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A DESCRIPTIVE STUDY OF THE ACCURACY OF INTERCOSTAL DRAIN PLACEMENT AND FACTORS INFLUENCING PLACEMENT.

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Prof LN Goldstein
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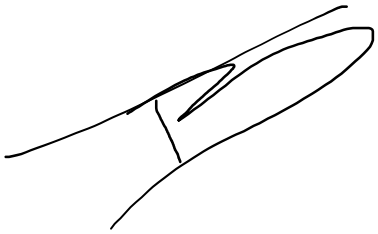
A research report submitted to the Faculty of Health Sciences,
University of the Witwatersrand, Johannesburg,
in partial fulfilment of the requirements for the degree of
Master of Medicine in Emergency Medicine

Johannesburg, September 2022

Declaration

I, Dr Tessa Korda, hereby declare that this research report is my own work. It is being submitted for the degree of Master of Medicine in Emergency Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.



Dr Tessa Korda
Signed on 16 September 2022

Contribution Declaration

Declaration: Student's contribution to article(s) and agreement of co-author(s)

I, Tessa Korda, student number 433192, declare that this Thesis/Dissertation/Research Report is my own work and that I contributed adequately towards research findings published in the article(s) stated below which are included in my Thesis/Dissertation/Research Report .

Signature of Student: **Date:** 29/04/2022

Name of Primary Supervisor: Dr T Baillie Stanton

Signature of Primary Supervisor ……**Date**……4/5/2022……

Agreement by co-authors: By signing this declaration, the co-authors listed below agree to the use of the article(s) by the student as part of his/her Thesis/Dissertation/Research Report. In cases where the student is not the 1st author of a published article, the primary supervisor must explain (under comments) why the student is entitled to use the paper for his/her degree purposes.

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Title:

A descriptive study of the accuracy of intercostal drain placement and factors influencing placement.

Journal name, year, volume and page numbers: African Journal of Emergency Medicine

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Statement

As per the University of the Witwatersrand Faculty of Health Sciences guidelines, this research report is being submitted in the following format: submission for publication ready format.

The research report consists of a manuscript for submission, author's guidelines, research protocol and annexures. The author's guidelines and protocol are included for background reference.

Manuscript for Submission

Type of article: Original research

Title of Manuscript: An observational simulation-based study describing the accuracy of intercostal drain placement and factors influencing placement.

Word, Figure and Table Counts:

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Abbreviations

AFJEM	African Journal of Emergency Medicine
ATLS	Advanced Trauma Life Support
BMI	Body Mass Index
BTS	British Thoracic Society
EC	Emergency Centre
ETC	European Trauma Course
ICD	Intercostal Drain
SA	South Africa

Section 1 – Manuscript

A descriptive study of the accuracy of intercostal drain placement and factors influencing placement.

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Abstract

Background

South Africa's significant burden of trauma and respiratory disease requires a high rate of intercostal drain (ICD) insertions by emergency centre practitioners. ICD misplacement is associated with significant complications. The aim of this study was to assess ICD insertion site accuracy and the factors affecting accuracy by emergency centre doctors.

Methods

This was an observational simulation-based study. Using ultrasound and an invisible ultraviolet marker, the chest wall structures of two simulated patients of different BMI categories (low and high) were marked. Participants placed stickers bilaterally on both patients at their intended ICD insertion site. Sticker placements were photographed under ultraviolet light and analysed. Accurate placement (within the area above the 6th rib, posterior to pectoralis major and 1cm anterior to the mid-axillary line) and within the British Thoracic Society's 'triangle of safety' was noted. Comparisons of accuracy were made between participant rank (junior vs senior), participant experience (<30 vs >30 ICDs placed), BMI category (low vs high) and placement side (left vs right).

Results

Insertion site was accurate in 47% of placements and within the 'triangle of safety' in 51% of placements. Accuracy was associated with greater participant experience (61% vs. 37%, $p<0.01$), and left-sided placement (54% vs 40%, $p = 0.02$). No difference was found when comparing patient BMI category (low vs high, 43% vs 51%, $p=0.18$) or participant rank (junior vs senior, 41% vs 51%, $p=0.10$). Of all placements, 13% were over muscle or the diaphragm.

Conclusion

Overall accuracy of ICD insertion site was low, and accuracy was only associated with greater participant experience and left sided placement. Further studies to determine methods to improve ICD placement accuracy are needed.

