Assessment of Surgical Outcome of Trocar versus Blunt Dissection Technique for Intercostal Drainage Insertion: A Prospective Interventional Study

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ABSTRACT

Introduction: Chest tube insertion is a common procedure designed to alleviate the accumulation of air, fluid, pus, or blood in the pleural cavity. Despite being a bedside procedure often performed by emergency residents, Intercostal Drain (ICD) tube insertion carries associated risks, if not executed with care. Complications such as misplacement, organ injury, bleeding and pain are noteworthy concerns.

Aim: To assess surgical outcome of Trocar versus Blunt dissection technique for ICD insertion.

Materials and Methods: The present prospective interventional study was conducted in the Department of General Surgery, M S Ramamiah Hospitals, Bengaluru, India, from September 2018 to August 2020, with a sample size of 64 after obtaining Institutional Ethical Committee approval. Patients requiring ICD insertion were divided into two groups: Blunt (group A) and Trocar (group B) dissection, with 32 participants in each group. Demographic, clinical and diagnostic data were meticulously documented. Statistical analyses, including descriptive statistics, t-tests and Chi-square test, were employed to compare variables such as insertion time, complications and pain scores. Both groups were assessed for the time required for insertion and complications with each method during and after the procedure.

Results: The mean age among subjects with the Blunt dissection method and Trocar method was 45.53±14.85 years and 45.06±10.46 years, respectively. In the Blunt dissection technique, 6 (18.8%) were females and 26 (81.3%) were males, while of those who underwent the Trocar method of insertion, 7 (21.9%) were females and 25 (78.1%) were males. The present study findings revealed that the Trocar method demonstrates comparable surgical outcomes to the Blunt dissection method. Trocar insertion proves notably quicker, especially in obese patients. The time taken for insertion was significantly longer (p-value<0.001) with the Blunt dissection method (17.53±8.835 min) compared to the Trocar method (2.31±0.998 min). Significantly more pain was experienced by patients with the Blunt dissection method compared to the Trocar method on day 1 (p-value<0.001). There was no statistically significant difference found between Visual Analog Scale (VAS) score and method of insertion postprocedure. There was a statistically significant difference found between malposition and method of insertion. With the conventional method of insertion, 43.8% of patients had malposition, whereas with the Trocar method of insertion, 18.8% had malposition. Postprocedural complications, including bleeding and infection rates, were comparable between the two methods.

Conclusion: In conclusion, the Trocar method exhibits similar surgical outcomes to the Blunt dissection method, with added advantages of reduced insertion time and reduced malposition. Proper training plays a pivotal role in mitigating potential complications, making the Trocar method a clinically viable option for ICD procedures.

INTRODUCTION

Chest tube insertion is a common procedure in General surgery practice to drain pneumothorax, haemothorax and pleural effusion. Most of the time, a single tube is required to drain the pleural cavity, unless specific indications warrant the use of two tubes. Pleural diseases are extremely prevalent, affecting approximately 3000 individuals per million in the United Kingdom (UK) annually [1].

Traumas, particularly those stemming from traffic accidents, stand as the leading cause of death within the initial four decades of life [2]. While thoracic traumas may not always necessitate surgical intervention, they can have severe consequences, with around 18% of patients requiring a chest drain and 2.6% undergoing thoracotomy [3]. In instances of penetrating chest trauma, ICD placement proves effective in up to 95% of cases without necessitating further surgical exploration [4,5]. Consequently, ICD emerges as a crucial, life-saving procedure in chest trauma and serves as the primary treatment option for various chest diseases.

The primary objective of ICD tube insertion is to maintain lung ventilation for adequate oxygenation of body tissues. This is achieved through chest decompression, which reduces intrapleural pressure, enabling the lungs to fully expand [6].

