Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Systematic review and meta-analysis of factors which reduce the length of stay associated with elective laparoscopic cholecystectomy

Jessica M. Ryan¹#, Emer O’Connell²#, Ailín C. Rogers³, Jan Sorensen² & Deborah A. McNamara²,4,5

¹Department of General Surgery, Midland Regional Hospital, Mullingar, Westmeath, ²Royal College of Surgeons, ³Department of Colorectal Surgery, St. James’ Hospital, ⁴Department of Colorectal Surgery, Beaumont Hospital, Dublin, and ⁵National Clinical Programme in Surgery, Royal College of Surgeons in Ireland, Proud’s Lane, Dublin 2, Ireland

Abstract

Background: Laparoscopic cholecystectomy is a safe ambulatory procedure in appropriately selected patients; however, day case rates remain low. The objective of this systematic review and meta-analysis was to identify interventions which are effective in reducing the length of stay (LOS) or improving the day case rate for elective laparoscopic cholecystectomy.

Methods: Comparative English-language studies describing perioperative interventions applicable to elective laparoscopic cholecystectomy in adult patients and their impact on LOS or day case rate were included.

Results: Quantitative data were available for meta-analysis from 80 studies of 10,615 patients. There were an additional 17 studies included for systematic review. The included studies evaluated 14 perioperative interventions. Implementation of a formal day case care pathway was associated with a significantly shorter LOS (MD = 24.9 h, 95% CI, 18.7–31.2, p < 0.001) and an improved day case rate (OR = 3.5; 95% CI, 1.5–8.1, p = 0.005). Use of non-steroidal anti-inflammatories, dexamethasone and prophylactic antibiotics were associated with smaller reductions in LOS.

Conclusion: Care pathway implementation demonstrated a significant impact on LOS and day case rates. A limited effect was noted for smaller independent interventions. In order to achieve optimal day case targets, a greater understanding of the effective elements of a care pathway and local barriers to implementation is required.
with higher ASA scores, previous acute gallstone-related admissions, and preoperative endoscopic intervention\(^1^9\); therefore, proper patient selection is important. The most frequently cited modifiable reasons for failed discharge where DCLC was intended are uncontrolled pain, nausea, drain insertion, urinary retention, late return from theatre, and patient wishes or expectations.\(^3^,9,12,14,22,23\) In addition to patient selection criteria, the other necessary components of a DCLC patient pathway, from an institutional and a technical surgical perspective, are not well defined in the literature.

The objective of this meta-analysis was to identify perioperative interventions which reduce the LOS or increase the day case rate associated with elective laparoscopic cholecystectomy in adult patients. A previous systematic review focused on interventions to facilitate ambulatory laparoscopic cholecystectomy,\(^2^4\) however no meta-analysis has been performed on this subject.

**Materials and methods**

**Search strategy**

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines.\(^2^5\) PubMed, PubMed Central, Medline, Embase, and Cochrane databases were searched using a Boolean search algorithm for articles published up to January 2019. Original comparable studies were included if they examined the effects of any clinical intervention during adult inpatients’ trajectories for elective LC (Fig. 1). Exclusion criteria were papers where data were unavailable or uninterpretable and authors were uncontactable, and papers in languages other than English. Ethical approval and written consent were not required for this systematic review and meta-analysis.

An initial search of the above databases was used to identify the interventions to be included and subsequent additional searches for each intervention using Boolean algorithms were carried out on Pubmed. All search terms used are available as a Supplementary file (appendix I). The initial search was designed to be as broad as possible to identify interventions published in relation to elective LC. The citations from the initial search were reviewed to create a list of interventions which are relevant to common clinical practice in laparoscopic cholecystectomy and may be modified by surgical teams. The interventions included appear in Fig. 1. Subsequent searches were conducted using Boolean search terms related to each intervention separately. A manual search of reference lists and published review papers were also conducted to ensure optimal identification of relevant publications. All search results were compiled in a reference manager database (Endnote, Version X7, Thompson Reuters, New York, NY). Duplicates were removed automatically and then by hand.

**Data extraction**

Two independent reviewers (J.R. and E.O’C.) applied the inclusion and exclusion criteria (Fig. 1) to retrieve citations, the abstracts were reviewed, and full-text articles were selected. Reviewers extracted data from the full-text articles and applied exclusion criteria; discrepancies were agreed by consensus. For each study, data on baseline characteristics (journal, year published, country, study period, total number of patients, sex, study methodology, and definition of perioperative intervention) were extracted. Where drug classes were used and grouped

---

Figure 1: Study inclusion and exclusion criteria. *Refers to interventions which are delivered specifically by the Anaesthesiologist, e.g. administration of parenteral or intrathecal anaesthesia, pressor management intraoperatively, etc.
together for meta-analysis, the specific dosages and drugs used in each study are available in the Supplementary file.

Authors were contacted if data were not available or interpretable. Where median and range were presented, the methods described by Hozo and colleagues were followed to derive mean and standard deviation (SD). Where means were presented without SD, but p values were available, the average of the two SDs was imputed. Study methodological quality and risk of bias were assessed by applying the MINORS criteria for observational studies and the Jadad score for randomized controlled trials (RCTs). This information is available in the Supplementary tables provided in the appendix.

**Statistical analysis**

Data were analysed using RevMan software (Review Manager, version 5.3; The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark). Statistical expertise was available to the authors. Studies were included for meta-analysis if three or more existed which reported the LOS or day case rate for the same comparator. Mean LOS was compared between studies using the mean difference calculated using the inverse variance method in a fixed effects model. Mean length of stay was measured in hours for the purpose of analysis. Day case rate was compared between studies using the odds ratio calculated using the Mantel-Haenszel technique in a fixed effect model. An objective measure of heterogeneity was obtained by calculation of the I² statistic from the Cochrane Q test; an I² value greater than 50% was taken to denote significant heterogeneity between studies. Where statistical heterogeneity existed in the analysis a random effects model was employed. Forest plots were included in the text where statistical significance was achieved; all forest plots for non-significant meta-analyses are included in the Supplementary file.

**Results**

**Literature search**

The literature search revealed 1173 publications, and a further 135 were identified from hand searches and bibliographic sources (Fig. 2). Following exclusion of duplicates and abstract review, 216 studies were subject to full text review. Quantitative data were available for meta-analysis from 80 studies. There were an additional 135 studies were subject to full text review. Quantitative data were summarised in Table 1. The forest plots for non-significant meta-analyses have been provided in the Supplementary file.

**Care pathway implementation**

Implementation of a dedicated care pathway for patients undergoing elective LC was examined in 10 non-randomized studies. Implementation of a care pathway was associated with a significantly shorter mean LOS (MD 24.9 h; 95% CI, 18.7–31.2; p < 0.001; Fig. 3a) and an improved day case rate (OR, 3.5; 95% CI, 1.5–8.1; p = 0.005; Fig. 3b).

**Preoperative carbohydrate loading**

The delivery of preoperative carbohydrate loading in the form of supplement drinks was examined in seven RCTs and no difference was found in either mean LOS (p = 0.970) or day case rate between those receiving carbohydrate loading and those fasting or receiving a placebo.

