

Prevalence of Complications in Chest Drain Insertion in the Emergency Department

J. Legge¹, M. Jee², J. O'Donnell², A. Soo³, C. Deasy⁴, E. Umana⁵, J. Foley², on behalf of Irish Trainee Emergency Research Network (ITERN) Collaborators.

1. Emergency Department, St Vincent's University Hospital, Elm Park, Dublin 4, Ireland.
2. Emergency Department, University Hospital Galway, Newcastle Rd., Co. Galway, Ireland.
3. Department of Cardiothoracic Surgery, University Hospital Galway, Newcastle Rd., Co. Galway, Ireland.
4. Emergency Department, Cork University Hospital, Wilton, Co. Cork, Ireland.
5. Emergency Department, Mater Misericordiae University Hospital, Eccles St, Phibsborough, Dublin 7, Ireland.

Abstract

Aim

Intercostal chest drains (ICDs) are commonly inserted in the Emergency Department (ED) with the reported complication rate between 20-40%. This study aims to better understand the process of the ED inserted ICD and to differentiate between immediate and delayed onset complications.

Methods

This was a prospective, multicentre observational study examining the current practice of ICD insertion in the ED. This study, co-ordinated by the Irish Trainee Research Network (ITERN) recruited ten EDs and collected data between May 2022 and February 2023.

Results

A total of 107 patients were recruited resulting in 130 ICD insertions. 88 ICDs (82.2%) were successfully inserted on first attempt. The immediate complication rate was 34.6% (37 patients) and the delayed onset complication rate was 41.1% (44 patients).

The complication rate found in this study is high when compared to that found in other studies.

Discussion

This study should inform consent procedures and identifies areas for practice improvement to improve patient outcomes.

Introduction

ICD insertion is regularly performed in EDs, an estimated 25,000 patients undergo this procedure annually in England and Wales¹. Existing literature reports a complication rate for ICD insertion of between 20-40%, the majority of these studies are retrospective and based on ICDs inserted for traumatic pathology^{2, 3}. Complications are described as major or minor in the existing literature⁴. The level of experience of the practitioner has been considered, with less experience and non-surgical backgrounds associated with higher complication rates.^{5, 6}

Methods

This was a prospective multicentre observational study analysing the outcomes of patients undergoing ICD insertion in the ED. All 26 Irish EDs were invited to participate in this study, 10 sites (38.5%) participated. The study was coordinated by ITERN and data was collected from May 2022 until February 2023. The study aimed to determine the overall complication rate associated with ICD insertion in EDs at the time of ICD insertion and at least 1 week post ICD insertion. A two stage Case Report Form (CRF) was designed to capture data on patient demographics, the skill level of the practitioner and patient outcomes. CRF A was completed at the time of ICD insertion and CRF B was then completed at least 1 week post ICD insertion by the study team. The site lead stored CRF A and B in the patient chart and anonymised data was uploaded to REDCapTM. Complications are categorised as insertional, positional, equipment related and other, as described in previous studies.⁷ Data was standardized by recruiting site leads who underwent an educational package delivered by the study team. It was accepted that there would be some subjectivity with this approach. Medians are reported for continuous variables and comparable using Mann-Whitney U tests. Chi-square tests were used to determine associations between categorical variables and age group or outcome with a continuity correction being applied for 2 x 2 tables. For data analysis, we used Statistical Package for Social Sciences (SPSS version 27, IBM, USA). A p-value less than 0.05 was considered statistically significant. Ethical approval was obtained from the Clinical Research Ethics Committee of Galway University Hospital (Ref: 2662), with each participating site gaining institutional approval locally prior to study commencement.

Results

107 patients were recruited resulting in 130 ICD insertions. The median number of ICDs inserted per patient was 1 (IQR 1, 1, Range 1-3) with 88 drains (82.2%) inserted successfully on the first attempt. Demographics, indications, type of ICD used and ICD insertors are shown in Table 1. No significant difference in first pass success rate between ICD insertors was found.

