Are chest drains routinely required after thoracic surgery? A drainology study of on-table chest-drain removals

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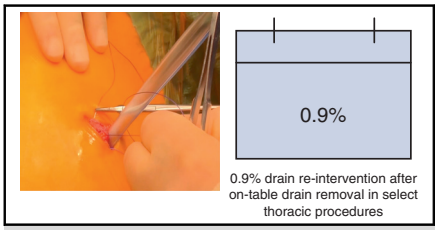
ABSTRACT

Objectives: Advances in perioperative management for thoracic surgery have accelerated the postoperative recovery of patients by decreasing postoperative pain and the incidence of complications. We aimed to study whether it's safe to remove chest drains on table in selected cases.

Methods: This was a 5-year retrospective analysis of protocolized chest-drain removal on the operating table. The chest drain was removed in patients undergoing sublobar/wedge lung resection and other minor thoracic procedure (pleural biopsy, mediastinal mass biopsy/resection) via a thoracoscopic approach (video-assisted thoracoscopic surgery). Chest drains were removed at the end of the operation if air leak as documented by the digital drain was less than 20 mL/min. Outcome data on postdrain removal pneumothorax, effusion, and need for further intervention were obtained by reviewing the postoperative chest films, all reported by a radiologist.

Results: Between 2016 and 2021, 107 patients underwent drain removal in theater. Mean age (standard deviation) was 58 (17) years and 54 (50.5%) were male. Postdrain removal pneumothorax occurred in 22 patients (21%), pleural effusion in 6 (5.6%), and 21 of 22 postoperative pneumothoraces were managed conservatively without reinsertion of chest drain. As it is our standard policy to leave no pneumothorax in patients undergoing surgical management of primary spontaneous pneumothorax, only 1 such patient (0.9%) had a drain reinserted as a result. The median (interquartile) length of hospital stay was 1 day (1-2), and 14 patients (13%) were discharged on surgery day.

Conclusions: Our results demonstrate that on table chest-drain removal in selected cases is safe and repeatable using a digital drain, challenging the practice of routine drain insertion after thoracic surgery. (JTCVS Open 2023;16:960-4)



Key outcome for on-table chest drain removal.

CENTRAL MESSAGE

On-table chest drain removal in selected cases is safe and repeatable using a digital drain, challenging the practice of routine drain insertion after thoracic surgery.

PERSPECTIVE

Optimal postoperative chest-drain management is key in thoracic surgery to enhance patient recovery and reduce length of hospital stay. We studied on-table drain removal in 107 patients who underwent wedge resections and minor thoracic procedures. With a good safety profile and minimal need for chest drain reintervention, we present chest drains are not routinely required in select thoracic cases.

The field of thoracic surgery has made significant progress in perioperative care, reducing the time needed to recover from surgery. Advances have been led by improvements in surgical techniques, such as minimal access surgery, surgeon-led regional analgesia, and the increasing adoption of "enhanced" recovery recommendations.[1]

The use of video-assisted thoracoscopic surgery (VATS) has been identified as an independent factor to reduce length of hospital stay (due to the association with less pain and reduced complications) compared with open surgery,[2] and although this was identified in lobectomy for cancer cases,

Video clip is available online.

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Abbreviations and Acronyms
IQR = interquartile range
VATS = video-assisted thoracoscopic surgery

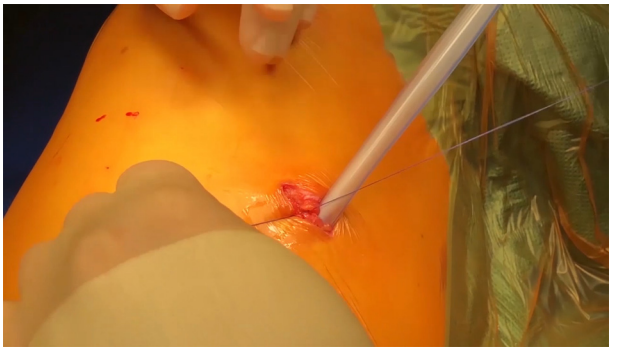
the advantages can be transferable to other thoracic procedures using minimally invasive approaches. We previously demonstrated that other aspects of perioperative and postoperative care, such as chest-drain management, have a very strong influence on length of hospital stay and patient recovery.[3]