**Pneumoperitoneum pressure**

The effect of reduced pneumoperitoneum pressure was examined in six RCTs and no difference was found in the mean LOS between patients undergoing surgery with a pressure of ≤10 mmHg compared to those undergoing surgery with pressure of 10–15 mmHg (p = 0.080).

**Preoperative non-steroidal anti-inflammatory drugs (NSAIDs)**

The effect of preoperative NSAIDs was examined in six RCTs. There was a significant reduction in mean LOS in patients receiving NSAIDs compared to placebo (MD 1.7 h; 95% CI, 1.0–2.4; p < 0.001; Fig. 3c). A subgroup analysis of studies specifically involving COX2 inhibitors also demonstrated a significant difference in mean LOS (MD 2.8 h; 95% CI, 0.7–4.9; p = 0.008; Fig. 3d).

**Preoperative anti-emetics**

The effect of preoperative dexamethasone was examined in eight RCTs with a mean reduction in LOS by 1.4 h noted amongst patients receiving dexamethasone compared with placebo (95%, CI 0.2–2.6; p = 0.020; Fig. 3e). No difference in LOS was noted in six RCTs comparing preoperative ondansetron with placebo (p = 0.080).

**Prophylactic intra-operative antibiotics**

The effect of prophylactic antibiotics was examined in 11 RCTs and one comparative study. Patients who received antibiotics before skin incision had a marginally shorter hospital stay, by 0.6 h, than those who received no antibiotics (p = 0.020, Fig. 3f).

**Local/regional anaesthesia**

The effect of incisional local anaesthesia (LA) was examined in four RCTs which did not lead to a reduction in LOS compared with placebo (p = 0.200). The effect of intraperitoneal LA was examined in 12 studies which demonstrated no change in LOS (p = 0.200) or day case rates (p = 0.110). A total of five studies found examining the effect of combined intraperitoneal and incisional LA and this likewise did not show a significant reduction (p = 0.060). Three studies examined
the effect of intraoperative transversus abdominis plane (TAP) blocks versus no TAP blocks and systematic review found no difference in LOS or day case rate.

**Prophylactic drain insertion**
A total of eight studies\textsuperscript{100–107} were found which reported on the effects of routine prophylactic drain insertion and found no significant difference in mean LOS between those receiving drainage and those with no drain insertion (p = 0.080). Two RCTs revealed that drain insertion significantly increased the likelihood of admissions in excess of 48 h.\textsuperscript{108,109} These studies were not suitable for meta-analysis as there were not enough studies reporting this LOS outcome (>/<48 h) in relation to drain insertion.
Preoperative education
Three studies\textsuperscript{10–12} were identified examining the effect of intensive versus standard preoperative education and none found differences in LOS or day case rate. This intervention was not amenable to meta-analysis as there were not enough studies for inclusion in either LOS or day case rate.

Perioperative fluid management
One RCT\textsuperscript{113} found a significant improvement in day case rate in patients who received a liberal intraoperative intravenous fluid regimen, however, a further four RCTs\textsuperscript{114–117} found no significant difference in mean LOS. None of these studies were amenable to meta-analysis due to heterogenous reporting of LOS outcomes.

Warmed pneumoperitoneum
Mean LOS was reported in two RCTs comparing warmed, humidified pneumoperitoneum with standard pneumoperitoneum\textsuperscript{118,119} and no significant difference in mean LOS was noted in either study. This intervention was not amenable to meta-analysis as it did not meet the number of studies required for inclusion.

Country and time period
Mean LOS was noted to be significantly longer in Japanese studies than the rest of the world (130.17 vs 44.22 h; \( p = 0.001 \)). There was no difference in mean LOS between studies published before or after 2010 (52.11 vs 50.47 h; \( p = 0.850 \)). A table of studies by country and year has been provided in the supplementary results file.

### Discussion

This review was designed to examine the evidence base for clinical interventions that have the potential to reduce LOS following LC. DCLC is associated with cost-savings\textsuperscript{3,13,14} and a high rate of patient satisfaction.\textsuperscript{17,18} In addition to this, shorter hospital stays lead to reduced healthcare associated infections\textsuperscript{120} and are likely to lead to reduced waiting list times due to better utilisation of resources. The 80 studies included in this meta-analysis, related to 10,615 LC patients who had a mean LOS of 61.2 h and a 41.1% day case rate. A total of 14 interventions were examined, of which only four were found to influence length of stay or likelihood of successful management as a day case: implementation of a dedicated care pathway, preoperative antibiotics, preoperative NSAIDs, and the antiemetic dexamethasone. Each of these demonstrated a statistically significant reduction in mean LOS. The largest effect size was seen with care pathway implementation, which led to a mean reduction in LOS of 24.9 h and a day case rate of 51.0%, compared with 27.9% for those treated prior to pathway implementation. The majority of the remaining interventions, used in isolation, did not lead to a reduction in LOS. Even among the three individual interventions with a significant difference, the change was of limited clinical importance, reducing LOS by 0.6–2.8 h. The reduction in LOS associated with the delivery of preoperative antibiotics is likely spurious. This is supported by the fact that antibiotics were only found to reduce LOS by 0.6 h, which is minimal.

A number of factors were not independently associated with reduced LOS in this meta-analysis. The provision of preoperative education, which played a role in several of the care pathways\textsuperscript{7–10,31}.

### Table 1: Meta-analyses of perioperative interventions to reduce the length of stay (LOS) or increase the day case rate in patients undergoing laparoscopic cholecystectomy

| Intervention                                      | Outcome     | Studies (n) | Participants (n) | Effect (95% CI)\textsuperscript{a} | p value |
|---------------------------------------------------|-------------|-------------|------------------|-------------------------------------|---------|
| Care pathway                                      | LOS         | 5           | 962              | 24.9 (18.7–31.2)                    | <0.001\textsuperscript{b} |
| Care pathway                                      | Day case rate | 6           | 2321             | OR 3.5 (1.5–8.1)                    | 0.005\textsuperscript{b} |
| Carbohydrate supplement                           | LOS         | 5           | 307              | 0.0 (−2.7 to 2.8)                   | 0.97    |
| Reduced pressure pneumoperitoneum                 | LOS         | 6           | 1001             | 4.2 (−0.4 to 8.9)                   | 0.08    |
| Preoperative non-steroidal anti-inflammatory drugs| LOS         | 6           | 447              | 1.7 (1.0–2.4)                       | <0.001\textsuperscript{b} |
| Antiemetic                                         | Dexamethasone | 8           | 1053             | 1.4 (0.2–2.6)                       | 0.02\textsuperscript{b} |
|                                                    | Ondansetron | 6           | 395              | 0.8 (−0.1 to 1.7)                   | 0.08    |
|                                                    | Antibiotics | 12          | 3410             | 0.6 (0.1–1.2)                       | 0.02\textsuperscript{b} |
| Local anaesthesia (LA)                             | Incisional LA | 4           | 382              | 9.4 (−5.0 to 23.8)                  | 0.2     |
|                                                    | Intrapertitoneal LA | 8       | 784              | 1.19 (−0.6 to 3.0)                 | 0.2     |
|                                                    | Intrapertitoneal LA | 4        | 308              | OR 1.8 (0.9–3.6)                    | 0.11    |
|                                                    | Combined incisional and intraperitoneal LA | 5       | 360              | 2.7 (−0.1 to 5.5)                   | 0.06    |
|                                                    | Drain insertion | 8       | 1629             | 11.97 (−1.5 to 25.5)                | 0.08    |

\textsuperscript{a} Units of effect size for length of stay are reported as hours. Effect size for day case rate is reported as odds ratios (OR).

