guidelines[13]. These guidelines are an evidence-based set of items that aim to enhance methodological and reporting clarity.

The Medline electronic database was searched from 1st January 1990 to 9th April 2014 using the free text "laparoscopic cholecystectomy".

Eligible studies were prospective or retrospective cohort studies that provided details on outcomes from consecutive LC procedures in single institutions. The relevant outcomes were the incidences of conversion to open surgery, bile leakage, BDI or mortality. The definitions and timeframes of these outcomes were those specified in retrieved manuscripts. There were no limitations on cohort sizes or on recruitment dates of studies. Studies reporting combined results from multiple centres were eligible provided that data were provided separately for individual centres. Studies were excluded if results did not allow the calculation of institutional complication rates. This lead to the exclusion of studies that reported on selected LCs rather than all consecutive LCs and studies that did not specify study start and finish dates. Case reports, narrative reviews and non-English language studies were also excluded.

One author (Murray M) identified eligible studies. Firstly, titles and abstracts were screened. Full-text manuscripts of potentially relevant studies were examined to finalise eligibility. Uncertainties regarding eligibility were discussed with a second author (Healy DA). For each included study, the following data were extracted independently by two authors (Murray M and Healy DA): author, publication date, study design, the institution's name, start and finish dates, duration, number of LCs, number of mortalities, number of conversions to open surgery, number of bile leaks and the number of cases of

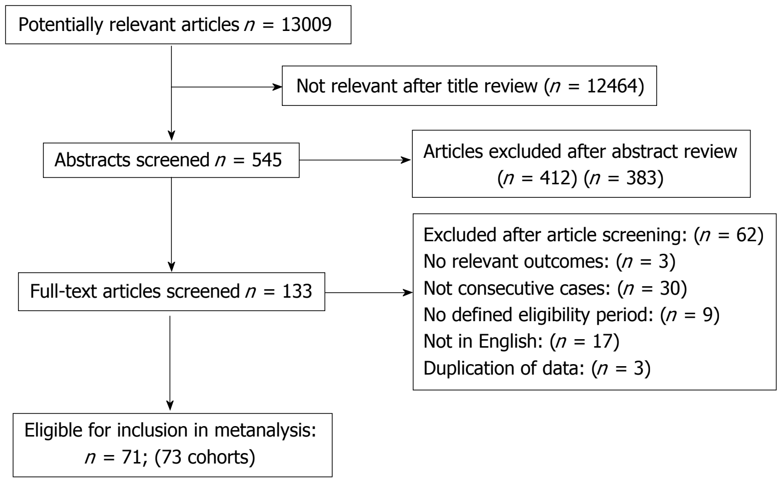

Figure 1 Summary of the results of the search.

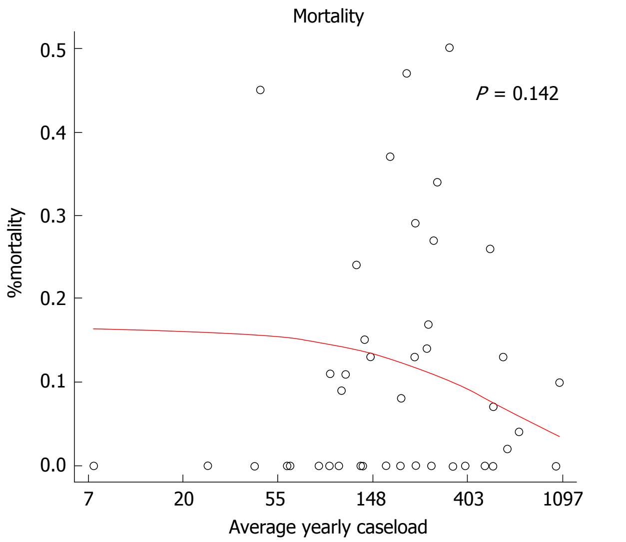

Figure 2 Scatterplot with regression line demonstrating the relationship between percentage mortality rate and average annual institutional volume of laparoscopic cholecystectomy (average caseload is plotted on a logarithmic scale).