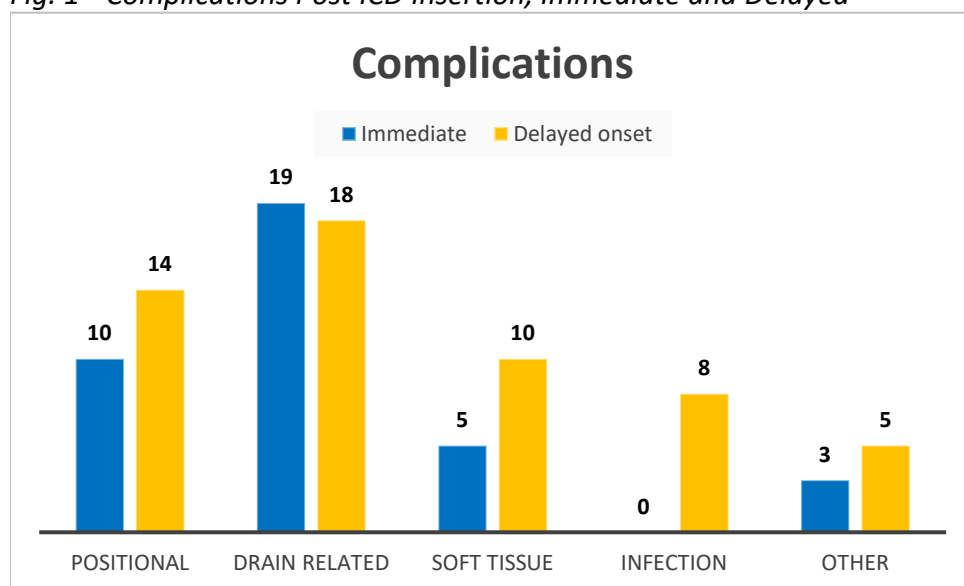
Table 1 Demographics, indications, ICD used and staffing

Variable	n 107 (%)100
Age, median (Interquartile range), range	48 (32,69) 15-90
Gender (Male)	80 (74.8)
Charlson co-morbidity Index, median (Interquartile range), range	3 (2,5) 1-9
Time of presentation	
08:00 -20:00	73 (68.2)
Monday - Friday	72 (63.7)
Indication for ICD	
Spontaneous Pneumothorax	56 (52.3)
Traumatic Pneumothorax	32 (29.9)
Haemopneumothorax	7 (6.5)
Iatrogenic Pneumothorax	4 (3.7)
Haemothorax	2 (1.9)
Tension Pneumothorax	2 (1.9)
Pleural Effusion	2 (1.9)
Traumatic Cardiac Arrest	1 (0.9)
Pre Intubation, suspected pneumothorax	1 (0.9)
Use of ultrasound	7 (6.5)
Aspiration pre ICD insertion	8 (7.5)
Type of drain used	
Seldinger	79 (74)
Surgical	28 (26)
ICD inserted by	
Emergency Medicine SHO	29 (27)
Emergency Medicine Registrar	67 (62.6)
Emergency Medicine Consultant	4 (3.7)
Cardiothoracic Registrar	5 (4.6)
Surgical Registrar	2 (1.9)

An immediate complication was reported in 37 out of 107 patients (34.6%). A delayed onset complication was reported in 44 out of 107 patients (41.1%). The most commonly encountered immediate (n=19) and delayed (n=18) complication was related to ICD insertion, for example, dislodgement, wire kinking or failed insertion. No significant predictable factors were identified for immediate or delayed complications. Immediate complications tended to be related to the drain or its insertion, for example drain malposition, failed first attempt and kinking of the guidewire featured prominently as immediate onset complications. Drain malposition, dislodgment, subcutaneous emphysema and infection featured more so as delayed onset complications, possibly because these type of

complications only declare after a period of time. Of the 107 patients, 24.2% (n=26) had a subsequent drain inserted on the ward. In this group there was a delayed onset complication noted after ICD insertion in 52.5% of patients versus 16.8% in patients who did not require a further ICD insertion after leaving the ED ($p<0.001$). Figure 1 details a breakdown of the encountered complications.

Fig. 1 Complications Post ICD Insertion, Immediate and Delayed



Immediate complications

Positional: Malposition (n=10)

Drain related: Failed First Attempt (n=7), Kinking of Seldinger (n=6), Dislodged ICD(n=3), Seldinger ICD converted to open ICD (n=2), ICD Not Functioning (1)

Soft tissue: Subcutaneous Emphysema (n=3), Bleeding (n=2)

Other: Re-Suturing (n=1), Restricted Shoulder Movement (n=1), Bradycardia (n=1)

Delayed complications

Positional: Malposition (n=8), Extrathoracic (n=2), Mediastinal (n=2), Intraparenchymal (n=1), Subcutaneous Placement (n=1)

Drain related: Complete Dislodgement (n=7), Partial Dislodgment (n=3), Blocked (n=6), Kinking of Tube (n=2)

Soft tissue: Subcutaneous Emphysema (n=10)

Infection (n=8)

Other: Persistent Pneumothorax (n=1), Chest Wall Pain (n=1), Re-insertion (n=2), Recurrence of Pneumothorax Post Drain Removal (n=1)

Of the 107 patients included in this study, 93.5% (n=100) were admitted, 3.7% (n=4) were transferred to another hospital, 1.9% (n=2) were referred to out-patients and 0.9% (n=1) were followed up in a review clinic. The median length of stay for admitted patients was 7 days (IQR 4,12, Range 1-60).