\textsuperscript{b} Indicates statistical significance.
### Table A

| Study or Subgroup | Care Pathway | Mean Difference | Odds Ratio | Year |
|-------------------|--------------|----------------|------------|------|
|                   |              |                | M-H, Random, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |

### Table B

| Study or Subgroup | Care Pathway | Mean Difference | Odds Ratio | Year |
|-------------------|--------------|----------------|------------|------|
|                   |              |                | M-H, Random, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |

### Table C

| Study or Subgroup | Care Pathway | Mean Difference | Odds Ratio | Year |
|-------------------|--------------|----------------|------------|------|
|                   |              |                | M-H, Random, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |

### Table D

| Study or Subgroup | Care Pathway | Mean Difference | Odds Ratio | Year |
|-------------------|--------------|----------------|------------|------|
|                   |              |                | M-H, Random, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |

### Table E

| Study or Subgroup | Care Pathway | Mean Difference | Odds Ratio | Year |
|-------------------|--------------|----------------|------------|------|
|                   |              |                | M-H, Random, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |

### Table F

| Study or Subgroup | Care Pathway | Mean Difference | Odds Ratio | Year |
|-------------------|--------------|----------------|------------|------|
|                   |              |                | M-H, Random, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |
|                   |              |                | N, Fixed, 95% CI |      |

---

**Figure:**

- **A:** Graph showing the comparison between Standard care and Care Pathway with mean differences and odds ratios.
- **B:** Graph showing the comparison between Placebo and Treatment with mean differences and odds ratios.
- **C:** Graph showing the comparison between Placebo and Treatment with mean differences and odds ratios.
- **D:** Graph showing the comparison between Placebo and Treatment with mean differences and odds ratios.
- **E:** Graph showing the comparison between Placebo and Treatment with mean differences and odds ratios.
- **F:** Graph showing the comparison between Placebo and Treatment with mean differences and odds ratios.

---

**Legend:**

- **Placebo**
- **Treatment**
- **Favours Placebo**
- **Favours Treatment**
- **Favours Placebo**
- **Favours Treatment**
- **Favours Placebo**
- **Favours Treatment**
- **Favours Placebo**
- **Favours Treatment**
and which is generally considered mandatory to achieve same day discharge did not lead to a reduced LOS in the studies included. Unfortunately, only three studies reported LOS outcomes with respect to this intervention, each of insufficient power to detect a difference. Equally unexpectedly, the insertion of prophylactic drainage was not associated with increased LOS. Avoidance of unnecessary drain insertion is generally recommended and the authors hypothesise that the similar LOS observed among drained and undrained patients relates to study protocols designed to compare endpoints such as pain, development of collections, and drain outputs, at standard timepoints.

LOS is a challenging outcome measure, subject to both incentives and perverse incentives that may be financial or organisational. The definition of a day case varies between departments, institutions and health systems ranging from just a few hours to 23. Accuracy of LOS reporting is difficult to assess or internally validate. The authors assume for this meta-analysis that in each system the same problems arise in a constant way, such that the measure of mean difference between groups then most accurately represents a valid unit, which varies by the intervention studied. The current study excluded papers which did not report LOS, resulting in exclusion of a large amount of good quality studies evaluating specific interventions. A further potential weakness is that many included studies were under-powered to identify changes in LOS, as it was often a secondary outcome. Interestingly, many studies had longer than average postoperative stays, possibly suggesting that investigators evaluating a new intervention exercised caution in discharging trial subjects or kept patients in hospital to capture data at specific timepoints. Japanese studies were found to have a significantly longer overall LOS than other countries, however the difference in LOS seen with each intervention should not have changed despite this finding. For example, regarding the care pathway intervention, despite the fact that patients involved in studies from Japan had longer overall LOS, there was still a significant reduction seen between those who were involved in a care pathway and those who were not. The available literature was heterogenous in terms of reporting of outcomes and interventions delivered. A further challenge is the potential publication bias where studies with negative results could be under-reported.

The findings of this paper can be used to improve outcomes associated with DCLC, but first it is necessary to establish which interventions are central to an effective day case pathway. This is difficult for a number of reasons. Firstly, the studies involving care pathways varied widely in their approach to elective surgery. A number of them specified admission prior to the day of surgery, retained patients for a number of days postoperatively, and referred to removal of routine drains. While the care pathway protocols may have reduced LOS, some of their elements or outcomes may have lost their relevance to contemporary surgery. The significant impact of care pathway implementation on shortening LOS in this meta-analysis may be attributed to the cumulative effect of multiple factors with smaller individual effects. For example, a number of factors are common to the studied care pathways including NSAID use, opiate minimisation, multimodal antiemetics, and combined skin and peritoneal anaesthesia. It remains unclear whether the interventions themselves lead to the benefit observed when a care pathway is implemented, or whether the improved team dynamics and multi-disciplinary collaboration characteristic of care pathway implementation is responsible. Additionally, some of the pathway components were poorly described. Three papers did not describe the pathway sufficiently to be able to replicate it. Lastly, none of the studies included were randomised, and all involved study of outcomes pre- and post-implementation of care pathways. Non-randomized designs are subject to many potential biases including the Hawthorne effect, recall bias and publication bias. Such potential biases could influence the effect on LOS from clinical pathways.

Evaluation of the studied care pathways provides some insight into the methods for introduction, but very little information on the barriers that exist to their implementation. Many health systems have defined care pathways for day case laparoscopic cholecystectomy, including guidance provided locally by the Irish National Clinical Programme for Surgery. In spite of the availability of such a care pathway, Irish day case rates continue to fall below expected targets of 60%. In addition, even among hospitals of similar characteristics, utilisation of day case laparoscopic cholecystectomy is widely variable, with rates of 0%–95.8% reported across Irish hospitals in 2019. It is clear that a defined care pathway is necessary but not sufficient to effect change in LOS; equal attention to factors relating to implementation is required. Attention to the context, planning and structures necessary for successful day case surgery implementation are also important but generally less emphasised by surgeons. Inclusion of implementation outcomes alongside intervention outcomes would greatly enhance the reproducibility

**Figure 3**

- **a** – Meta-analysis of mean length of stay for dedicated care pathway implementation for laparoscopic cholecystectomy versus standard care pathway implementation.
- **b** – Meta-analysis of day case rate for dedicated care pathway implementation for LC versus standard care pathway implementation.
- **c** – Meta-analysis of mean length of stay in patients who received preoperative non-steroidal anti-inflammatory drugs (NSAIDs) during laparoscopic cholecystectomy versus those who received no NSAIDs or a placebo.
- **d** – Subgroup analysis of mean length of stay for those who received COX2 inhibitors versus no COX2 inhibitors or placebo.
- **e** – Mean length of stay for preoperative dexamethasone versus no dexamethasone or placebo.
- **f** – Meta-analysis of mean length of stay for patients who received prophylactic antibiotics during laparoscopic cholecystectomy versus those who received no antibiotics.
of surgical literature. It is apparent that further research regarding care pathway components is unlikely to increase the effectiveness of care pathways. Rather, understanding methods of care pathway implementation is necessary to facilitate effective pathway use.

