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Thoracic irrigation prevents retained hemothorax: a pilot study

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ABSTRACT

Background: Upward of 20% of patients undergoing thoracostomy tube (TT) placement develop retained hemothorax (HTx) requiring secondary intervention. The aim of this study was to define the rate of secondary intervention in patients undergoing prophylactic thoracic irrigation.

Methods: A prospective observational trial of 20 patients who underwent thoracic irrigation at the time of TT placement was conducted. Patients with HTx identified on chest x-ray were included. After standard placement of a 36-French TT, the HTx was evacuated using a sterile suction catheter advanced within the TT. Warmed sterile saline was instilled into the chest through the TT followed by suction catheter evacuation. The TT was connected to the sterile drainage atrium and suction applied. TTs were managed in accordance with our standard division protocol.

Results: The population was predominantly (70%) male at median age 35 years, median ISS 13, with 55% suffering penetrating trauma. Thirteen (65%) patients underwent TT placement within 6 h of trauma with the remainder within 24 h. Nineteen patients received the full 1000-mL irrigation. The majority demonstrated significant improvement on post-procedure chest x-ray. The secondary intervention rate was 5%. A single patient required VATS on post-trauma day zero for retained HTx. Median TT duration was 5 d with median length of stay of 7 d. No adverse events related to the pleural lavage were noted.

Conclusions: Thoracic irrigation at the time of TT placement for traumatic HTx may decrease the rate of retained HTx.

Introduction

Most of thoracic trauma resulting in formation of pneumothorax (PTx), hemothorax (HTx), or hemopneumothorax (HPTx) is successfully managed with placement of a thoracostomy tube (TT) to evacuate blood and/or air from the pleural space.[1] Successful management after TT placement for hemothorax has remained stable at 80% for decades.[2-5] When TT fails however, the resulting retained collection can lead to complications including empyema and fibrothorax.[3,6,7] Accordingly, the bulk of thoracic trauma research has focused on the timing and treatment of retained collections in an attempt to avoid these devastating complications. Early video assisted thoracoscopic surgery (VATS) decreases the associated morbidity of retained hemothorax but does nothing to prevent the formation of such collections.[8-16]

The intervention rate for retained HTx remains around 15%-20% regardless of the intrathoracic position of the TT.[1,12,17-20] Our institutional rate of reintervention is 20%-25%. A pilot study of 10 patients undergoing initial Yankauer

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suction evacuation of HTx before TT placement demonstrated a 45% reduction in the reintervention rate.[19] Irrigating the thorax through the TT has been suggested to reduce empyema rates after combined abdominal and thoracic injury;[21] however, no published data exist on the utilization of prophylactic TT irrigation for the prevention of retained HTx.

We designed a prospective pilot study to determine the efficacy of prophylactic thoracic cavity irrigation after TT placement for the management of traumatic HTx or HPTx. We hypothesized that thoracic cavity irrigation at the time of initial TT placement would decrease the rate of intervention for retained hemothorax by 50%.

Methods

Froedtert Memorial Lutheran Hospital is an American College of Surgeons' Committee on Trauma-verified Level I adult trauma center that serves the suburban and urban population of Milwaukee, Wisconsin. This prospective observational trial study was reviewed and approved by the Medical College of Wisconsin's Institutional Review Board. Twenty consecutive adult trauma patients who underwent prophylactic thoracic irrigation at the time of TT placement for the management of traumatic HTx or HPTx were enrolled. Patients were excluded if they were aged <18 y, presented >24 h after their trauma, required immediate thoracic operative intervention, underwent intraoperative TT placement, had pneumothorax only, or had an occult hemothorax.

For this study, all TT placements were performed in standard fashion with the TT directed in a posterior apical direction.[22] Initial sterile suction evacuation of the thoracic cavity was performed using the TT. Subsequently, 500 mL of warm sterile saline was instilled through the TT and then evacuated. This process was repeated so a total of 1000 mL of warm sterile irrigation was used. The irrigation fluid was suctioned as completely as possible before the TT was connected to the pleural drainage system. All TTs were placed to −20-cm H_20 suction. Please see Figure 1 for complete protocol details.

Patients were analyzed using an intent-to-treat protocol, which included those who received less than the protocol specified volume of irrigation. All patients were followed throughout their hospital stay and subsequent outpatient appointments. Outpatient imaging was only obtained if clinically indicated.[12] Secondary intervention was defined as need for additional TT placement, VATS, or thoracotomy because of retained hemothorax, persistent effusion, or empyema.

Results

Twenty patients underwent prophylactic thoracic irrigation for the management of traumatic HTx or HPTx. The cohort demonstrated a median age of 35 y (interquartile range [IQR], 28-54) with the majority having sustained penetrating trauma (55%). Patient demographics are outlined in Table 1. All patients underwent 36-French thoracostomy tube placement within 24-h of injury, the majority (65%) were placed within 6 h of injury. The median initial measurable output was 200 mL with all patients demonstrating unmeasured loss during placement. An average of 53% of the total TT output was collected within the first 24 h. Thoracic irrigation protocol compliance was 95% with a single individual undergoing 500 mL of irrigation. This single 500-mL irrigation was the result of a protocol deviation. All patients tolerated the irrigation procedure well with no irrigation-induced arrhythmias, shortness of breath, or desaturation noted. Postplacement CXR demonstrated "significant improvement" or "complete resolution" in 40% and 20%, respectively (see Fig. 2). A single patient had no improvement on the postplacement imaging.

Thoracic irrigation at the time of TT placement was successful in 19 (95%) of 20 patients resulting in a secondary intervention rate of 5%. The single patient requiring a secondary intervention required immediate repositioning for a kinked TT on initial postplacement imaging. That patient subsequently required VATS on post-trauma day 1 for the management of clinically significant retained hemothorax. The rate of postpull pneumothorax was 20% with no individuals requiring intervention for management. Additional results are outlined in Table 2. The 30-d readmission was 10%, and no individuals required thoracic reintervention within 30 d of discharge.

Discussion

This prospective pilot trial suggests thoracic irrigation performed at the time of initial TT placement, up to 24-h after trauma, reduces the rate of retained HTx requiring secondary intervention. The current pilot data show a 75% reduction in the secondary intervention rate (5% vs. a historic secondary intervention rate of 20%). Previous studies demonstrate retained HTx results in an increased ICU length of stay, an increased risk of empyema, and increased mortality.[11,23,24] The results of this pilot study provide the groundwork on which future studies investigating prevention of retained hemothorax may be conducted.

Improvements in intrathoracic TT positioning through the adjunct imaging such as fluoroscopic or CT guided TT placement sought to decrease rates of retained HTx. However, recent work including a study by Benns et al. investigated the relationship of intrathoracic TT positioning and the development of retained HTx.[1] That study determined different intrathoracic TT positions, as determined by CT imaging, does not affect the rate of retained HTx as measured by the rate of secondary intervention. Thus it would appear, techniques aiming to improve intrathoracic position would provide no clinical benefit.

Historically, our institution's retained HTx rate has been 20%-25%, whereas previous literature demonstrates rates between 16%-25%.[1,10,12,18-20] Studies demonstrate increased rates of retained HTx in the setting of penetrating injuries compared to blunt.[2] Most patients in this pilot cohort (55%) sustained penetrating injuries of which thoracic gunshot injuries accounted for 72.7% of such injuries. Given the propensity for gunshot wounds to increase the rates of retained HTx, the results of this pilot study reinforce the potential benefit of thoracic irrigation.