BDI. Percentage complication rates were calculated for each outcome. Disagreements regarding data extraction were resolved by discussion with a third author (Walsh SR). Data were entered into a computerised spreadsheet for analysis.

All analyses were designed and performed by a biomedical statistician (JF). Scatterplots were used to summarise the relationships between numbers of LC procedures per year and percentage complication rates. Regression analyses were performed using generalized estimating equations. The generalized estimation equations were fit using a variance structure based on the binomial distribution. The response was the percentage of complications out of all procedures performed. A robust variance was used to account for extra variance around the regression line because of center specific effects. The function "gee" in the statistical language R was used. A sensitivity analysis was performed that was limited to studies that were published after 1995. This time point was chosen with the aim of eliminating the effects of learning curves and improvements in perioperative care. Significance was set at 5%.

Statistical analysis

The authors state that all statistical analyses were designed and performed by a biomedical statistician. A statement to this effect is included in the methods section.

RESULTS

Figure 1 summarises the results of the search. 13009 citations were identified and 12876 were excluded based on titles and abstracts. 133 full text manuscripts were retrieved and 71 articles (corresponding to 73 cohorts) were finally eligible for inclusion.

Table 1 provides a summary of the 73 eligible cohorts[14-84]. Most were retrospective and some were prospective cohorts. Study recruitment periods varied from 1990 to 2013. The total number of LC procedures was 127404.

Forty-three studies (71305 patients) provided data on mortality (43 cases of mortality; average mortality was 0.06%). Figure 2 displays the relationship between average annual number of LC procedures and institutional mortality rates as percentages. There was no significant relationship between mortality and annual number of procedures (P = 0.142). When only those cohorts published after 1995 were included (32 cohorts, 64273 patients) there was no significant relationship (P = 0.168).

Fifty-eight studies (87840 patients) provided data on conversion rates (2835 cases of conversion; average conversion rate was 3.23%). Figure 3 displays the relationship between average annual number of LC procedures and institutional percentage conversion rates. Increasing caseload was associated with lower conversion rates (P = 0.019). When only those studies that were published after 1995 were included (43 studies, 79311 patients) the result remained significant (P = 0.019).