Discussion

The limitation of this study is its generalisability as it focuses on practice in Ireland with just 38% of EDs participating. However we believe that the findings give a real world view of ICD insertion and practice. Site leads endeavoured to ensure consecutive recruitment by engaging with local clinicians. The complication rate of 34.6% was higher when compared to the literature reported complication rate of 8-20%, while the delayed complication rate was similar at 41.1%^{5,8,9,10}. For immediate and delayed scenarios the most common complications were drain related followed by positional factors. Patients requiring subsequent ICD insertion had higher complication rates compared to those undergoing a single ICD insertion. These patients may have been a sicker cohort and more likely to develop complications or this could represent a need for further training of not just EM clinicians but ward based clinicians as well.

The findings in this study suggest that the complication rates for the insertion of an ICD in the ED are higher than expected when compared to the existing literature. Our findings can help clinicians in the consenting process with information for their patients about potential complications of ICD insertion. To improve first pass success rates adequate training is required both on the shop floor and in simulated environments such as simulation labs to improve exposure and confidence, particularly for NCHDs. The high complication rate suggests that further quality improvement should be undertaken in this area. This could take the form of an ICD insertion registry, similar to the airway registries already in existence. This study did not find a single contributing factor that results in a complication.

Declarations of Conflicts of Interest:

None declared.

Corresponding author:

John Legge,
Emergency Department,
St Vincent's University Hospital,
Elm Park,
Dublin 4,

Ireland.

E-Mail: johnleggy@gmail.com

References:

1. Committed. Conservative Management in Traumatic Pneumothoraces in the Emergency Department, a Randomised Controlled Trial, <https://comited.blogs.bristol.ac.uk>
2. Bailey RC, Complications of tube thoracostomy in trauma, J Accid Emerg Med 2000; 17:111-114
3. Vilkkilä VA, Gunn JM, Complications Related to Tube Thoracostomy in Southwest Finland Hospital District Between 2004 and 2014, Scan J Surg. 2020 Dec;109(4):314-319.doi:10.1177/1457496919857262. Epub 2019 Jun 23
4. Hernandez MC et al, Complications in Tube Thoracostomy: Systemic review and meta-analysis, J Trauma Acute Care Surg. 2018 August; 85(2): 410-416
5. Kong VY *et al*, An Audit of the Complications of Intercostal Chest Drain Insertion in a High Volume Trauma Service in South Africa, Ann R Coll Surg Engl. 2014 Nov;96(8):609-13
6. Ball CG *et al*, Chest Tube Complications: How well are we training our residents? Can J Surg. 2007 Dec; 50(6): 450 – 458
7. Aho JM *et al*, Tube Thoracostomy: A Structured Review of Case Reports and a Standardized Format for Reporting Complications, World Journal of Surgery, July 2015 DOI: 10.1007
8. Laws D, Neville E, Duffy J, BTS Guidelines for the Insertion of a Chest Drain, Thorax 2003;58(Suppl II):ii53-ii59
9. Hooper CE, Welham SA, Maskell NA, *et al*, Pleural Procedures and Patient Safety: A National BTS Audit of Practice, Thorax 2015;80:189-191
10. Jackson K *et al*, Complications after Thoracocentesis and Chest Drain Insertion: A Single Centre Study from the North East of England, J. Respir. 2021, 1, 135-140

Acknowledgements:

The authors gratefully acknowledge the Irish Trainee Emergency Research Network (ITERN) Collaborators for supporting this project.
Collaborators (members of the group) are as follows:

Wan Hasbi Hanafi (Cavan General Hospital)
Abdul Sattar Abdul Safras (Connolly Hospital Blanchardstown)
Saema Saeed (Cork University Hospital)
Michael Dunphy (Cork University Hospital)
Abdullah Rana (Our Lady of Lourdes Hospital, Drogheda)
Mairead Reidy (Galway University Hospital)
Joseph Daly (Mater Misericordiae University Hospital)