Implementing a care pathway which incorporates a range of perioperative interventions is more likely to lead to a significant reduction in LOS and increase in day case rate than any single intervention, although there has yet to be an RCT demonstrating this. Very few interventions in isolation have an effect on LOS after elective LC, and the effect size of such isolated interventions is small. Future studies should focus to a greater extent on the contextual and organisational factors associated with successful implementation of short-stay LC pathways instead of on the individual components of the care pathway.

Funding
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declarations of interest
None.

References
1. Beckingham I, & Royal College of surgeons of England. Association of Upper Gastrointestinal surgeons. (2016) Commissioning guide: gall-stone disease. London: Royal College of Surgeons of England.
2. Mortimore G, & NICE Internal Clinical Guidelines team. (2014) Gall-stone disease: diagnosis and management. Clinical guideline [CG 188]. Available from: https://www.nice.org.uk/guidance/cg188/chapter/1-Recommendations#managing-gallbladder-stones.
3. Ahmad NZ, Byrnes G, Naqvi SA. (2008) A meta-analysis of ambulatory versus inpatient laparoscopic cholecystectomy. Surg Endosc 22: 1928–1934. https://doi.org/10.1007/s00464-008-8687-2.
4. Tang H, Dong A, Yan L. (2015) Day surgery versus overnight stay laparoscopic cholecystectomy: a systematic review and meta-analysis. Dig Liver Dis 47:556–561. https://doi.org/10.1016/j.dld.2015.04.007.
5. van Dijk AH, de Reuver PR, Besselink MG, van Laarhoven KJ, Harrison EM, Wigmore SJ et al. (2017) Assessment of available evidence in the management of gallbladder and bile duct stones: a systematic review of international guidelines. HPB 19:297–309. https://doi.org/10.1016/j.jpnp.2016.12.011.
6. Uchiyama K, Takifuji K, Tani M, Onishi H, Yamaue H. (2002) Effectiveness of the clinical pathway to decrease length of stay and cost for laparoscopic surgery. Surg Endosc 16:1594–1597. https://doi.org/10.1007/s00464-002-9018-0.
7. Soria V, Pellicer E, Flores B, Carrasco M, Candel Maria F, Aguayo JL. (2005) Evaluation of the clinical pathway for laparoscopic cholecystectomy. Am Surg 71:40–45.
8. Yanagi K, Sasajima K, Miyamoto M, Suzuki S, Yokoyama T, Maruyama H et al. (2007) Evaluation of the clinical pathway for laparoscopic cholecystectomy and simulation of short-term hospitalization. J Nippon Med Sch 74:409–413. https://doi.org/10.1272/jnms.74.409.
9. Calland JF, Tanaka K, Foley E, Bobvijev VE, Markey DW, Blome S et al. (2001) Outpatient laparoscopic cholecystectomy: patient outcomes after implementation of a clinical pathway. Ann Surg 233:704–715. https://doi.org/10.1097/00000658-200105000-00015.
10. Sandberg WS, Canty T, Sokal SM, Daily B, Berger DL. (2006) Financial and operational impact of a direct-from-PACU discharge pathway for laparoscopic cholecystectomy patients. Surgery 140:372–378. https://doi.org/10.1016/j.surg.2006.02.007.
11. Greilisarmer T, Orion F, Deniral F, De Kerviler B, Jean MH, Dimet J et al. (2018) Increasing success in outpatient laparoscopic cholecystectomy by an optimal clinical pathway. ANZ J Surg. https://doi.org/10.1111/ans.14297.
12. Aslet M, Yates D, Wasawo S. (2019) Improving the day case rate for laparoscopic cholecystectomy via introduction of a dedicated clinical pathway. J Perioper Pract. https://doi.org/10.1177/1750458919862701.
13. Trevino CM, Katchko KM, Verhaalen AL, Bruce ML, Webb TP. (2016) Cost effectiveness of a fast-track protocol for urgent laparoscopic cholecystectomies and appendectomies. World J Surg 40:856–862. https://doi.org/10.1007/s00268-015-3266-3.
14. Topal B, Peeters G, Verbort A, Penninckx F. (2007) Outpatient laparo-

scopic cholecystectomy: clinical pathway implementation is efficient and cost effective and increases hospital bed capacity. Surg Endosc 21:1142–1146. https://doi.org/10.1007/s00464-006-9083-x.
15. Vaughan J, Gurusamy KS, Davidson BR. (2013) Day-surgery versus overnight stay surgery for laparoscopic cholecystectomy. Cochrane Database Syst Rev, Cd006798. https://doi.org/10.1002/14651858.CD006798.pub4.
16. Gurusamy K, Junnarkar S, Farouk M, Davidson BR. (2008) Meta-analysis of randomized controlled trials on the safety and effectiveness of day-case laparoscopic cholecystectomy. Br J Surg 95:161–168. https://doi.org/10.1002/bjs.6105.
17. Leeder PC, Matthews T, Krzeminska K, Dehn TC. (2004) Routine day-case laparoscopic cholecystectomy. Br J Surg 91:312–316. https://doi.org/10.1002/bjs.4409.
18. Rathore MA, Andribi SI, Mansha M, Brown MG. (2007) Day case laparoscopic cholecystectomy is safe and feasible: a case controlled study. Int J Surg 5:255–259. https://doi.org/10.1016/j.ijsu.2006.12.003.
19. El-Sharkawy AM, Tewari N, Vohra RS. (2019) The cholecystectomy as A day case (CAAD) score: a validated score of preoperative Predictors of successful day-case cholecystectomy using the CholeS data set. World J Surg 43:1928–1934. https://doi.org/10.1002/bjs.04981-5.
20. NHS. (2006) Delivering quality and value. Focus on: cholecystectomy. Available from: https://www.qualitasconsortium.com/index.cfm/reference-material/delivering-value-quality/focus-oncholecystectomy-commissionings-guide.
21. Bailey CR, Ahuja M, Bartholomew K, Bew S, Forbes L, Lipp A et al. (2019) Guidelines for day-case surgery 2019: guidelines from the association of anaesthetists and the British Association of Day Surgery. Anaesthesia 74:778–792. https://doi.org/10.1111/anae.14639.
22. Solodkyy A. (2017) Re-audit of ‘true day case’ laparoscopic cholecystectomy in a high-volume specialist unit in a district general hospital. Surg Endosc Int Tech 31:S326. https://doi.org/10.1007/s00464-017-5565-2.
23. Al-Dahtani HH, Alam MK, Asalamah S, Akeely M, Ibrar M. (2015) Day-case laparoscopic cholecystectomy. Saudi Med J 36:46–51. https://doi.org/10.15537/smj.2015.1.9738.
24. Ahn Y, Woods J, Connor S. (2011) A systematic review of interventions to facilitate ambulatory laparoscopic cholecystectomy. HPB 13: 677–686. https://doi.org/10.1111/j.1477-2574.2011.00371.x.
25. Moher D, Liberati A, Tetzlaff J, Altman DG. (2009) Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ* 339:b2535. https://doi.org/10.1136/bmj.b2535.