Keywords

Chest tubes
Thoracostomy
Clinical competence
Intercostal drain
Complications

African relevance

- High burden of respiratory disease and trauma in low- and middle-income countries results in a high rate of intercostal drain requirement.
- Placement of intercostal drains is a critical skill in acute care medicine that is often carried out unsupervised by junior or inexperienced doctors working in overburdened public healthcare systems
- Complications associated with misplaced intercostal drains are an unnecessary added strain on already overloaded healthcare systems.
- Identification of factors associated with intercostal drain misplacement is an important step in the path to improving accuracy of placement and thus reducing the complications associated with misplacement.

Background

Intercostal drain (ICD) insertion is a common emergency centre (EC) procedure [1,2]. High rates of penetrating thoracic trauma and HIV-associated pulmonary illness have led to a significant number of patients presenting to the EC requiring ICD insertion in South Africa (SA) [3,4]. Training to insert an ICD correctly is an essential skill for doctors working in acute care [2,5].

SA is a middle-income country which means that in certain hospitals there are staff and resource limitations along with a high patient load. This medical landscape means that junior doctors are expected to perform procedures, such as ICD insertion, which would usually be completed by specialists in more developed countries [2,6–8]. An SA study identified that there was inadequate supervision of junior staff inserting ICDs, wide variability in the experience level of staff regarding ICD insertion and higher complication rates associated with ICD insertion by staff outside of major trauma centres [2].

As with most medical procedures, complications can occur with the insertion of an ICD. The classification thereof is not standardised with complication rates varying between 1-40% [9]. Complications may result in longer hospital stays, additional investigations and reparative surgery for visceral or vascular injury [10]. ICD complication-related morbidity and mortality including financial implications can thus be significant, particularly in a resource-constrained environment [2,9,10].

Several commonly used guidelines describe landmark-based palpation techniques for ICD placement including the British Thoracic Society (BTS), the Advanced Trauma Life Support (ATLS) and the European Trauma Course (ETC) methods [11–

13]. BTS guidelines refer to the ‘triangle of safety’ as the appropriate area for ICD insertion. This triangle constitutes: the lateral border of the pectoralis major anteriorly, the fifth intercostal space inferiorly and the lateral border of latissimus dorsi posteriorly, with the axilla as the apex [11]. ATLS guidelines recommend placement in the fourth/fifth intercostal space between the anterior and mid-axillary lines [12]. The ETC guidelines recommend placement one hand width below the anterior axillary fold just anterior to the mid-axillary line [13]. ATLS principles have been adopted and taught as part of a formal ATLS training course in many countries including South Africa, however not all doctors who are expected to place ICDs are certified [7]. The Trauma Society of South Africa recommends the method taught by ATLS, however, the BTS triangle of safety has been described in previous South African studies as convention and used when analysing ICD placement in previously carried out South African studies. [7,8]. It has been shown that it is difficult to find the correct area by palpation alone [13,14].

The aim of this study was to describe the accuracy of palpation-based ICD insertion site identification by EC staff of varying levels of experience and describe some of the factors associated with ICD misplacement.

Methodology

A prospective observational simulation-based study design was used. The study was approved by the University of the Witwatersrand Human Research Ethics Committee (M1911137). Written informed consent was obtained from all participants and simulated patients.

The study population comprised of EC doctors working in three academic hospitals in Johannesburg, SA. Doctors were ranked as either junior or senior. Junior doctors included second year interns and community service medical officers. Senior doctors included medical officers and emergency medicine registrars.

Data collection

Data were collected from August – September 2020. Two male volunteers acted as simulated patients, one with a body mass index (BMI) of 20 and one with a BMI of 34. The simulated patients were positioned supine with arms behind the head and the head of the bed raised at 30°. Prior to the start of the data collection, ultrasound was used to identify thoracic structures on the simulated patients, which were then marked using an invisible 8280 Special Securitas UV Marker (Edding, Germany). This included the diaphragm at the end of inspiration and expiration, the 4th-7th intercostal spaces, the lateral border of the pectoralis major muscle and the lateral border of the latissimus dorsi muscle (Figure 1A). The chest wall was then divided into four quadrants (A-D) by a line drawn 1cm anterior to the mid-axillary line in a cranio-caudal direction, intersected by a second line along the inferior border of the fifth intercostal space (Figure 1B). Quadrants A and B combined represent the BTS triangle of safety. For this study, Quadrant A represents the 'accurate' placement area, anterior to the line 1cm anterior to the mid-axillary line and above or within the 5th intercostal space. Quadrants B-D represent areas of placement that would be deemed not accurate as Quadrants B and C would be too posterior and Quadrants C and D would be too caudal on the thoracic wall. Cadaveric studies that assessed markers placed using the three commonly used palpation techniques (BTS, ATLS, ETC) concluded that not all areas within the BTS 'triangle of safety' are, in fact, safe.