Table 1 Characteristics and results of included studies

Ref.	Publication year	Study duration in months	Design	Total LC number	Average annual LC number	Mortality incidence	Percentage mortality rate (%)	Conversion to open surgery incidence	Percentage conversion rate (%)	Bile leak incidence	Percentage bile leak rate (%)	Bile duct injury incidence	Percentage bile duct injury rate (%)
Szego *et al*[14]	1991	6	Retrospective	31	62.00	0	0.00	2	6.45	0	0	0	0
Bailey *et al*[15]	1991	16	Prospective	375	281.25	1	0.27	20	5.33	1	0.27	1	0
Peters *et al*[16]	1991	6	Prospective	100	200.00	0	0.00	4	4.00	2	2	1	1
Rees *et al*[17]	1992	12	Retrospective	155	155.00	N/A	N/A	8	5.16	2	1.29	1	1
Huang *et al*[18]	1992	11	Retrospective	200	218.18	N/A	N/A	N/A	N/A	1	0.5	1	1
Davis *et al*[19]	1992	24	Retrospective	622	311.00	N/A	N/A	26	4.18	N/A	N/A	1	0
Fielding *et al*[20]	1992	12	Retrospective	220	220.00	N/A	N/A	8	3.64	2	0.91	N/A	N/A
Soper *et al*[21]	1992	21	Prospective	600	342.80	0	0.00	18	3.00	N/A	N/A	1	0
Périssat *et al*[22]	1992	32	Retrospective	700	262.50	1	0.14	41	5.86	N/A	N/A	3	0
Troidl *et al*[23]	1992	14.5	Prospective	400	331.00	2	0.50	20	5.00	3	0.75	N/A	N/A
Rubio *et al*[24]	1993	31	Retrospective	500	193.55	N/A	N/A	4	0.80	1	0.2	1	0
Huang *et al*[25]	1993	18	Retrospective	350	233.33	0	0.00	6	1.71	4	1.14	1	0
Cox *et al*[26]	1994	24	Prospective	410	205.00	N/A	N/A	N/A	N/A	N/A	N/A	1	0
Williams *et al*[27]	1994	27	Retrospective	600	266.67	1	0.17	24	4.00	N/A	N/A	3	1
Cappuccino *et al*[28]	1994	14	Retrospective	563	482.57	0	0.00	5	0.89	N/A	N/A	N/A	N/A
Bonatsos *et al*[29]	1995	41	Retrospective	1788	523.32	0	0.00	45	2.52	19	1.06	0	0
Newman *et al*[30]	1995	36	Retrospective	1525	508.33	4	0.26	34	2.23	0	0	0	0
Chen *et al*[31]	1996	42	Retrospective	2428	693.71	1	0.04	N/A	N/A	1	0.04	4	0
Bond *et al*[32]	1996	36	Retrospective	534	178.00	2	0.37	N/A	N/A	N/A	N/A	N/A	N/A
Sartori *et al*[33]	1996	14	Retrospective	322	276.00	0	0.00	N/A	N/A	N/A	N/A	N/A	N/A
Rather *et al*[34]	1997	24	Retrospective	340	170.00	0	0.00	26	7.65	6	1.76	2	1
Jan *et al*[35]	1997	60	Retrospective	1115	223.00	N/A	N/A	N/A	N/A	4	0.36	3	0
Ahmad *et al*[36]	1997	45	Retrospective	1300	346.67	0	0.00	40	3.08	6	0.46	0	0
Kok *et al*[37]	1998	58	Prospective	220	45.52	1	0.45	9	4.09	N/A	N/A	1	0
Targarona *et al*[38]	1998	61	Retrospective	1630	320.66	N/A	N/A	109	6.69	N/A	N/A	16	1
Kurauchi *et al*[39]	1998	32	Retrospective	1408	528.00	1	0.07	89	6.32	N/A	N/A	9	1
Jones-Monahan *et al*[40]	1998	60	Retrospective	2654	530.80	N/A	N/A	N/A	N/A	1	0.04	6	0
Matthews *et al*[41]	1999	53	Retrospective	1025	232.08	3	0.29	27	2.63	2	0.2	1	0
Calvete *et al*[42]	2000	72	Prospective	784	130.67	0	0.00	4	0.51	4	0.51	7	1
Patel *et al*[43]	2000	38	Prospective	135	42.63	0	0.00	7	5.19	2	1.48	N/A	N/A
Sikora *et al*[44]	2001	72	Retrospective	1200	200.00	N/A	N/A	N/A	N/A	N/A	N/A	16	1
Lichten *et al*[45]	2001	12	Retrospective	300	300.00	N/A	N/A	17	5.67	N/A	N/A	N/A	N/A
Miroshnik *et al*[46]	2002	110	Retrospective	1216	132.65	N/A	N/A	90	7.40	7	0.58	1	0
Hasaniah *et al*[47]	2002	84	Retrospective	2750	392.86	0	0.00	127	4.62	11	0.4	3	0
Fathy *et al*[48]	2003	93	Retrospective	2000	258.06	N/A	N/A	147	7.35	11	0.55	7	0
Duca *et al*[49]	2003	108	Retrospective	9542	1060.22	10	0.10	184	1.93	54	0.57	17	0
Mahatharadol *et al*[50]	2004	116	Retrospective	1522	157.45	N/A	N/A	N/A	N/A	N/A	N/A	9	1
Daradkeh *et al*[51]	2005	108	Retrospective	1208	134.22	0	0.00	32	2.65	N/A	N/A	0	0
Diamantis *et al*[52]	2005	132	Retrospective	2079	189.00	N/A	N/A	N/A	N/A	N/A	N/A	13	1
Söderlund *et al*[53]	2005	50	Prospective	1568	376.32	N/A	N/A	N/A	N/A	23	1.47	24	2
Baird[54]	2005	16	Prospective	782	586.50	1	0.13	18	2.30	N/A	N/A	0	0
Vagenas *et al*[55]	2006	156	Retrospective	1220	93.85	0	0.00	23	1.89	3	0.25	2	0
Tan *et al*[56]	2006	9	Prospective	202	269.33	N/A	N/A	14	6.93	3	1.49	1	0
Mufti *et al*[57]	2007	12	Retrospective	60	60.00	0	0.00	3	5.00	1	1.67	0	0