26. Hozo SP, Djulbegovic B, Hozo I. (2005) Estimating the mean and variance from the median, range, and the size of a sample. *BMJ Med Res Methodol* 5:13. https://doi.org/10.1186/1471-2288-5-13.

27. Kuo YH, Lee FK, Chin CC, Huang WS, Yeh CH, Wang JY. (2012) Does body mass index impact the number of LNs harvested and influence long-term survival rate in patients with stage III colon cancer? *Int J Colorectal Dis* 27:1625–1635. https://doi.org/10.1007/s00384-012-1496-5.

28. Higgins JP, Deeks JJ. (2011) Selecting studies and collecting data. *Cochrane Handbook for systematic reviews of interventions*. Cochrane Book Series, pp. 151–185.

29. Slim K, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J. (2003) Methodological index for non-randomized studies (minors): development and validation of a new instrument. *ANZ J Surg* 73:712–716. https://doi.org/10.1111/j.1445-2197.2003.02748.x.

30. Clark HD, Wells GA, Huet C, McAlister FA, Salmi LR, Ferguson D et al. (1999) Assessing the quality of randomized trials: reliability of the Jadad scale. *Control Clin Trials* 20:448–452. https://doi.org/10.1016/S0197-2456(99)00026-4.

31. Müller MK, Dedes KJ, Dindo D, Steiner S, Hahnloser D, Clavien P-A. (2009) Impact of clinical pathways in surgery. *Langenbecks Arch Surg* 394:31–39.

32. Graham L, Neal CP, Garcea G, Lloyd DM, Robertson GS, Sutton CD. (2012) Evaluation of nurse-led discharge following laparoscopic surgery. *J Eval Clin Pract* 18:19–24. https://doi.org/10.1111/j.1365-2753.2010.01510.x.

33. Hausel J, Nygren J, Thorell A, Lagerkranser M, Ljungqvist O. (2005) Randomized clinical trial of the effects of oral preoperative carbohydrates on postoperative nausea and vomiting after laparoscopic cholecystectomy. *Br J Surg* 92:415–421. https://doi.org/10.1002/bjs.4901.

34. Faria MS, de Aguilar-Nascimento JE, Pimenta OS, Alvarena LC, Jr, Dock-Nascimento DB, Stihessarenko N. (2009) Preoperative fasting of 2 hours minimizes insulin resistance and organic response to trauma after video-cholecystectomy; a randomized, controlled, clinical trial. *World J Surg* 33:1158–1164. https://doi.org/10.1007/s00268-009-0010-x.

35. Pedziwiatr M, Pisarska M, Matlok M, Major P, Ksielewski M, Wierdak M et al. (2015) Randomized clinical trial to compare the effects of preoperative oral carbohydrate loading versus placebo on insulin resistance and cortisol level after laparoscopic cholecystectomy. *Pol Przegl Chir* 87:402–408. https://doi.org/10.1515/pjc-2015-0079.

36. Lee JS, Song Y, Kim JY, Park JS, Yoon DS. (2018) Effects of preoperative oral carbohydrates on quality of recovery in laparoscopic cholecystectomy: a randomized, double blind, placebo-controlled trial. *World J Surg* 42:3150–3157. https://doi.org/10.1007/s00268-018-4717-4.

37. de Andrade Gagheggi Ravanini G, Portari Filho PE, Abrantes Luna R, Almeida de Oliveira V. (2015) Organic inflammatory response to reduced preoperative fasting time, with a carbohydrate and protein enriched solution: a randomized trial. *Nutr Hosp* 32:953-7. https://doi.org/10.3305/nh.2015.32.2.8944.

38. Dock-Nascimento DB, de Aguilar-Nascimento JE, Magalhaes Faria MS, Caporossi C, Stihessarenko N, Waltzberg DL. (2012) Evaluation of the effects of a preoperative 2-hour fast with maltodextrine and glutamine on insulin resistance, acute-phase response, nitrogen balance, and serum glutathione after laparoscopic cholecystectomy: a controlled randomized trial. *JPN* 36:43–52. https://doi.org/10.1177/014860711422719.

39. Bisgaard T, Kristiansen VB, Hjortso NC, Jacobsen LS, Rosenberg J, Kehlet H. (2004) Randomized clinical trial comparing an oral carbohydrate beverage with placebo before laparoscopic cholecystectomy. *Br J Surg* 91:151–158. https://doi.org/10.1002/bjs.4412.

40. Wallace DH, Serpell MG, Baxter JN, O’Dwyer PJ. (1997) Randomized trial of different insufflation pressures for laparoscopic cholecystec- tomy. *Br J Surg* 84:455–458.

41. Sarli L, Costi R, Sansebastiano G, Trivelli M, Roncoroni L. (2000) Prospective randomized trial of low-pressure pneumoperitoneum for reduction of shoulder-tip pain following laparoscopy. *Br J Surg* 87:1161–1165. https://doi.org/10.1046/j.1365-2168.2000.01507.x.

42. Barczynski M, Herman RM. (2003) A prospective randomized trial on comparison of low-pressure (LP) and standard-pressure (SP) pneumoperitoneum for laparoscopic cholecystectomy. *Surg Endosc* 17:533–538. https://doi.org/10.1007/s00464-002-9121-2.

43. Esmat ME, Elsebaee MM, Nasr MM, Elsebaie SB. (2006) Combined low pressure pneumoperitoneum and intraperitoneal infusion of normal saline for reducing shoulder tip pain following laparoscopic cholecystectomy. *World J Surg* 30:1969–1973. https://doi.org/10.1007/s00268-005-0752-z.

44. Sandhu T, Yamada S, Ariyakachon V, Chakrabandhu T, Chongruskit W, Ko-iam W. (2009) Low-pressure pneumoperitoneum versus standard pneumoperitoneum in laparoscopic cholecystectomy, a prospective randomized clinical trial. *Surg Endosc* 23:1044–1047. https://doi.org/10.1007/s00464-008-0119-2.

45. Joshipura VP, Haribhatki SP, Patel NR, Naik RP, Soni HN, Patel B et al. (2009) A prospective randomized, controlled study comparing low pressure versus high pressure pneumoperitoneum during laparoscopic cholecystectomy. *Surg Laparosc Endosc Percutan Tech* 19:234–240. https://doi.org/10.1097/SLA.0b013e3181a97012.