Khalid Mohamed Ali (Mayo University Hospital)
 Abuagla Mohammed (Mayo University Hospital)
 Rachel Burke (Sligo University Hospital)
 Sinead Power (St James Hospital)
 Deirdre Breslin (St James Hospital)
 Claudio Dalla Vecchia (University Hospital Limerick)
 Jessie Lynch (Waterford University Hospital)
 Máire Bourke (Sligo University Hospital)
 Matt Casey (St Vincent's University Hospital)
 Jessica O'Connell (St Vincent's University Hospital)
 Roisin Ni Dhonaill (St. Vincent's University Hospital)
 Alsomoal Ali Alhaj (Portiuncula University Hospital)
 Andrew Ngaditono (Tallaght University Hospital)
 Lisa Sibthorpe (Midland Regional Hospital Tullamore)
 Conor Prendergast (Children's Health Ireland, Crumlin).

Supplementary Tables

Table 1. Immediate Complications (% of Initial Drain with Complication)

Complication		P Value
Drain Insertor v First Pass Success %	EM Registrar, 80.6% (n=67) EM SHO, 86.2% (n=29) Cardiothoracic Registrar, 100% (n=5) EM Consultant, 50% (n=4) Surgical Registrar, 100% (n=2)	P=0.377
Drain Insertor v Immediate Complication %	EM Registrar, 32.8 (n=67) EM SHO, 41.4% (n=29) Cardiothoracic Registrar, 20% (n=5) EM Consultant, 50% (n=4) Surgical Registrar, 0% (n=2)	P=0.606
Drain Insertor (EM vs. Surgical Specialties) v Immediate Complication %	EM, 36% (n=100) Surgery, 14.3% (n=7)	P=0.243
Type of Drain v First Pass Success %	Seldinger, 79.7% (n=79) Surgical, 75% (n=28)	P=0.363
Day of Week v Immediate Complication %	Weekday, 34.7% (n=72) Weekend, 34.3% (n=35)	P=0.964
Time of Day v Immediate Complication %	0800-2000, 38.4% (n=73) 2000-0800, 26.5%, (n=34)	P=0.229
Gender v Immediate Complication %	Male, 56.9% (n=80) Female, 29.6% (n=27)	P=0.532
Age v Immediate Complication %	<65 Years, 35.8% (n=67) >65 Years, 32.5% (n=40)	P=0.727

Drain in Safe Triangle on Imaging v Immediate Complication %	Yes in Triangle, 28.8% (n=52) Not in Triangle, 35% (n=34) Not reported, 47.6% (n=21)	P=0.310
Type of Drain v Insertion in Safe Triangle	Seldinger, 46.8% (n=79) Surgical, 36.6% (n=28)	P=0.02

Table 2. Delayed Complications (Overall % Any Delayed Complication)

Complication		P Value
Day of Week v Delayed Complication %	Weekday, 40.2% (n=72) Weekend, 42.3% (n=35)	P=0.799
Time of Day v Delayed Complication %	0800-2000, 41.1% (n=28) 2000-0800, 41.2%, (n=34)	P=0.95
Gender v Delayed Complication %	Male, 35% (n=80) Female, 59.3% (n=27)	P=0.03
Type of Drain v Delayed Complication %	Seldinger, 37.9% (n=79) Surgical, 42.9% (n=28)	P=.903
Indication for Drain v Delayed Complication %	Spontaneous Pneumothorax, 44.6% (n=56) Traumatic Pneumothorax, 31.3% (n=32) Haemopneumothorax, 57.1% (n=7) Iatrogenic Pneumothorax 50% (n=4) Haemothorax, 0% (n=2) Tension Pneumothorax, 0% (n=2) Pleural Effusion, 100% (n=2) Traumatic Cardiac Arrest, 0% (n=1) Pre-intubation, suspected pneumothorax, 100%(n=1)	P=0.25
Drain Insertor v Delayed Complication %	EM Registrar, 37.3% (n=67) EM SHO, 51.7% (n=29) Cardiothoracic Registrar, 20% (n=5) EM Consultant, 50% (n=4) Surgical Registrar, 50% (n=2)	P=0.581
Successful First Attempt v Delayed Complication %	First Pass Yes, 38.6% (n=88) First Pass No, 52.6% (n=19)	P=0.261
Insertion in Safe Triangle v Delayed Complication %	Yes in Triangle, 30.8%% (n=52) Not in Triangle, 55.9% (n=34) Not reported, 42.9% (n=21)	P=0.68