Sites posterior to the line 1cm anterior to the mid-axillary line place the long thoracic nerve at risk [13]. Although Quadrant B lies within the triangle of safety it is posterior to the line 1cm anterior to the mid-axillary line and thus was not considered to be within the accurate area for this study. Thus, accurate placement in this study only included placements anterior to the line 1cm in front of the mid-axillary line.

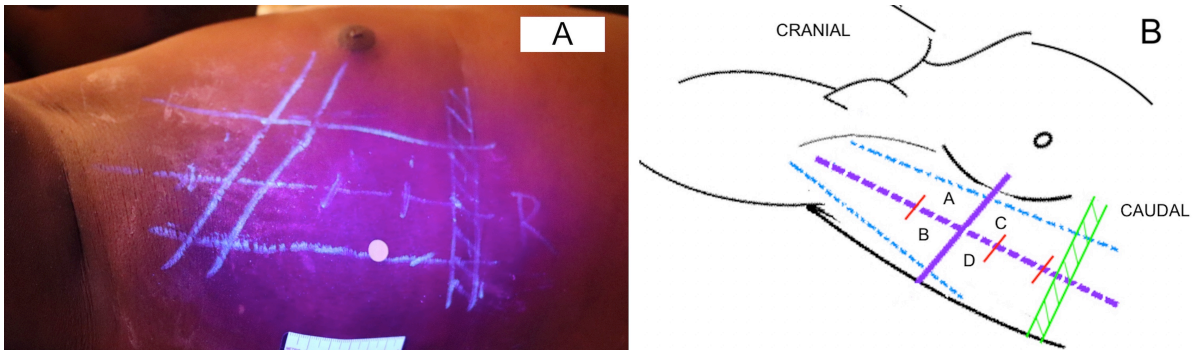

Figure 1 – Photograph (A) and diagram (B) indicate how the right side of the thoracic wall was demarcated in the simulated patients. Photograph A additionally shows the circular sticker that was used by participants to indicate their preferred ICD insertion site. Diagram B has a green shaded area that represents the expiratory and inspiratory extents of the diaphragm. The anterior light blue line represents the lateral margin of pectoralis major and the posterior light blue line represents the lateral margin of latissimus dorsi. The dashed purple line represents the line 1cm anterior to mid-axillary line. The solid purple line represents the inferior margin of the 5th intercostal space. The red lines that intersect the solid purple line indicate adjacent intercostal spaces' inferior margin. Quadrants A-D shown as marked in diagram B.

Participants used their preferred palpation technique to locate and mark the ICD insertion site on each side of both of the simulated patients' chest walls with a

circular sticker. Participants were unable to see the markings made with the ultraviolet marker and were assessed individually. Each sticker was photographed in situ using a Canon 850D SLR camera (Canon, SA), with the ultraviolet markings made visible using a Zartek ZA-490 UV Flashlight (Zartek, SA).

During analysis, marked structures were divided into two groups: muscular (latissimus dorsi and pectoralis major) and diaphragmatic structures (diaphragm/ subdiaphragmatic). Intercostal space placement was divided into 5th intercostal space or above and 6th Intercostal space or below.

Statistical Analysis

Descriptive variables were presented as frequencies and percentages. The data was analysed using IBM SPSS Statistics, version 22 (2013). The Chi-square test was used to compare frequency of ICD placement between the following variables: rank, experience level, BMI, and side of placement. Significance testing was set at the 95% confidence level with a p-value < 0.05 indicating statistical significance.

Results

In total, 71 doctors participated, each placing 4 simulated ICDs, resulting in a total of 284 placements. The participant characteristics are shown in Table 1.

Table 1: Participant demographics

Ranking of doctor	Number of ICDs inserted	n (%)
Junior doctors		**27 (38)**
	< 30 ICDs	26 (96)
	> 30 ICDs	1 (4)

Senior doctors		**44 (62)**
	< 30 ICDs	15 (34)
	> 30 ICDs	29 (66)

ICD = intercostal drain

Accuracy of placement and placement within the triangle of safety

Of the 284 simulated ICDs, 47% were placed in the predefined 'accurate' area and 51% fell within the BTS triangle of safety. The differences in placement between rank, experience level, patient BMI and side of placement are shown in Table 2 for both the defined accurate area and the BTS triangle of safety.