46. Michaloliakou C, Chung F, Sharma S. (1996) Preoperative multimodal analgesia facilitates recovery after ambulatory laparoscopic cholecystectomy. *Anesth Analg* 82:44–51. https://doi.org/10.1213/00000539-199601000-00009.

47. Schuster R, Stewart D, Schuster L, Greaney G, Waxman K. (2005) Preoperative oral rofecoxib and postoperative pain in patients after laparoscopic cholecystectomy: a prospective, randomized, double-blinded, placebo-controlled trial. *Am Surg* 71:827–829.

48. Newcomb W, Lincourt A, Hope W, Schmelzer T, Sing R, Kercher K et al. (2007) Prospective, double-blinded, randomized, placebo-controlled comparison of local anesthetic and nonsteroidal anti-inflammatory drugs for postoperative pain management after laparo-scopic surgery. *Am Surg* 73:618–624. discussion 24–5.

49. Sandhu T, Paiboonworachat S, Ko-iam W. (2011) Effects of preemptive analgesia in laparoscopic cholecystectomy: a double-blind randomized controlled trial. *Surg Endosc* 25:23–27. https://doi.org/10.1007/s00464-010-1122-y.

50. Shuying L, Xiao W, Peng L, Tao Z, Ziyong L, Liang Z. (2014) Preoperative intravenous parecoxib reduces length of stay on ambulatory laparoscopic cholecystectomy. *Int J Surg* 12:464–468. https://doi.org/10.1016/j.ijsu.2014.03.013.

51. Ekinci M, Ciftci B, Celik EC, Kose EA, Karakaya MA, Ozdenkaya Y. (2019) A randomized, placebo-controlled, double-blind study that
evaluates efficacy of intravenous ibuprofen and acetaminophen for postoperative pain treatment following laparoscopic cholecystectomy surgery. J Gastrointest Surg. https://doi.org/10.1007/s11605-019-04220-1.

52. Coloma M, White PF, Markowitz SD, Whitten CW, Macaluso AR, Bernsford SB et al. (2002) Dexamethasone in combination with dolasetron for prophylaxis in the ambulatory setting: effect on outcome after laparoscopic cholecystectomy. Anesthesiology 96:1346–1350. https://doi.org/10.1097/00000542-200206000-00013.

53. Bisgaard T, Klarskov B, Kehlet H, Rosenberg J. (2003) Preoperative dexamethasone improves surgical outcome after laparoscopic cholecystectomy: a randomized double-blind placebo-controlled trial. Br J Surg 90:295–299. https://doi.org/10.1002/bjs.5252.

54. Sanchez-Rodriguez PE, Fuentes-Orozco C, Gonzalez-Ojeda A. (2010) Effect of dexamethasone on postoperative symptoms in patients undergoing elective laparoscopic cholecystectomy: randomized clinical trial. World J Surg 34:895–900. https://doi.org/10.1007/s00268-010-0457-9.

55. Murphy GS, Szokol JW, Greenberg SB, Avram MJ, Vender JS, Feo CV, Sortini D, Ragazzi R, De Palma M, Liboni A. (2006) Ranitidine and dexamethasone improves recovery after laparoscopic cholecystectomy. JSLS 10:639–643. https://doi.org/10.1371/journal.pone.0106702.

56. Viriyaraj V, Boonsinsukh T, Rookkachart T, Yigsakmongkol N. (2015) The effects of single-dose preoperative intravenous dexamethasone on clinical outcome after laparoscopic cholecystectomy. J Med Assoc Thai 98(Suppl. 10):S112–S117.

57. Bianchini A, Marchi C, Caminiti A. (2007) Postoperative dexamethasone reduces postoperative nausea and vomiting after laparoscopic cholecystectomy: a large-scale, multicenter, randomized, double-blind study. J Med Assoc Thai 90:346–352.

58. Ruiz de Adana J, Tobalina Boris R, Garcia Galan F, Hernandez Matias A, Fernandez Luengas D, Ortega Debalion P et al. (1999) Antimetabolic efficacy of ondansetron in laparoscopic cholecystectomy. A randomized, double-blind, placebo-controlled study. Rev Esp Enferm DIG 91:639–643.

59. Elhakim M, Nafie M, Mahmoud K, Atef A. (2002) Dexamethasone 8 mg in combination with ondansetron 4 mg appears to be the optimal dose for the prevention of nausea and vomiting after laparoscopic cholecystectomy. Can J Anaesth 49:922–926. https://doi.org/10.1007/bf03016875.

60. Takemoto T, Hata T, Ohno M, Tanaka T, Hirohata T, Iseki K et al. (2003) Prophylactic dexamethasone reduces postoperative nausea and vomiting after laparoscopic cholecystectomy: a randomized, double-blind placebo-controlled trial. J Gastrointest Surg 7:229–235. https://doi.org/10.1016/j.giss.2003.02.005.

61. Coloma M, White PF, Markowitz SD, Whitten CW, Macaluso AR, Bernsford SB et al. (2002) Dexamethasone in combination with dolasetron for prophylaxis in the ambulatory setting: effect on outcome after laparoscopic cholecystectomy. Anesthesiology 96:1346–1350. https://doi.org/10.1097/00000542-200206000-00013.

62. Liberman MA, Howe S, Lane M. (2000) Ondansetron versus placebo for prophylaxis of nausea and vomiting in patients undergoing ambulatory laparoscopic cholecystectomy. Am J Surg 179:80–82. https://doi.org/10.1016/s0002-9610(99)00251-2.

63. Elhakim M, Nafie M, Mahmoud K, Atef A. (2002) Dexamethasone 8 mg in combination with ondansetron 4 mg appears to be the optimal dose for the prevention of nausea and vomiting after laparoscopic cholecystectomy. Can J Anaesth 49:922–926. https://doi.org/10.1007/bf03016875.

64. Kim HJ, Kang SH, Roh YH, Kim MC, Kim KW. (2017) Are prophylactic antibiotics necessary in elective laparoscopic cholecystectomy, regardless of patient risk? Ann Surg Treat Res 93:76–81. https://doi.org/10.4174/014701.2017.93.2.76.

65. Pavlidis TE, Atmatzidis KS, Papaziogas BT, Makris JG, Lazanidis CN, Papaziogas TB. (2003) The effect of preincisional periporal infiltration...
with ropivacaine in pain relief after laparoscopic procedures: a prospective, randomized controlled trial. JSLS 7:305–310.

79. Liu YY, Yeh CN, Lee HL, Wang SY, Tsai CY, Lin CC et al. (2009) Local anesthesia with ropivacaine for patients undergoing laparoscopic cholecystectomy. World J Gastroenterol 15:2376–2380. https://doi.org/10.3748/wjg.v15.i23.2376.

80. Lin S, Hua J, Xu B, Yang T, He Z, Xu C et al. (2015) Comparison of bupivacaine and paracetamol for postoperative pain relief after laparoscopic cholecystectomy: a randomized controlled trial. Int J Clin Exp Med 8:13824–13829.