Ideal chest-drain management involves optimizing the timing and removal of drains to balance shortest-possible drain duration within the bounds of the highest levels of safety. We presented advances in drain management through digital drains and the sole use of air-leak criteria (without fluid output) as a safe determinant for timing of postoperative drain removal (when air leak is less than 20 mL/h for greater than 6 hours) and safely remove the majority of drains in our practice the day after surgery.[3] Our work showed that air leak as the sole criterion of drain removal reduced length of hospital stay without increasing postdrain removal complications (pneumothorax or pleural effusion); thus, since 2012 in our institution, digital drainage using air leak only is our protocol for postoperative drain removal. The logical next step in our perioperative management progress is to challenge the need for routine use of chest drains in patients undergoing low-risk procedures (for air leak or fluid losses). In this work, we present our technique and results of intraoperative (on-table) drain removal to optimize patient recovery and further our efforts toward day-case thoracic surgery.

METHODS

We conducted a retrospective study on patients undergoing thoracic surgical procedures with on-table chest drain removals under a single surgeon at the Royal Brompton Hospital, London, United Kingdom, between August 2016 and April 2021. The study was conducted in accordance with the Declaration of Helsinki. The study was approved by the Royal Brompton Institutional Board of Quality and Safety Department (institutional review board number 004550) on May 27, 2021, and individual consent for this retrospective analysis was waived. Electronic patient records were used to record baseline demographics, including age, sex, and length of hospital stay. All postoperative chest films and formal radiology reports were reviewed to document presence and size of pneumothorax (measured from apex to cupola dome of the thoracic cavity) or pleural effusion (measured from apex of contralateral diaphragm to fluid level) and reinsertion of chest drains.

Single-port VATS was the standard approach for our cases, and we included all pleural procedures (including surgery for pneumothorax, effusion, and empyema), mediastinal procedures, pericardial procedures, and wedge resection of the lung. After careful hemostasis, a 24-F chest drain was inserted, the lung inflated, and connected to a digital drain (Thopaz; Medela) to give objective measurements of air leak after evacuation of air within the hemithorax at a pressure of –2.0 kPa, and the rate of stabilized air leak was less than 20 mL/min, the chest drain was removed, and the incision closed (Video 1).



VIDEO 1. Method of on-table drain removal. Video available at: https://www.jtcvs.org/article/S2666-2736(23)00123-7/fulltext.

Postoperatively, all patients would have a chest film once stabilized after arrival to the recovery unit. All subsequent chest films were reviewed during the hospital stay and any pneumothorax or pleural effusion was recorded and measured, as was any need for reintervention (chest drain reinsertion).

Statistical Analysis

Baseline characteristics were presented as mean and standard deviation or median and interquartile range (IQR) for normally and non-normally distributed data, respectively. Frequency data were presented with numbers and proportions. Statistical analysis was performed using Stata 16 (Stata Corp).

RESULTS

During the 5-year period between 2016 and 2021, we operated on 617 patients, of whom 107 (17%) had chest drains removed on-table. Of these 107 patients, the mean age (standard deviation) was 58 (17) years, and 54 (50.5%) were male. The predominant procedures were pulmonary wedge resection, n = 58 (54%) and pleurodesis (all for pneumothorax, n = 23), (22%) (Table 1).

Median (IQR) duration of length of stay in hospital was 1 (1-2) day, of which 14 (13%) patients were discharged on the same day of surgery. Postdrain removal pneumothorax was observed in 22 (21%) patients, with a median size measured from the apex of the lung to the top of the chest of 15 (11-27) mm, and postdrain removal effusion was observed in 6 (5.6%) patients, with a median size measured from apex of contralateral diaphragm to the fluid line of 20 (16-24) mm (Table 2). Reintervention measured by chest-drain reinsertion was required in 1 patient (0.9%) (Figure 1) after pleurodesis for pneumothorax (as we do not accept any level of air for this procedure). With regards to the 21 patients with pneumothoraces who did not require chest-drain reinsertion, patients underwent follow-up chest films both as an inpatient and in the follow-up clinic. All patients demonstrated a decrease in size and resolution of pneumothorax on films, or stable appearances in the small apical pneumothoraces. The median (IQR) size of

TABLE 1. Baseline demographics

Variable	Mean (SD) or number (%)
Mean age, y (SD)	58 (17)
Male, n (%)	54 (50.5%)
Procedure, n (%)	
Wedge resection	58 (54%)
Pleurodesis	23 (22%)
Mediastinal surgery	16 (15%)
Other	10 (9%)

Other includes thymectomy, lymph node biopsy and pericardial surgery. *SD*, Standard deviation.

pneumothorax in these patients was 14 (10-24) mm, and median (IQR) number of repeat chest films required to monitor the pneumothoraces was 2 (2-2), of which the median (IQR) number of repeat films required as an inpatient was 1 (1-1.75). Most of these patients stayed overnight in hospital, with the median (IQR) length of hospital stay 1 (1-1.75) day.