ICD insertion is a common procedure, most of the time performed by residents. However, it is associated with risks, if not performed with care, as it requires skill and knowledge about the chest wall. The most common complications found in the literature which are noteworthy are misplacement, organ injury, bleeding, surgical emphysema and pain [6]. The debate surrounding the preferred approach, Blunt method versus Trocar insertion method adds to the complexity of the procedure. In 2008, a National Patient Safety Agency (NPSA) Alert, prompted by a considerable number of deaths and serious iatrogenic complications following chest drain insertion, underscored concerns about training, supervision and the limited availability of Thoracic Ultrasound (TUS) [7]. After this alert, the British Thoracic Society (BTS) Pleural Disease Guideline strongly recommended the use of TUS for all pleural procedures, advocating the development of local hospital policies and training for pleural diseases [8].
In the Blunt dissection method [Table/Fig-1,2], layers of the chest wall are traversed gradually until the pleural cavity is reached, at which point a finger is inserted to detect any pleural adhesions. However, this technique can be particularly challenging in obese individuals, as the thickness of the chest wall may hinder finger access to the pleural cavity, making the insertion of an ICD tube cumbersome.

In the Trocar technique [Table/Fig-3,4], navigating the chest wall is generally easier, especially in obese individuals, facilitating the insertion of an ICD tube. However, due to its blind nature, there remains a risk of vascular and organ injuries that cannot be entirely eliminated [6]. Amidst the evolving landscape of advanced diagnostic and therapeutic interventions for pleural diseases, specialist pleural services have emerged in numerous UK hospitals. Despite this, there remains a scarcity of studies analysing the various techniques of ICD insertion [6]. Thus, the present study was aimed to assess the surgical outcome of Trocar versus Blunt dissection technique of ICD insertion.

**MATERIALS AND METHODS**

This was a prospective interventional study conducted in the Department of General Surgery, M S Ramaiah Hospitals, Bengaluru, India, from September 2018 to August 2020 after receiving Institutional Ethical Committee approval (EC/PG37/2018).

**Inclusion criteria:** All patients requiring ICD tube insertion with moderate to severe pneumothorax, haemothorax, or pleural effusion and patients aged between 18-80 years were included in the study.

**Exclusion criteria:** Patients with mild pneumothorax/haemothorax or pleural effusion, with coagulopathies and those aged less than 18 years or more than 80 years were excluded from the study.

The study included patients requiring ICD insertion for various indications who met the predefined inclusion and exclusion criteria. Informed consent was obtained from all participating patients prior to their inclusion in the study.

**Sample size calculation:** The sample size was calculated based on a previous study conducted by Dural K et al., in which it was found that the complication rate was 13.3% for Blunt ICD insertion compared to 7.8% in the Trocar method of insertion [9]. In the present study, expecting a similar difference in the complication rate between the groups, considering a power of 80% and an alpha error of 5%, the sample size was calculated to be a minimum of 32 in each group.

**Study Procedure**

A total of 64 patients who required ICD tube insertion were included in the study after obtaining informed consent. They were allocated into two groups on an alternate basis into Group A and Group B. Group A consisted of 32 patients subjected to Blunt ICD tube insertion, and another 32 patients in Group B were subjected to the Trocar method of ICD tube insertion.

Data were collected in a preformed proforma that included demographic data, indications for ICD, and method of ICD insertion. The parameters assessed were:

1) Time required for insertion with each method;
2) Pain (VAS score assessed on Day 1, 5 and 10);
3) Complications during the procedure such as pain (VAS score) and bleeding;
4) Postprocedure complications such as malposition, bleeding (bleeding in the ICD bag when there was no haemothorax primarily), organ injury and infection.

**STATISTICAL ANALYSIS**

The data were analysed using SPSS software. All quantitative variables will be summarised using descriptive statistics such as mean and standard deviation. All qualitative variables will be summarised and presented using frequency and percentage. The comparison of time required between the two groups will be carried out using an Independent t-test or Mann-Whitney U test. The comparison of complication rates between the two groups will be carried out using a Chi-square test. A p-value of ≤0.05 was considered statistically significant.

**RESULTS**

The study included 64 patients, with 32 in each group (Blunt dissection and Trocar method). Among the patients subjected to the Blunt dissection technique, 6 (18.8%) were females and 26 (81.3%) were males, while of those who underwent the Trocar method of insertion, 7 (21.9%) were females and 25 (78.1%) were males. The mean age among subjects with the Blunt dissection method was 45.53±14.85 years, and the mean age among subjects with the Trocar method was 45.06±10.46 years. Although there was a variation in...
the percentage of overweight and obese individuals between the Blunt dissection and Trocar insertion methods, this variance was not statistically significant (p-value=0.421) [Table/Fig-5].

