Selecting Tube Size for Traumatic Thoracostomy

Opposing authors provide succinct, authoritative discussions of controversial issues in emergency medicine. Authors are provided the opportunity to review and comment on opposing presentations. Each topic is accompanied by an Editor's Note that summarizes important concepts. Participation as an authoritative discussant is by invitation only, but suggestions for topics and potential authors can be submitted to the section editors.

Editor's Note: *Chest tubes play an important role in trauma care, but there is little evidence on how chest tube diameter affects care and influences outcomes. This installment of Clinical Controversies presents diverging views on the use of large versus small chest tubes in trauma patients who require thoracostomy.*

PIGTAIL CATHETERS ARE EFFECTIVE AND PROVIDE ADDED BENEFITS IN TRAUMATIC HEMOTHORAX MANAGEMENT

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The thorax is among the most commonly injured body systems in major trauma, with an annual estimate of 300,000 hemothorax cases in the United States.[1,2] Current trauma guidelines recommend drainage of a moderate hemothorax (>300 to 500 mL).[1,3] Conventionally, Hagen-Poiseuille's law dictates that larger bore (28 to 40 French) thoracostomy tubes are more effective than smaller bore percutaneous thoracostomy tubes (14 French).[4] Challenging literature claims that clotted blood will not flow through any tube diameter and that liquid blood will drain equally well.[1,5] We sought to review the recent literature and support the notion that percutaneous thoracostomy may be equally effective in the management of traumatic hemothoraces.

Rivera et al[6] retrospectively compared 131 nonemergent percutaneous thoracostomy patients to 71 nonemergent thoracostomy patients at their trauma center. However, only 30% of their patients had a hemothorax. Subsequent procedure rates were similar (14.1% for percutaneous thoracostomy versus 20.5% for thoracostomy tubes, *P* value not significant), indicating effective percutaneous thoracostomy drainage. Two prospective single-center studies by Kulvatunyou et al[5] (percutaneous thoracostomy [36] versus thoracostomy tubes [191]) and Bauman et al[7] (percutaneous thoracostomy [189] versus thoracostomy tubes [307]) followed. Both reported similar initial drainage output or greater output in patients with percutaneous thoracostomy ([560 mL, standard deviation (SD) ± 81 mL for percutaneous thoracostomy versus 426 mL, SD ± 37 mL for thoracostomy tubes; *P*=.13] and [425 mL, interquartile range [IQR] 200 to 800 mL percutaneous thoracostomy versus 300 mL IQR 150 to 500 mL thoracostomy tubes; *P*<.001], respectively) with similar failure rates ([8% for percutaneous thoracostomy versus 24% for thoracostomy tubes, *P*=.09] and [21% for percutaneous thoracostomy versus 24% for thoracostomy tubes, *P*=.39], respectively).[5,7] Notably during the early phase of implementation, a higher complication rate in the percutaneous thoracostomy group occurred, attributed to the lack of procedure experience. As they gained proficiency, complications were equivalent.[5,7]

Subsequent randomized clinical trials, one single-center (percutaneous thoracostomy [20] versus thoracostomy tubes [23]), and one multisite (percutaneous thoracostomy [56] versus thoracostomy tubes [63]) found no difference in failure rates defined as retained hemothorax requiring additional intervention (10% for percutaneous thoracostomy versus 17% for thoracostomy tubes; *P*=.49) and (11% for percutaneous thoracostomy versus 13% for thoracostomy tubes; *P*=.74), respectively.[4,8] Initial output was similar or greater for percutaneous thoracostomy ([650 mL, IQR 375 to 1087 for percutaneous thoracostomy versus 400 mL, IQR 240 to 700 for thoracostomy tubes; *P*=.06] and [600 mL,

IQR 375 to 1037 for percutaneous thoracostomy versus 400 mL, IQR 250 to 650 for thoracostomy tubes; $P<.01$]).[4,8] Tube duration was similar ([4 days, IQR 3 to 5.5 for percutaneous thoracostomy versus 4 days, IQR 2 to 7 for thoracostomy tubes; $P=.79$] and [4 days, IQR 3-6 for percutaneous thoracostomy versus 5 days, IQR 3 to 7 for thoracostomy tubes; $P=.31$]), and percutaneous thoracostomy had lower insertion perception experience pain scores ([1, IQR 1 to 2 for percutaneous thoracostomy versus 3, IQR 3 to 4 for thoracostomy tubes, $P<.01$] and [1, IQR 1 to 2 for percutaneous thoracostomy versus 3, IQR 2 to 5 for thoracostomy tubes; $P<.01$]).[4,8] Overall, outcomes were similar or improved in the percutaneous thoracostomy cohort regarding insertion-related complications, thoracostomy tube days, ventilator days, intensive care unit days, hospital length of stay, and mortality.[4–8]