Table 2: Accuracy of placement and placement in BTS triangle of safety

Accurate Placement			
	n (%)	**n (%)**	***p-value***
Rank	*Senior doctors* 90 (51)[#]	*Junior doctors* 44 (41)	*0.10*
Experience level	*>30 ICDs placed* 73 (61)	*<30 ICDs placed* 61 (37)	*< 0.01*
Patient BMI	*Low BMI* 61 (43)	*High BMI* 73 (51)	*0.18*
Side of placement	*Left* 77 (54)	*Right* 57 (40)	*0.02*

Placement in BTS Triangle of Safety			
	n (%)	**n (%)**	***p-value***
Rank	*Senior doctors* 96 (55)	*Junior doctors* 49 (45)	*0.10*
Experience level	*>30 ICDs placed* 77 (62)	*<30 ICDs placed* 68 (41)	*<0.01*
Patient BMI	*Low BMI* 64 (45)	*High BMI* 81 (57)	*0.04*
Side of placement	*Left*	*Right*	

	84 (59)	61 (43)	*0.01*

BTS = British Thoracic society; ICD = Intercostal drain; BMI = Body mass index
Note: percentages reflect proportion of accurate and BTS placements within the indicated group – e.g. 51% of all placements by senior doctors were accurate[#]

Anatomical location of placements based on marked structures

Overall, 13% of placements were overlying marked structures: 4% overlying the diaphragmatic structures and 9% overlying the muscular structures. Senior doctors were significantly less likely to place the simulated ICDs over marked structures when compared to junior doctors (10% vs 19%, p = 0.03). Both senior doctors and junior doctors placed 4% of attempts over diaphragmatic structures. Senior doctors placed 6% over muscular structures, compared to 15% of junior doctors (p < 0.01). No significant differences were found regarding placements overlying marked structures when comparing experience level, patient BMI and side of placement.

Participants placed 163 attempts (57%) within the 5th intercostal space or above. Almost a quarter of attempts (23%) were closest to the 7th intercostal space. Participants with a higher experience level indicated a significantly larger proportion of simulated ICDs in the 5th intercostal space or above (69% vs 49%, p < 0.01) whereas no significant difference was found when comparing rank, patient BMI or side of placement.

Discussion

Accurate placement of ICDs in patients is paramount in ensuring appropriate medical management and patient safety. It is thus vital that practitioners inserting ICDs are aware of the importance of accurate placement, as well as the various factors that could possibly contribute to poor placement.

The overall accuracy of placement of simulated ICDs in the BTS triangle of safety was low. These low accuracy rates are comparable to those found in related literature. A United Kingdom-based study assessing 50 junior doctors found that only 44% accurately located the triangle of safety, while another clinical audit showed 55% of doctors chose ICD placement inside the BTS triangle of safety [15,16].

ICD placement in the EC is common and placement outside of the accepted 'safe' areas is associated with higher complication rates [1,8,11,12]. A South African study by Sritharen et al. noted an overall complication rate of 16% and a meta-analysis by Hernandez et al. found a complication rate of 19% for the insertion of ICDs in trauma patients [9,17]. These significant complication rates as well as those described in other studies emphasise the importance of accurate, safe placement of ICDs [2,7,9,18]. This highlights an urgent need for intervention to improve accuracy of placement and potentially reduce complication rates. However, the rate of accuracy is not akin to the complication rate, as complications associated with depth, ectopic insertion, infection, and angle of insertion can still occur with accurate placement [5,13,17,19]. An institutional audit of placed ICDs would be required to assess complication rates, which could then be compared to accuracy of placement.

In contrast to other studies that found a significantly higher complication rate associated with ICDs placed by junior staff, this study found no difference when comparing participant rank [7–9,15]. This discrepancy may be a result of variations in training and clinical experience. A study that assessed anatomical placement of ICDs by Kong et al. found that only 28% of reviewed ICD placements by junior

doctors (interns) were located within the BTS triangle of safety [8]. The authors found a significant difference when comparing first and second year intern doctors as well as those who had previously attended an ATLS course [8]. These findings likely reflect improvement in accuracy with experience, which may be reflected in the results from the current study. Self-reported level of experience (number of ICDs placed) may serve as a better proxy than rank, as shown in Table 2. An audit from the United Kingdom also showed previous experience in ICD placement to be a critical factor in choosing the correct placement site [15]. The best approach to improving accuracy would thus likely be a focus on methods that build upon experience, such as simulation training, improved guidance and oversight of placement during internship years and trauma course (e.g ATLS) attendance [8,20].