With regards to the 23 patients whose primary procedure was for pleurodesis, 3 demonstrated postdrain removal pleural effusion, 5 with postdrain removal pneumothorax, and only 1 required drain reinsertion as described. The median (IQR) size of pneumothorax in these patients was 16 (14-19) mm. All 3 patients with pleural effusion had repeat chest films in outpatient clinic, 2 of whom showed stable/resolving appearances of effusion, with 1 patient with malignant pleural effusion demonstrating reaccumulation, nonamenable to drainage and asymptomatic.

Postoperatively, patients were asked to rate their pain at rest on a scale from 0 to 10. The median (IQR) postoperative pain score, in those that were documented (n = 88), was 0 (0-4).

DISCUSSION

The results of our study suggest that the practice of on-table removal of chest drains is safe for selected patients undergoing thoracic surgery and challenges the need for routine chest drain usage. Digital drain usage has already enhanced patient recovery—using air leak as a sole criterion for safe drain removal,[3] allowing earlier patient mobilization with reduced pain[4] and ultimately facilitating earlier chest-drain removal and reduced length of stay.[5] Further optimization would be selection of cases for which chest drains are not required postoperatively, paving the way toward day-case thoracic surgery.

TABLE 2. Outcomes of on-table chest-drain removals

Outcomes	Result
Sample size, n	107
Median length of stay, d (IQR)	1 (1-2)
Postdrain pneumothorax, n (%)	22 (21%)
Median size, mm [IQR]	15.0 [11.1-27.4]
Postdrain pleural effusion, n (%)	6 (5.6%)
Median size, mm [IQR]	20.4 [16.3-23.9]
Reintervention, n (%)	1 (0.9%)

IQR, Interquartile range.

Although previous studies have compared chest drain use with the control of no drain insertion, there is limited presentation of intraoperative chest-drain removal in the literature. El-Badry and colleagues[6] studied a series of 29 patients showing improved patient pain scores and similar incidences of pneumothoraces between patients undergoing intraoperative chest drain removal and control patients with chest drains. Satherley and colleagues[7] also showed reduced length of stay in patients selected for VATS lung biopsy who did not have chest drains inserted compared with those who did. Both studies used visual assessment of air leak using underwater air bubbling. It can be argued that digital drains are not required to make removal decisions, as "tubeless" thoracic surgery has already been advocated by surgeons in China[8]; however, protocols advocate on-table drain removal using a bowl of water without any robust means for documentation in case of error. The focus of our practice is how this can be done safely, reliably, repeatably with a documented method that can be auditable (clinical governance focus), and this was achieved using the benefit of digital drains—a more objective measurement, with reduced interobserver variability,[9,10] which is more user-friendly.[11] We have subsequently formed a protocol of intraoperative air leak less than 20 mL/h as the criteria for safe on-table drain removal.

Our results show selected VATS thoracic surgical cases—primarily wedge resection, pleurodesis, and other minor thoracic procedures—allow for safe intraoperative chest drain removal following immediate digital drainage monitoring, demonstrating a postoperative recovery of short length of hospital stay, with an average duration of 1 postoperative day. Our protocol for on-table drain removal governance reflects a good safety profile, with incidence of postdrain removal pneumothorax similar to comparable studies[6,7,12,13] and a very low rate of reintervention, the most accurate measure of delayed or missed continuing air leak. Although most patients were discharged on the same day of or first day after surgery, reasons for stay beyond this included pain optimization, patient readiness, or social factors. In our series of patients, there were no immediate readmissions nor interventions required in their outpatient follow-up.