81. Cha SM, Kang H, Baek CW, Jung YH, Koo GH, Kim BG et al. (2012) Peritrocaral and intraperitoneal ropivacaine for laparoscopic cholecystectomy: a prospective, randomized, double-blind controlled trial. J Surg Res 175:251–258. https://doi.org/10.1016/j.sas.2011.04.033.

82. Scheinin B, Kellokumpu I, Lindgren L, Haglund C, Rosenberg PH. (1995) Effect of intraperitoneal bupivacaine on pain after laparoscopic cholecystectomy. Acta Anaesthesiol Scand 39:195–198. https://doi.org/10.1111/j.1399-6576.1995.tb04042.x.

83. Szem JW, Hydo L, Barie PS. (1996) A double-blinded evaluation of intraperitoneal bupivacaine vs saline for the reduction of postoperative pain and nausea after laparoscopic cholecystectomy. Surg Endosc 10: 44–48. https://doi.org/10.1007/s004649910011.

84. Ahmed BH, Ahmed A, Tan D, Awad ZT, Al-Aali AY, Kilkenny J, 3rd et al. (2008) Post-laparoscopic cholecystectomy pain: effects of intraperitoneal local anesthetics on pain control – a randomized prospective double-blind placebo-controlled trial. Am Surg 74:201–209.

85. Zimmer PW, McCann MJ, O’Brien MM. (2010) Bupivacaine use in the Insuflow device during laparoscopic cholecystectomy: results of a prospective randomized double-blind controlled trial. Surg Endosc 24: 1524–1527. https://doi.org/10.1007/s00464-009-0804-9.

86. Ingelmo PM, Buciero M, Somaini M, Sahillioglu E, Garbagnati A, Charton A et al. (2013) Intraperitoneal nebulization of ropivacaine for pain control after laparoscopic cholecystectomy: a double-blind, randomized, placebo-controlled trial. Br J Anaesth 110:800–806. https://doi.org/10.1093/bja/aes495.

87. Niknam F, Saxena A, Niles N, Budak UU, Mekiscic A. (2014) Does irrigation of the subdiaphragmatic region with ropivacaine reduce the incidence of right shoulder tip pain after laparoscopic cholecystectomy? A prospective randomized, double-blind, controlled study. Am Surg 80:E17–E18.

88. Ahmad A, Faridi S, Siddiqui F, Edhi MM, Khan M. (2015) Effect of bupivacaine soaked gauze in postoperative pain relief in laparoscopic cholecystectomy: a prospective observational controlled trial in 120 patients. Patient Saf Surg 9:31. https://doi.org/10.1186/s13037-015-0077-2.

89. Chundiragar T, Hedges AR, Morris R, Stamatakis JD. (1993) Intraperitoneal bupivacaine for effective pain relief after laparoscopic cholecystectomy. Ann R Coll Surg Engl 75:437–439.

90. Paulson J, Mellinger J, Baguley W. (2003) The use of intraperitoneal bupivacaine to decrease the length of stay in elective laparoscopic cholecystectomy patients. Am Surg 69:275–278. discussion 8–9.

91. Roberts KJ, Gilmour J, Pande R, Nightingale P, Tan LC, Khan S. (2011) Efficacy of intraperitoneal analgesic techniques during laparoscopic cholecystectomy. Surg Endosc 25:3698–3705. https://doi.org/10.1007/s00464-011-1757-3.

92. Abet E, Orion F, Denimal F, Braun-Weber AG, de Kerviler B, Jean MH et al. (2017) Interest of using ropivacaine for outpatient laparoscopic cholecystectomy: prospective randomized trial. World J Surg 41: 687–692. https://doi.org/10.1007/s00268-016-3797-2.

93. Tsimoyniannis EC, Glantzounis G, Lekkas ET, Siakas P, Jabarin M, Tzourou H. (1998) Intraperitoneal normal saline and bupivacaine infusion for reduction of postoperative pain after laparoscopic cholecystectomy. Surg Laparosc Endosc 8:416–420.

94. Hilvering B, Draaisma WA, van der Bilt JD, Valk RM, Kofman KE, Consten EC. (2011) Randomized clinical trial of combined preincisional infiltration and intraperitoneal instillation of levobupivacaine for post-operative pain after laparoscopic cholecystectomy. Br J Surg 98: 784–789. https://doi.org/10.1002/bjs.7435.

95. Yeh CN, Tsai CY, Cheng CT, Wang SY, Liu YY, Chiang KC et al. (2014) Pain relief from combined wound and intraperitoneal local anesthesia for patients who undergo laparoscopic cholecystectomy. BMC Surg 14:28. https://doi.org/10.1186/1471-2482-14-28.

96. Protić M, Veljkovic R, Bilchik AJ, Popovic A, Kresoja M, Hassan A et al. (2017) Prospective randomized controlled trial comparing standard analgesia with combined intra-operative cystic plate and port-site local anesthesia for post-operative pain management in elective laparoscopic cholecystectomy. Surg Endosc 31:704–713. https://doi.org/10.1007/s00464-016-5024-5.

97. Tihan D, Totoz T, Tokocin M, Ercan G, Koc Calikoglu T, Vartanoglu T et al. (2016) Efficacy of laparoscopic transversus abdominis plane block for elective laparoscopic cholecystectomy in elderly patients. Bosn J Basic Med Sci 16:139–144. https://doi.org/10.17305/bjbsm.2016.841.

98. Siriwardana RC, Kumarage SK, Gunathilake BM, Thilakarathne SB, Wijesinghe JS. (2019) Local infiltration versus laparoscopic-guided transverse abdominis plane block in laparoscopic cholecystectomy: double-blind randomized control trial. Surg Endosc 33:179–183. https://doi.org/10.1007/s00464-018-6291-0.

99. Elamin G, Waters PS, Hamid H, O’Keefe HM, Waldron RM, Duggan M et al. (2015) Efficacy of a laparoscopically delivered transversus abdominis plane block technique during elective laparoscopic cholecystectomy: a prospective, double-blind randomized trial. J Am Coll Surg 221:335–344. https://doi.org/10.1016/j.jamcollsurg.2015.03.030.

100. Nomidee J, Salvador J, Piqueras R, Escrig J, Garcia R. (1997) The systematic use of drainage in laparoscopic cholecystectomy. A prospective study, Cir Esp 61:254–257.

101. Mrozowicz A, Rucinski P, Polkowski W. (2006) Routine drainage of the subhepatic area after laparoscopic cholecystectomy: prospective, controlled study with random patient selection. Pol Przegl Chir 78: 597–609.

102. Uchiyama K, Tani M, Kawai M, Terasawa H, Hama T, Yamaue H. (2007) Clinical significance of drainage tube insertion in laparoscopic cholecystectomy: a prospective randomized controlled trial. J Hepatobiliary Pancreat Surg 14:551–556. https://doi.org/10.1007/s00534-007-1221-x.

