Editorial Commentary

Less is more: the benefits of low suction for digital pleural drainage devices after pulmonary resection

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The cost of healthcare is increasing and the resources available are limited. Optimization and efficiency have become important for reduction of hospital length of stay for surgical patients and subsequent costs. This financial pressure has stimulated the development of enhanced recovery pathways following thoracic surgery, aimed at early patient discharge and reduction in post-operative complications (1). The decision of the ideal time for pleural drain removal remains a significant determinant of patient length of stay in hospital following pulmonary resection (2).

Classical post-operative drain management guidelines have advocated for suction to be applied to thoracic drains for varying lengths of time with the goal to enhance apposition of the visceral and parietal pleura, thereby accelerating sealing of air leaks. Unfortunately, with larger pulmonary resections, the expansion of the remaining lung to fill the pleural space may not occur. In that case, there is some evidence that suction can prolong the duration of post-operative air leaks rather than accelerating their resolution (3). Most studies attempting to address this issue have not been randomized and when randomized trials were performed, the majority did not follow CONSORT guidelines or provided power calculations to help with the interpretation of any negative findings reported (4). Additional short comings of these studies include the use of analogue pleural drainage devices which are subject to significant variability with respect to interpretation of post-operative air leaks (5). This has led to conflicting results and significant variability in study design preventing meaningful interpretation of meta-analysis data (4).

The relatively recent advent of digital pleural drainage devices has allowed for real time analysis of post-operative air leak and pleural fluid drainage leading to the creation of models aimed at predicting not only the risk of prolonged post-operative air leaks but also determining the earliest conditions under which pleural drains can safely be removed (5). An important advantage of digital pleural drainage devices is their superior interobserver agreement compared to traditional analogue devices (5,6). Given that the prolonged post-operative air leak (PAL) is not only associated with increased length of stay but is also a risk factor for post-operative pneumonia and empyema (7), optimal post-operative pleural drain management is of critical importance.

For these reasons, Holbek *et al.* (8) sought to determine the optimal suction settings of the post-operative digital chest drainage system utilizing a single center, parallel arm, randomized trial. A total of 228 patients undergoing thoracoscopic lobectomy for suspected or confirmed lung cancer were randomized to receive −2 or −10 cmH_2O suction on a digital pleural drainage device. Allocation was randomized and blinded until the completion of surgery. Removal of chest drains occurred as early as post-operative day 1 when the detected air leak was below 20 mL/min for a minimum of 12 h without bloody or chylous pleural discharge. No volume limit of pleural liquid

drainage prevented chest drain removal. The primary outcome assessed was the duration of chest drainage and secondary outcomes were time until drain removal criteria were fulfilled, incidence of prolonged air leak, incidence of treatment for subcutaneous emphysema, incidence of respiratory complications, readmission for thoracic surgical complications, and hospital length of stay. The authors hypothesized that reduced suction would decrease drainage duration and the time to meet drain removal criteria. Using a median pre-trial drain duration of 2 days with an interquartile range of 1–4 days, a sample size of 230 patients was determined to provide a 90% chance of detecting an 18-hour difference in drainage duration.

The use of a lower suction of –2 cmH_2O compared to –10 cmH_2O resulted in a significant reduction in drainage duration [27.4 h (range, 23.3–71.2 h) and 47.5 h (range, 24.5–117.8 h); P=0.047, respectively]. The total pleural fluid production was 566 mL (range, 329–1,155 mL) *vs.* 795 mL (range, 454–1,605 mL) (P=0.007), and median time to consistent air leak cessation was 5.2 h (range, 0.3–34.2 h) and 23.7 h (range, 0.8–90.8 h) (P<0.001). Incidence of prolonged air leak was also reduced, with 14.4% and 24.3% (P=0.089). No differences in post-operative morbidity, readmission or mortality were observed. The median length of in-hospital stay was lower in the –2 cmH_2O suction group, but the difference was not statistically significant [2.0 days (range, 2.0–5.8 days) *vs.* 3.0 days (range, 2.0–9.0 days); P=0.18]. The authors concluded that a suction level of –2 cmH_2O significantly reduced pleural drainage duration. Secondary outcomes suggested by the trial include a reduction in time to air leak cessation and total fluid production without an increase morbidity. Eight patients in each group had their suction levels increased for progression of subcutaneous emphysema.

The findings in this paper agree with two previous trials that have demonstrated a shorter duration of pleural drainage and lower incidence of persistent air leak when lower levels of pleural drain suction were applied. One trial included patients who underwent pleurectomy and bullectomy for spontaneous pneumothorax (9) while the other included patients who underwent lobectomy, wedge or bullectomy (10). Two additional previous studies have examined low *vs.* high suction levels using digital drainage devices for patients undergoing lung resection by VATS or thoracotomy (11,12). One trial with 50 patients per arm compared regulated seal (–2 cmH_2O) with regulated suction (–11 to –20 cmH_2O). The regulated seal (–2 cmH_2O) group demonstrated a shorter duration of drainage 22 h compared to 28.8 h for regulated suction that was not statistically significant. Importantly, this trial was only powered to detect a difference in air leak duration of 24 h between groups. There was no difference in drainage duration, prolonged air leak or time to air leak cessation, however the authors concluded that regulated seal was equally as effective as regulated suction in managing post-operative pleural drainage after pulmonary resection (12). Another trial of 53 patients per arm demonstrated a significant increase in pleural fluid drainage in a high suction (–20 cmH_2O) compared to low suction (–5 cmH_2O), however did not report on duration of post-operative air leak (11).

This study has several strengths. This trial was registered, and the CONSORT guidelines were followed. A power calculation to determine superiority for drainage duration was applied and resulted in a large sample size of 228 patients. Randomization was blinded until the completion of surgery. Both baseline and surgical characteristics were similar between the two study groups. Rates of exclusion following randomization were low, with 2 patients excluded to thoracotomy, 4 patients excluded for placement of 2 pleural drains, and 2 patients excluded for intraoperative conversion to pneumonectomy. No patients were lost during follow up.

There are several important limitations to this trial. Although the study was blinded during surgery, it was unblinded postoperatively. Unfortunately, patient crossover occurred for 4 patients were incorrectly assigned to –10 cmH_2O and 3 patients incorrectly assigned to –2 cmH_2O as a result of operating room staff not changing the suction levels following randomization. These patients were analyzed based on the actual suction settings they received using a modified intention-to-treat analysis. Although length of stay and prolonged air leak secondary outcomes trended toward better results in the –2 cmH_2O suction group, the study was likely not adequately powered to detect these differences.

An important question that remains unanswered is: how do we adequately predict patients that will develop prolonged air leaks following pulmonary resection? Several preoperative risk assessment indexes have been developed and the various risk factors are known (13,14). Through analysis of digital thoracic drainage systems, it may be possible to predict patients likely to develop prolonged air leaks within the first 24–48 hours following surgery. This would allow patients to be discharged early from hospital with their pleural drains *in situ* or early attempts at in hospital air leak interventions such as pleurodesis, endobronchial valves or reoperation explored.

In conclusion, this study demonstrates decreased

duration and volume of pleural drainage as well as earlier cessation of post-operative air leaks as a result of reduced thoracic drain suction following VATS lobectomy. This provides further support for the benefits of low suction digital thoracic drainage in patients following thoracoscopic lobectomy.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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