In addition to safety, postoperative pain is an important reason to undertake this study. In our institution, since the introduction of minimally invasive surgery with effective intercostal blocks and routine screening for pain postoperatively, the contribution of chest drain to postoperative pain becomes more prominent.[14] Chest drains have been shown to increase patient pain and discomfort.[15-17]

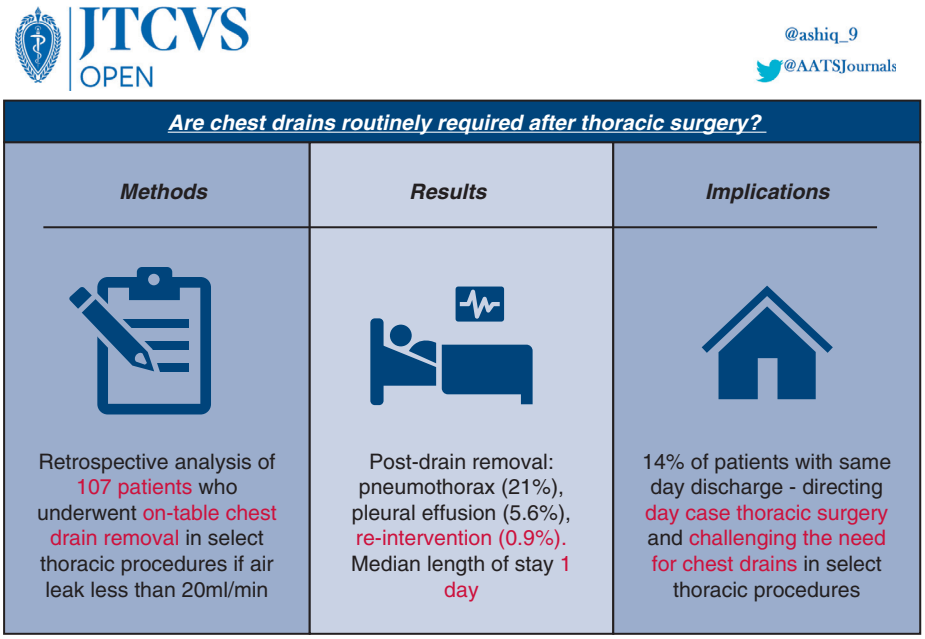


FIGURE 1. Summary of methods, results, and key implications.

As such, we reviewed postoperative pain scores in our series of patients. Our excellent postoperative pain results demonstrates that on-table drain removal contributes to decreased postoperative complications and the enablement of a short length of hospital stay.

Our work also challenges the practice of routine suction or prolonged drainage required after surgery for pneumothorax or pleural effusion, as shown in our acceptable results in patients treated with pleurodesis. In cases in which a high-output effusion is suspected (eg, full hemithorax of fluid within 7 days of complete drainage), we would not remove the drain on table but rather discharge the patient with a drain (on the same day of surgery if feasible) and remove it electively the next week.

A limitations of our work is that we do not have accurate long-term data for the rates of recurrences of any pneumothorax or effusion; they may have occurred in local hospitals without informing us and, also, we have relatively small numbers with short follow-up. Digital drainage systems are also costlier than traditional drains; however, this is balanced with any clinical benefit in recovery and cost savings of potential reduced hospital stays.

CONCLUSIONS

Intraoperative digital drain usage allows for quick and safe assessment for on-table drain removal in select thoracic cases, reinforcing the paradigm that chest drains are not routinely required for all thoracic surgical procedures and facilitating enhanced patient recovery, minimal postoperative pain, earlier discharge and ultimately directing a future toward day case thoracic surgery.

Conflict of Interest Statement

E.L. reports personal fees from Johnson and Johnson/Ethicon, Covidien/Medtronic, Guardant Health, Beigene, Roche, and BMS; and grants and personal fees from AstraZeneca, Boehringer Ingelheim, Medela, and Lilly, outside the submitted work; In addition, E.L. has patent P52435 GB and patent P57988 GB issued to Imperial Innovations and CI for VIOLET NIHR HTA (13/04/03), CI for MARS 2 NIHR HTA (15/188/31), CI for RAMON NIHR HTA (131306), and founder of My Cancer Companion Healthcare. P.D.S. reports conference fees from Lilly and Takeda Oncology and personal fees from Vitae Professionals and Boehringer Ingelheim, outside the submitted work. All other authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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Key Words: chest drain, air leak, digital drains, perioperative care, enhanced recovery, enhanced recovery after surgery (ERAS)