103. Tzovaras G, Liakou P, Fafoulakis B, Baloyiannis I, Zacharoulis D, Hatzitheofilou C. (2009) Is there a role for drain use in elective laparoscopic cholecystectomy? A controlled randomized trial. Am J Surg 197:759–763. https://doi.org/10.1016/j.amjsurg.2008.05.011.

104. Ishikawa K, Matsumata T, Kishihara F, Fukuyama Y, Masuda H, Kitano S. (2011) Laparoscopic cholecystectomy with and without abdominal prophylactic drainage. Dig Endosc 23:153–156. https://doi.org/10.1111/j.1443-1661.2010.01068.x.
105. Picchio M, De Angelis F, Zazza S, Di Filippo A, Mancini R, Pattaro G et al. (2012) Drain after elective laparoscopic cholecystectomy: A randomized multicentre controlled trial. Surg Endosc 26:2817–2822. https://doi.org/10.1007/s00464-012-2252-1.

106. Gurer A, Dumlu EG, Dikili E, Kiyak G, Ozlem N. (2013) Is a drain required after laparoscopic cholecystectomy? Asian J Med 45: 181–184. https://doi.org/10.5152/ajm.2013.37.

107. Sharma A, Mittal S. (2016) Role of routine subhepatic abdominal drain placement following uncomplicated laparoscopic cholecystectomy: a prospective randomised study. J Clin Diagn Res 10:Pc03–Pc05. https://doi.org/10.7860/jcdr/2016/21142.8983.

108. Georgiou C, Demetriou T, Pallaris T, Theodosopoulos T, Katsouyanni K, Polymenes G. (2011) Is the routine use of drainage after elective laparoscopic cholecystectomy justified? A randomized trial. J Laparoendosc Adv Surg Tech A 21(2):119–123. https://doi.org/10.1089/lap.2010.0003.

109. Sharma A, Gupta SN. (2016) Drainage versus no drainage after elective laparoscopic cholecystectomy. Kathmandu Univ Med J 14:69–72.

110. Subirana Magdaleno H, Caro Tarrago A, Olona Casas C, Diaz Padillo A, Franco Chacon M, Vadillo Bargallo J et al. (2018) Evaluation of the impact of preoperative education in ambulatory laparoscopic cholecystectomy: A prospective, double-blind randomized trial. Cir Esp 96:88–95. https://doi.org/10.1016/j.ciresp.2017.10.002.

111. Blay N, Donoghue J. (2005) The effect of pre-admission education on domiciliary recovery following laparoscopic cholecystectomy. Aust J Adv Nurs 22:14–19.

112. de Aguilar-Nascimento JE, Leal FS, Dantas DC, Anabuki NT, de Souza AM, Silva ELVP et al. (2014) Preoperative education in cholecystectomy in the context of a multimodal protocol of perioperative care: a randomized, controlled trial. World J Surg 38:357–362. https://doi.org/10.1007/s00268-013-2255-7.

113. Holte K, Klasrskov B, Christensen DS, Lund C, Nielsen KG, Bie P et al. (2004) Liberal versus restrictive fluid administration to improve recovery after laparoscopic cholecystectomy: a randomized, double-blind study. Ann Surg 240:892–899. https://doi.org/10.1097/01.sla.0000143269.96649.3b.

114. Yao L, Wang Y, Du B, Song J, Ji F. (2017) Comparison of post-operative pain and residual gas between restrictive and liberal fluid therapy in patients undergoing laparoscopic cholecystectomy. Surg Laparosc Endosc Percutan Tech 27:346–350. https://doi.org/10.1097/sle.0000000000000463.

115. Belaviv M, Sotosek Tokmadzic V, Brozovic Krijan A, Kvatemark I, Matijas K, Strikic N et al. (2018) A restrictive dose of crystalloids in patients during laparoscopic cholecystectomy is safe and cost-effective: prospective, two-arm parallel, randomized controlled trial. Ther Clin Risk Manag 14:741–751. https://doi.org/10.2147/tcrm.S160778.

116. Bonventre S, Inviati A, Di Paola V, Morreale P, Di Giovanni S, Di Carlo P et al. (2014) Evaluating the efficacy of current treatments for reducing postoperative ileus: a randomized clinical trial in a single center. Minerva Chir 69:47–55.

117. Caliskan N, Bulut H, Konan A. (2016) The effect of warm water intake on bowel movements in the early postoperative stage of patients having undergone laparoscopic cholecystectomy: a randomized controlled trial. Gastroenterol Nurs 39:340–347. https://doi.org/10.1097/sga.0000000000000181.

118. Farley DR, Greenlee SM, Larson DR, Harrington JR. (2004) Double-blind, prospective, randomized study of warmed, humidified carbon dioxide insufflation vs standard carbon dioxide for patients undergoing laparoscopic cholecystectomy. Arch Surg 139:739–743. https://doi.org/10.1001/archsurg.139.7.739. discussion 43-4.

119. Mouton WG, Bessell JR, Millard SH, Baxter PS, Maddern GJ. (1999) A randomized controlled trial assessing the benefit of humidified insufflation gas during laparoscopic surgery. Surg Endosc 13: 106–108. https://doi.org/10.1007/s004649900915.

120. Wang L, Baser O, Wells P, Peacock WF, Coleman CI, Ferrmann GJ et al. (2017) Benefit of early discharge among patients with low-risk pulmonary embolism. PLoS One 12. https://doi.org/10.1371/journal.pone.0185022. e0185022-e.

121. Appleby J. (2015) Day case surgery: a good news story for the NHS. BMJ 351:h4060. https://doi.org/10.1136/bmj.h4060.

122. Solodkyy A, Hakeem AR, Oswald N, Di Franco F, Gergely S, Harris AM. (2018) ‘True Day Case’ laparoscopic cholecystectomy in a high-volume specialist unit and review of factors contributing to unexpected overnight stay. Minim Invasive Surg 2018:1260358. https://doi.org/10.1155/2018/1260358.

123. Smith I, Cooke T, Jackson I, Fitzpatrick R. (2006) Rising to the challenges of achieving day surgery targets. Anaesthesia 61:1191–1199.

124. NCPS. (2014) National clinical programme in surgery: care pathway for the management of day case laparoscopic cholecystectomy. Royal College of Surgeons in Ireland. Available from: https://www.rcsi.com/the-management-of-day-case-laparoscopic-cholecystectomy.pdf.

125. Health service executive: management data report [Internet] Health Serv Exec, (September 2019). Available from: https://www.hse.ie/eng/services/Publications/performanceraports/september-management-data-report.pdf.

126. Kehlet H. (2018) ERAS implementation-time to move forward. Ann Surg 267:998–999. https://doi.org/10.1097/sla.0000000000002720.

127. Hu QL, Liu JY, Hobson DB, Cohen ME, Hall BL, Wick EC et al. (2019) Best practices in data use for achieving successful implementation of enhanced recovery pathway. J Am Coll Surg 229. https://doi.org/10.1016/j.amjsurg.2019.08.1446, 626–632.e1.

Appendix A. Supplementary data
Supplementary data to this article can be found online at https://doi.org/10.1016/j.hpb.2020.08.012.