Brekalo *et al*[58]	2007	120	Retrospective	952	95.20	1	0.11	32	3.36	N/A	N/A	0	0
Marakis *et al*[59]	2007	144	Retrospective	1225	102.08	N/A	N/A	91	7.43	1	0.08	2	0
Herve *et al*[60]	2007	120	Retrospective	1255	125.50	3	0.24	25	1.99	N/A	N/A	12	1
Brekalo *et al*[58]	2007	120	Retrospective	1066	106.60	1	0.09	N/A	N/A	43	4.03	3	0
Shrestha *et al*[61]	2007	21	Prospective	140	80.00	N/A	N/A	13	9.29	N/A	N/A	N/A	N/A
Tantia *et al*[62]	2008	156	Retrospective	13305	1023.46	0	0.00	8	0.06	10	0.08	52	0
Priego *et al*[63]	2009	204	Retrospective	3933	231.35	5	0.13	331	8.42	17	0.43	13	0
Avgerinos *et al*[64]	2009	72	Prospective	1046	174.33	N/A	N/A	27	2.58	5	0.48	0	0
Clegg-Lamptey *et al*[65]	2010	24	Prospective	52	26.00	0	0.00	1	1.92	1	1.92	0	0
Al-Kubati *et al*[66]	2010	48	Retrospective	336	84.00	0	0.00	43	12.80	3	0.89	2	1
Ying *et al*[67]	2010	144	Retrospective	2400	200.00	2	0.08	11	0.46	7	0.29	3	0
Zha *et al*[68]	2010	156	Prospective	13000	1000.00	N/A	N/A	N/A	N/A	N/A	N/A	11	0
Wichmann *et al*[69]	2010	18	Prospective	140	93.33	N/A	N/A	11	7.86	3	2.14	N/A	N/A
Wichmann *et al*[69]	2010	18	Prospective	219	146.00	N/A	N/A	18	8.22	2	0.91	N/A	N/A
Kanakala *et al*[70]	2011	120	Retrospective	2117	211.70	10	0.47	133	6.28	31	1.46	7	0
Al-Mulhim *et al*[71]	2011	36	Prospective	968	322.67	N/A	N/A	5	0.52	3	0.31	N/A	N/A
Halilovic *et al*[72]	2011	12	Prospective	293	293.00	1	0.34	8	2.73	N/A	N/A	N/A	N/A
Hasbahceci *et al*[73]	2012	129	Retrospective	1557	144.84	2	0.13	39	2.50	10	0.64	4	0
Bekele *et al*[74]	2012	60	Retrospective	681	136.20	1	0.15	20	2.94	N/A	N/A	N/A	N/A
Le *et al*[75]	2012	24	Retrospective	3371	1685.50	N/A	N/A	86	2.55	N/A	N/A	N/A	N/A
Afuwape *et al*[76]	2012	20	Retrospective	13	7.80	0	0.00	1	7.69	N/A	N/A	1	8
Grbas *et al*[77]	2013	202	Retrospective	10317	612.89	2	0.02	220	2.13	52	0.5	25	0
Sultan *et al*[78]	2013	120	Retrospective	4434	443.40	N/A	N/A	234	5.28	N/A	N/A	N/A	N/A
Pulvirenti *et al*[79]	2013	120	Retrospective	882	88.20	N/A	N/A	51	5.78	N/A	N/A	N/A	N/A
Dip *et al*[80]	2014	5	Prospective	43	103.20	0	0.00	N/A	N/A	0	0	0	0
Comajuncosas *et al*[81]	2014	12	Prospective	276	276.00	N/A	N/A	26	9.42	N/A	N/A	N/A	N/A
Paajanen *et al*[82]	2014	204	Retrospective	1895	111.47	2	0.11	126	6.65	14	0.74	2	0
Alvarez *et al*[83]	2014	248	Retrospective	11423	552.73	N/A	N/A	N/A	N/A	5	0.04	20	0.18
Afaneh *et al*[84]	2014	44	Retrospective	1382	376.91	N/A	N/A	44	3.18	N/A	N/A	2	0.14