Anatomical factors such as large body habitus have been reported to be associated with more difficult ICD placement and higher complication rates [1,19]. However, Sethuraman et al. found no significant increase in complications in patients with a large body habitus who had ICDs placed [20]. The results of the current study were not in keeping with the available literature as no statistical difference was found when comparing accurate placement according to patient BMI, although a significant difference was found when assessing placement within the BTS triangle of safety. The accuracy was, however, better in the simulated patient with the higher BMI. This outcome may have been influenced by a possible awareness by the participants of the comparison between low and high BMI as both simulated patients were in the same room. This Hawthorne effect may have resulted in participants taking greater care when placing the sticker in the simulated patient with the higher BMI [21].

The finding of a difference in accuracy and placement in the triangle of safety depending on the side of placement in the patient is a finding not in keeping with other literature either. Carter et al. found no difference when comparing left versus right sides [22]. The significance of this is uncertain. The handedness of participants and the fact that sticker placement is not as complex a motor task as actual ICD placement are possible factors which were not evaluated. This difference would be better assessed by auditing actual ICD insertions.

Placements overlying diaphragmatic structures would have significant potential for patient harm and therefore major cost implications in an already resource-constrained setting [2,10]. Avoiding such placement should thus be a particular focus during ICD insertion training. In this study, although it was found that junior doctors were significantly more likely to place the stickers over marked structures, it was more common over muscular and not diaphragmatic structures. That said, placement through large muscles should also be avoided and awareness of these anatomical structures when placing ICDs should be emphasised. The incorporation of ultrasound as an adjunct when planning ICD insertion by junior doctors may ameliorate this [14].

Diaphragmatic excursion has been noted in other studies to be as low as the 7th intercostal space where the diaphragm contacts the costal portion of the parietal pleura in expiration [22]. Thus, peritoneal placement becomes more likely in or below the 7th intercostal space. Kwiatt et el. describe diaphragmatic excursion as rising to as high as the 4th intercostal space in full expiration, thus placement lower than the 5th intercostal space would be a higher risk of subdiaphragmatic placement. This is

especially true in pregnant women with a gravid uterus, obese patients and patients with intraabdominal tumours or ascites [1]. In one cadaveric study it was found that more than 80% of the ICDs were placed in the 6th intercostal space or below [23]. Carter et al. assessed marker placement by EC registrars and consultants and found that 36.2% of placements were in the 4th/5th intercostal space [22]. Both subgroups would be classed as senior doctors as per the current study's criteria. A much higher rate of senior doctors placed the marker in the 5th intercostal space or above. Doctors with more ICD insertion experience were also more likely to place the ICD in the 5th intercostal space or above. This discrepancy between findings may be a function of experience as many ICDs are placed in SA related to the high trauma and tuberculosis caseload [2,22].

Doctors should be aware of factors that may hinder accurate ICD insertion such as female biological sex, high BMI and previous trauma or distorted anatomy [1]. These are the cases where ultrasound-guided ICD placement could be used, or alternatively, senior supervision could be requested [1,14]. A study comparing accuracy of placement within the 5th intercostal space using traditional palpation techniques versus using ultrasound found that only 48% of the attempts by EM residents and students were in the correct intercostal space when using palpation. After a short hands-on training session in the use of ultrasound to identify the intercostal space, the accuracy of placement improved to 91% [14]. Ultrasound-guided placement in non-emergent cases, especially where factors have been identified that may make the insertion of an ICD more difficult, should be considered.

Departments that are responsible for many drain placements may also consider a checklist [1]. Checklists could assist junior/inexperienced doctors to prepare correctly for the procedure and potentially make successful placement more likely. A checklist could also help make them aware of potential difficulties and offer solutions such as adequate analgesia and safe sedation methods for the combative patient. Another potential intervention could be the implementation of simulation-based training. A study by Leger et al. showed that simulation-based training improved ICD insertion success rate in a traumatic pneumothorax model [24]. This could be explored as a method to improve upon experience without having to place ICDs in a clinical setting.