When comparing the method of insertion in relation to various medical conditions such as Chronic Obstructive Pulmonary Diseases (COPD), diabetes, hypertension, and smoking, no statistically significant differences were observed between the groups (p-value>0.05). The distribution of these medical conditions was comparable in both the Blunt dissection and Trocar insertion groups [Table/Fig-6]. Although there were slight variations in the percentages of moderate/severe haemothorax and pleural effusion between the methods, these differences were not found to be statistically significant (p-value=0.803). Consequently, the choice of insertion method does not significantly impact the distribution of indications for ICD insertion [Table/Fig-7].

The time taken for insertion was significantly longer (p-value <0.001) in the Trocar method compared to the Blunt dissection method (2.31±0.998 min) [Table/Fig-8]. There was a significant difference in the VAS scores for pain on day 1 between the two methods (p-value<0.001), but not on days 5 and 10 [Table/Fig-10]. All patients experienced pain during the procedure. Bleeding during the procedure was observed in a slightly higher percentage with the Trocar method, but the difference was not statistically significant [Table/Fig-11].

There was a significant difference in the incidence of complications during the procedure (other than bleeding) that were comparable between the two methods. Malposition after the procedure did not show a statistically significant difference between the two groups. The bleeding was mild, which did not require any surgical intervention.

Complication rates during the procedure were comparable between the two methods. Infection rates after the procedure were similar between the two groups. Organ injury was observed only in the Trocar group, but the difference was not statistically significant. Bleeding after the procedure did not show a statistically significant difference between the two groups. The bleeding was mild, which did not require any surgical intervention.

**DISCUSSION**

The current study reveals a noteworthy contrast in the insertion time of ICDs, with the Trocar method exhibiting swifter performance. While complication rates remained relatively comparable across both methods, the Trocar group demonstrated a notably reduced incidence of mispositioning.

The ICD insertion is an invasive procedure, and complications can result from inadequate knowledge of thoracic anatomy or
Postprocedural complications following ICD insertion can stem from various technical issues such as malpositioning, blocked drains, kinking of drains and potential organ injury or infective complications ranging from simple surgical site infection to necrotising fasciitis. As far as large catheter (>20F) is concerned, commonly reported postinsertion complications are malposition (6.5%), drain blockage (5.2%), organ injuries (1.4%) and empyema [16]. Studies done in different clinical settings found the rate of Chest Tube Malposition (CTM) to be over 20% [17-19]. Harris A et al., noted that intrapulmonary placement was the most common adverse clinical event, constituting 38% of complications. Additionally, besides lung complications, laceration of the diaphragm could occur, potentially leading to injuries to abdominal organs such as the liver, spleen, stomach, and colon [17]. Empyema secondary to tube thoracostomy has been reported with complication rates, as low as, 1% and, as high as, 25%. The rate of infection increases with the presence of pleural effusion [20].

In the present study, malposition was found to be more common with the Blunt dissection method than the Trocar method, which was statistically significant. Two patients who underwent the Trocar method experienced organ injuries; one had a diaphragm perforation, and the other had a lung injury. The patient with diaphragm perforation required surgery. The infection rate was higher in the Blunt method; however, it did not reach statistical significance. These complications can potentially be mitigated through adequate training and proper positioning of the ICD tube within the safety triangle.

**Limitation(s)**
The present study faced several limitations, such as the lack of randomisation, variability in surgeon experience levels, and a single-centre design. The absence of long-term follow-up may impact the interpretation of the results.

**CONCLUSION(S)**
The Trocar method demonstrated significantly shorter insertion times, offering potential efficiency benefits. While both methods showed similar complication rates, the Trocar method had lower malposition rates. The present findings suggest the superiority of the Trocar method, emphasising its efficiency and accuracy for ICD insertion. Further research, particularly randomised controlled trials with larger sample sizes, is needed to confirm these results and effectively inform clinical practice.

**REFERENCES**


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**Table/Fig-12**: Distribution of subjects according to complication postprocedure and method of insertion. Chi-square test used; p-value<0.05* statistically significant.
Ashita Elizabeth Thomas et al., Surgical Outcome of Trocar versus Blunt Dissection Method of ICD Insertion

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