LC: Laparoscopic cholecystectomy; N/A: Not available.

Forty-four studies (86025 patients) provided data on bile leak rates (381 cases of bile leakage; average bile leak rate was 0.44%). Figure 4 displays the relationship between average annual number of LC procedures and the institutional percentage bile leak rate. There was no significant relationship between bile leak rates and annual number of procedures (P = 0.111). When only those studies that were published after 1995 were included (33 cohorts, 80381 patients) the result was similar (P = 0.123).

Fifty-six cohorts (113526 patients) provided data on bile duct injury rates (316 cases of bile duct injury; average bile duct injury rate was 0.28%). Figure 5 displays the relationship between average annual number of LC procedures and institutional percentage bile duct injury rate. There was no significant relationship between bile duct injury rates and annual number of procedures (P = 0.198). When only those studies that were published after 1995 were included (42 cohorts, 105570 patients) the result was similar (P = 0.19).

DISCUSSION

This systematic review examined the effect of institutional LC volume on LC outcomes-it identified 73 single centre cohorts involving 127404 patients. Using regression analyses based upon generalised estimating equations we found that there were no significant relationships between institutional LC volume and mortality (P = 0.142), bile leakage (P = 0.111) or bile duct injury (P = 0.198). However, increasing institutional LC volume was associated with reduced incidence of conversion (P = 0.019). These pooled results relate

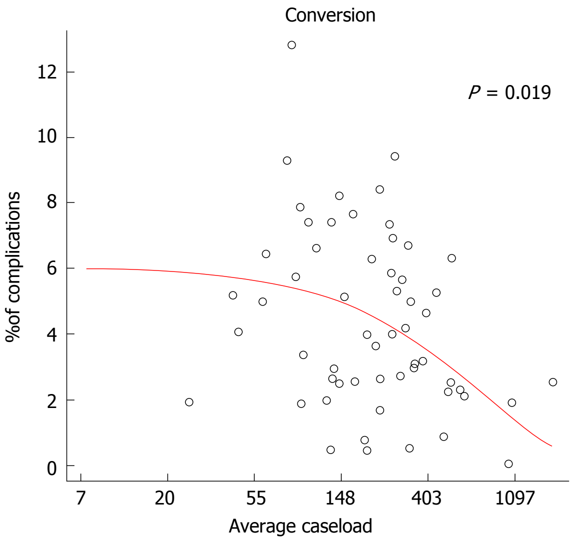

Figure 3 Scatterplot with regression line demonstrating the relationship between percentage conversion rate and average annual institutional volume of laparoscopic cholecystectomy (average caseload is plotted on a logarithmic scale).

