Editorial

The significance of digital drainage devices on standardization of air leak management after pulmonary resection

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Tremendous strides have been in the field of thoracic surgery inside and outside the operating room to reduce morbidity and mortality. Utilization of newer minimally invasive surgical techniques and implementation of an enhanced recovery after surgery program work together in tandem to maximize our patients' quality of life (1). For elective pulmonary resections, the minimally invasive video-assisted thoracoscopic surgery (VATS) has largely supplanted the classical open, thoracotomy approach leading to both improved short- and long-term patient outcomes (1). Despite the increasing of use of VATS however, there remains ambiguity in the manner of post-operative management, particularly with chest drain management (1-3). Currently, there are no consensus guidelines or standardized approach for chest drain removal (2). One of the most common complications of pulmonary resections is post-operative air leak, and unlike fluid output which may be feasibly recorded and measured, it is much more subjective which can potentially lead to varying clinical interpretations by different medical health professionals (2,3). Abdul Khader *et al.* present their extensive study over nine years utilizing digital drainage, as an objective marker to quantify air leak, as the sole parameter to dictate chest drain removal after elective pulmonary surgery (2). Their work highlights the feasibility of minimizing abundant diagnostic options while maintaining quality patient outcomes with a re-intervention rate of only 2.1% (2). Optimal timing of chest drain removal remains the crux of the patient's post-operative course and may serve as the rate-limiting step for a patient to leave the hospital. To address this, Abdul Khader *et al.* provide a potential pathway for future standardization of chest drain removal to help discharge patients earlier in a safe and responsible manner (2).

By using a digital drainage device (Thopaz, Medela, Switzerland) to quantify air leak using the criterion of less than 20 mL/min for more than six hours for drain removal, the authors found post-removal pneumathoraces in approximately 18% of patients and post-removal pleural effusions in approximately 9% of patients on post-removal chest X-ray (CXR) (2). As these patients have undergone major anatomical pulmonary surgery, we have previously demonstrated the lack of utility in relying on post-operative CXR as post-operative changes such as subtle pneumathoraces and pleural effusions may not be as clinically reliable as evaluation of patient symptoms, regardless of an "abnormal" CXR, as they do not lead to actual changes in management (4). Thus, as the authors point out, the most clinically relevant marker to evaluate the implications of attempting earlier chest drain removal is

the rate of interventions after drain removal (2). Using their criterion using digital drainage with air leak quantification alone, their re-intervention rate was 2.1% over a period of nine years which was comparable to prior studies evaluating digital drainage and air leak (2,5). Though chest drain fluid output may be easily quantifiable with direct chamber measurement, there remains no consensus guidelines regarding the optimal drainage amount or even if pleural effusions seen on post-operative CXR have clinical significance as their presence does not lead to changes in management after chest drain removal (2,4). Thus, with the difficulty on relying on fluid output for safe chest drain removal, Abdul Khader *et al.* highlight not only a feasible way to objectively quantify air leaks but also demonstrate its ability to allow for low complication rates after chest drain removal (2).

The ability to quantify air leaks through digital drainage rather than through subjective clinical measurements may have multifaceted advantages over the classical, subjective evaluation of chamber "air bubbles" evaluation (2). Prior attempts to quantify and qualify air leaks have been inconsistent. Varying definitions and characteristics of expiratory, inspiratory, combination, or continuous air leaks have been utilized in prior literature though interpretation remains subjective (1,6,7). These differences in fundamental definitions make a standardized approach on identifying clinically relevant air leaks for chest drain management guidelines difficult. By using a set criterion of less than 20 mL/min for more than six hours for drain removal, the authors demonstrate not only an effective method of limiting re-interventions after chest drain removal, but additionally provide a pathway to universal standardization by implementing air leak as a repeatable and reliable parameter (2).

Use of digital drainage devices to detect quantifiably clinically relevant air leaks is an excellent example of modern healthcare taking advantage of current technological advances and resources. In a large multicenter randomized clinical trial, use of digital drainages devices led to shorter duration in air leak, chest drainage, and hospital stay compared to traditional chest drainage devices (6). Despite these advantages, routine and standardized use of digital device systems has not been implemented to all healthcare systems. One barrier to its universal implementation may be due to its economic implications. When analyzing the cost of digital devices compared to traditional drainage devices, it was found that the cost of the materials used for the digital devices was similar to the costs of the traditional chambers (6). Thus, one might hastily conclude that similar cost with decrease in hospital length of stay may lead digital devices to be the obvious choice (6). However, it should be noted that the "costs" of the materials used to make the device may be similar, their actual "charges" to the patient and hospital may be highly underrepresented. Thus, though length of stay may have been decreased with digital devices, further in-depth economic analyses are required to evaluate charges, rather than costs, to patient and hospital which may help elucidate as possible reasoning for its non-universal implementation.

Standardization of chest drain removal is difficult as it involves diagnostic interpretation of multiple subjective and objective elements. From evaluating post-operative chest radiographs (CXR) to quantifying fluid output and air leak, Abdul Khader *et al.* provide a basis to challenge these existing management nuances through use of a digital drainage device in an attempt to translate these findings in clinically relevant manner for the betterment of our patients.

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