A systematic review and meta-analysis provided further support, highlighting a similar failure rate among patients with percutaneous thoracostomy (393) versus thoracostomy tubes (750) (relative risk 1.13, 95% confidence interval [CI] 0.85 to 1.51).[9] The initial mean output of percutaneous thoracostomy (425 to 811mL) in 461 patients was greater when compared to the initial mean output (300 to 738 mL) in 644 thoracostomy tube patients (mean difference 115 mL; 95% CI 71 to 159).[9] The mean tube duration was shorter among 575 patients with percutaneous thoracostomy than 1,032 patients with thoracostomy tubes (mean difference −0.8 days [−1.0 to −0.6 days]).[9] However, 94% (990/1,050) of the thoracostomy tube patients and 72% (415/575) of the percutaneous thoracostomy patients in this analysis were from the same previously mentioned author teams, thus limiting the generalizability of these findings.[4,5,7,8]

After insertion, clinicians should monitor for signs warranting immediate operative intervention including initial drainage of more than 1500 mL and persistent drainage (150 to 200mL/h for 2 to 4 hours).[2] Concern has been raised that the smaller diameter of percutaneous thoracostomy may not allow for adequate drainage rates; however, a simulation study by McLauchlan et al[10] demonstrated that the percutaneous thoracostomy cohort could evacuate at least 500 mL within 15 minutes. A significant limitation of this study is that the authors simulated a hemothorax using gelatin to maintain consistency across trials. Nevertheless, this study is supported by the two randomized controlled trials, as their definition of initial output was output within the first 30 minutes, which was 650 mL (IQR 375 to 1087 mL) and 600 mL (IQR 375 to 1037 mL), respectively.[4,8] As such, these studies demonstrate percutaneous thoracostomy draining for at least 200 mL/hr.

In conclusion, these data support using percutaneous thoracostomy as a safe and reliable treatment option for hemodynamically stable adult patients with traumatic hemothorax and are backed by major trauma society guidelines including the Eastern Society for the Surgery of Trauma and the Western Trauma Association.[1,3] It has the added benefit of the insertion being less painful with the understanding that the percutaneous thoracostomy can always be upsized to a thoracostomy tube.[1] Randomized controlled trials in hemodynamically unstable patients, those with an initial output of more than 1000 mL, and those with penetrating trauma-induced hemothoraces are needed before pigtails should be considered as a replacement for those patient populations.

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REFERENCES

1. Patel NJ, Dultz L, Ladhani HA, et al. Management of simple and retained hemothorax: A practice management guideline from the Eastern Association for the Surgery of Trauma. *Am J Surg*. 2021;221:873-884.
2. Mowery NT, Gunter OL, Collier BR, et al. Practice management guidelines for management of hemothorax and occult pneumothorax. *J Trauma*. 2011;70:510-518.
3. de Moya M. Traumatic hemothorax. Western Trauma Association. Accessed November 24, 2023. https://www.westerntrauma.org/western-trauma-association-algorithms/
4. Bauman ZM, Kulvatunyou N, Joseph B, et al. Randomized clinical trial of 14-French (14F) pigtail catheters versus 28-32F chest tubes in the management of patients with traumatic hemothorax and hemopneumothorax. *World J Surg*. 2021;45:880-886.
5. Kulvatunyou N, Joseph B, Friese RS, et al. 14 French pigtail catheters placed by surgeons to drain blood on trauma patients:is 14-Fr too small? *J Trauma Acute Care Surg*. 2012;73:1423-1427.
6. Rivera L, O'Reilly EB, Sise MJ, et al. Small catheter tube thoracostomy: effective in managing chest trauma in stable patients. *J Trauma*. 2009;66:393-399.
7. Bauman ZM, Kulvatunyou N, Joseph B, et al. A prospective study of 7-year experience using percutaneous 14-French pigtail catheters for traumatic hemothorax/hemopneumothorax at a level-1 trauma center: size still does not matter. *World J Surg*. 2018;42:107-113.
8. Kulvatunyou N, Bauman ZM, Zein Edine SB, et al. The small (14 Fr) percutaneous catheter (P-CAT) versus large (28-32 Fr) open chest tube for traumatic hemothorax: a multicenter randomized clinical trial. *J Trauma Acute Care Surg*. 2021;91:809-813.
9. Beeton G, Ngatuvai M, Breeding T, et al. Outcomes of pigtail catheter placement versus chest tube placement in adult thoracic trauma patients: a systematic review and meta-analysis. *Am Surg*. 2023;89:2743-2754.
10. McLauchlan NR, Igra NM, Fisher LT, et al. Open versus percutaneous tube thoracostomy with and without thoracic lavage for traumatic hemothorax: a novel randomized controlled simulation trial. *Trauma Surg Acute Care Open*. 2023;8:e001050.