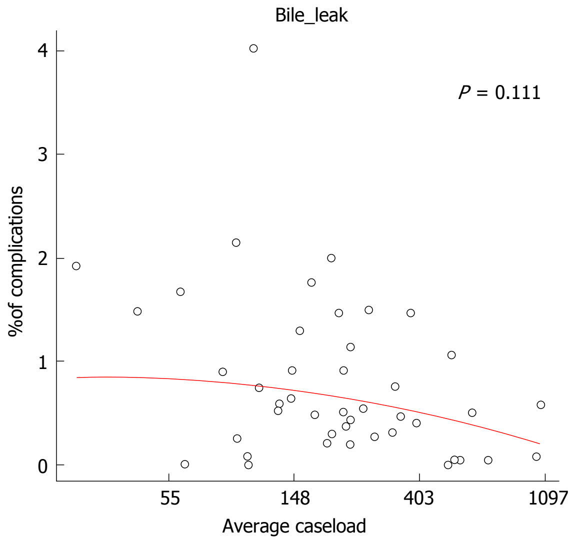

Figure 4 Scatterplot with regression line demonstrating the relationship between percentage bile leak rate and average annual institutional volume of laparoscopic cholecystectomy (average caseload is plotted on a logarithmic scale).

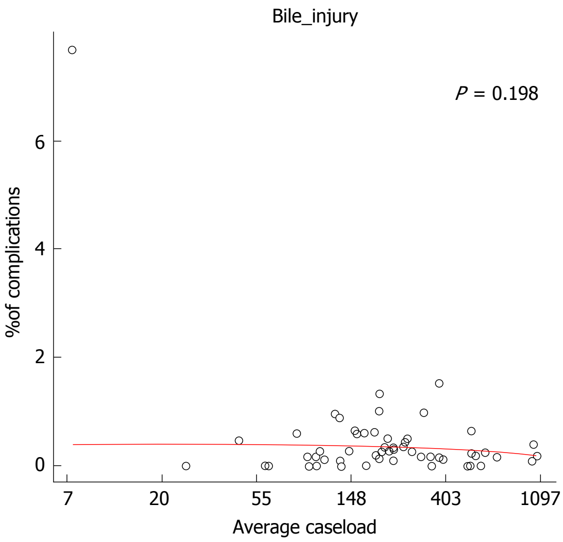

Figure 5 Scatterplot with regression line demonstrating the relationship between percentage bile duct injury rate and average annual institutional volume of laparoscopic cholecystectomy (average caseload is plotted on a logarithmic scale).

to cohorts that involved procedures performed between 1990 and 2013. Our sensitivity analysis was designed to limit the influence of the learning curve by excluding publications from before 1995-this analysis yielded similar results. Our findings are timely as mounting evidence confirms the importance of high-volume LC surgeons. Furthermore, evidence confirms the importance of high-volume centres and high-volume care providers in relation to other conditions[6]. Therefore the observation that LC complications may be influenced by institutional case load has implications for the future research and future service provision.

Our results are broadly consistent with previous studies that have examined the topic. The largest previous study was a retrospective population based study involving over one million patients from the United States National Inpatient Sample[85]. In a univariate analysis the authors of this study found that high-volume centres (≥ 225 LCs annually) had slightly improved major complication rates compared with lower-volume centres (6.4% *vs* 7.0%, $P < 0.0001$)[85]-significance was likely to have been related to the sample size and not to a clinically important effect. The effect on major complications was lost on multivariate testing. However an effect of hospital volume on conversion rates was present in a multivariable analysis-hospital volume of ≤ 120 cases per year was associated with an odds ratio (OR) for conversion of 1.32 (95%CI: 1.18-2.19) when compared with hospital volume of ≥ 225 per year. Another large population based study from Scotland involving 59918 procedures found higher mortality in lower volume (< 173 cases/year; OR = 1.45; 95%CI: 1.06-2.00; $P = 0.022$) and medium volume (173-244 cases/year; OR = 1.52; 95%CI: 1.11-2.08; $P = 0.01$) centres when high-volume centres (> 244 cases/year) were the reference group[86]. Although this again represents evidence for a hospital volume-outcome relationship for mortality, absolute effects were negligible for those patients at average risk-this suggests that the finding of significance may have simply been a reflection of the large sample size. In the late 1990s, another United States retrospective cohort study of 8602 procedures found no relationship between hospital volume and mortality[87] although a study from Norway on 4332 cases found a significant association between hospital volume and severe complications index[88]. Notably, the latter two studies only involved hospitals that nowadays would be deemed small volume.

From a wider perspective, patient safety is likely to have many underlying components and it is likely that hospital volume probably reflects clustering of these factors[86]. In the future it is important that studies explore the possibility that "high volume" may be a surrogate for streamlined management and strict adherence to protocolised care. Equivalent outcomes may be achievable in smaller centres provided that a high quality of care is maintained. High volume LC centres should only be required if institutional volume is shown to have a clinically important effect that is independent of other aspects of quality of care. As mentioned previously, several studies suggest the existence of a surgeon volume-outcome relationship for LC[2,4,5,9-12]-this seems plausible given the high-volume but low-risk nature of gallbladder surgery. The relatively low overall complication rate of gallbladder surgery makes volume-related research difficult and therefore it is essential that high quality registries including case-mix data are maintained into the future. In the long term, this will be the only way to determine important patient, surgeon and hospital-related components of safety.

The chief strength of the current study relates to the inclusion of a large number of studies, including both small and large cohorts. Furthermore, we used an extensive search strategy and we focused on patient-important outcomes that are simply defined and easily diagnosed and are thus likely to be accurate even in retrospective studies. The external validity of the study is further enhanced by the finding of average complication rates that are quite similar to accepted published rates. The main limitation is the lack of data on case mix. Furthermore, as we included studies that spanned a twenty year period across all areas of the world, undoubtedly temporal and geographical variations in care would have existed. Notably, we declined to evaluate trends in outcomes over time as study inclusion periods were heterogenous (Table 1) and results were not provided by year but rather for entire study inclusion periods. Finally we were limited to univariate analyses, thereby restricting conclusions on other factors that influence safety. We also wish to highlight that we did not aim to estimate specific optimal volume thresholds but rather we aimed to measure the effect of institutional volume on outcomes using a regression analysis. Overall, we think that the results of our review are striking. We wish to encourage research on volume-outcome relationships in surgery, particularly through the use of large scale registries.

COMMENTS

Background

Laparoscopic cholecystectomy (LC) is one of the most commonly performed operations worldwide. It is preferred over open cholecystectomy as it offers a shorter length of hospital stay and a quicker recovery but it is associated with the chance of needing conversion to open surgery and the risks of bile leakage, bile duct injury and mortality.

Research frontiers

Studies have shown that institutional volume is an important determinant of outcome in a variety of conditions such as cancers, aortic aneurysms and cardiac surgery. Furthermore surgeon experience is an important factor in these conditions also. Although recent evidence suggests that surgeon volume is an important determinant of outcomes following LC, the authors have a poor understanding of the effect of institutional volume. Knowing the effect of institutional volume is important as it may influence how healthcare systems are organised.

Innovations and breakthroughs

Based on the authors review, they have identified that conversion rate is related to institutional volume. Increasing institutional LC volume leads to reduced incidence of conversion to opens surgery. The authors found no evidence to suggest the institutional volume influences mortality, bile leakage or bile duct injury rates.

Applications

Institutional volume is an important determinant of outcomes following LC. However, it is uncertain whether this is a direct effect or a surrogate for optimum standardised and protocolised care. Large scale prospective registries are needed to explore this topic further.

Terminology

Bile duct injury is a serious and potentially life-threatening complication of LC resulting from inadvertent damage to biliary system structures during the operation. Bile leakage refers is a serious complication that results to continued leakage of bile from the biliary system after the operation. Most bile leaks can be managed effectively but they contribute to morbidity and have economic implications.

Peer review

The current meta-analysis presents interesting.

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