Study limitations

This was a small study with 71 participants: a small proportion of the number of doctors working within ECs in Johannesburg. Of these, few were junior doctors as the majority of EC staffing is made up of medical officers. This was a simulation-based situation and would thus not reflect the pressures involved during actual ICD insertion in an EC. The simulation setting may have resulted in participants taking greater care when placing the simulated ICD in the simulated patient with the higher BMI as part of a Hawthorne effect [21]. This study included three large academic hospitals in Johannesburg, as such there was no assessment of smaller facilities, rural facilities, or facilities in other parts of SA. Two of the centres assessed were medical emergency units which are separate departments from the trauma units. The non-trauma ECs receive fewer trauma patients, which constitutes a large proportion of patients who require ICD insertion in South Africa [2]. Doctors in those departments were less likely to be as experienced in inserting ICDs than those doctors from the trauma units. Due to anonymity, this could not be analysed

separately. The simulated patients were requested to remain with the top half unclothed for the duration of each session, no female simulated patients were thus incorporated in the study. Assessing female breast tissue as a possible contributing factor to ICD misplacement was thus not carried out as a part of this study.

Conclusion

Accurate placement of ICDs is imperative to reduce the rate of complications associated with ICD insertion. The overall accuracy of placement was worryingly low in this simulation-based study. The clinical experience of the inserting doctor was found to be a significant factor affecting the accuracy of ICD placement. Experience was found to be a common theme throughout this study and the associated literature. Methods to improve upon experience and thus accuracy should be further studied, and potentially include simulation-based training and ultrasound-guided placement. Training should emphasise the importance of recognising factors predicting difficult ICD insertion. Senior staff should be encouraged to oversee junior staff ICD placement so that immediate corrective action can be undertaken to prevent patient harm.

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Section 2 – Research Protocol

A DESCRIPTIVE STUDY OF THE ACCURACY OF INTERCOSTAL DRAIN PLACEMENT AND FACTORS INFLUENCING PLACEMENT.

Dr Tessa Korda
MMed Emergency Medicine
Student Number: 433192
Staff Number: A0032101

Supervisors: Dr T. Baillie-Stanton, Prof. L.N. Goldstein

INTRODUCTION
Background

A large number of intercostal drains (ICDs) are placed in patients in South Africa [1]. The high levels of interpersonal violence and motor vehicle collisions as well as the scourge of Human Immunodeficiency Virus and its associated respiratory complications have led to significant pathology presenting to the emergency department (ED) requiring ICD insertion[2, 3].

South Africa is a middle-income country where the public health system has many resource restrictions[4]. The resource limitations within the healthcare system extend to staff numbers with many EDs being sub-optimally staffed[2]. Staff and physical resource limitations along with high patient numbers have created a medical landscape whereby junior medical doctors are expected to perform a number of procedures that would only be completed by seniors or even specialists in many developed countries[5]. Rural areas are more likely to be staffed by junior doctors, who would likely be expected to perform invasive procedures such as ICD insertion with minimal supervision.

It has been reported that there is inadequate supervision and guidance of junior staff inserting ICDs in South Africa. A study by Maritz et al.[1] found that there were higher

complication rates associated with ICDs placed by staff outside of major trauma centres. There is wide variation in the level of expertise and experience of staff responsible for ICD insertion in South Africa[1]. This variation may be a factor when considering complications associated with ICD insertion.

Complications of ICD insertion

Complications can be classified as insertional, positional, related to removal, infective/immunologic as well as instructional/educational/equipment-related[6]. The insertion of intercostal drains in the incorrect anatomical space is associated with a range of complications, including diaphragmatic, visceral and vascular injury. Complications associated with malposition are the most common and incorrect placement can result in significant morbidity and mortality[1, 7]. The rates of complications associated with ICD insertion are significant[6]. A UK-based study showed 45% of junior doctors placed the ICD outside of the accepted safe zone[8]. In a South African study Sritharen et al., they noted that 44% of documented complications were positional. In that study, complications occurred in 16% of the patients' ICD placements analysed[6].

Implications of complications in a resource-restricted setting such as SA are magnified due to an already financially-strained healthcare system. The cost to the healthcare system as a result of ICD-associated complications can be high including further resource utilisation associated with correction of a misinserted drain[1]. A CT scan may be required in any patient where drain malposition is suspected[5]. Patients with complications would require a longer hospital stay and reparative surgery may be required in cases of visceral or vascular injury.

Methods for determining ICD insertion site

There are multiple methods of determining ICD insertion site. The method used may affect the accuracy of placement. There are two well-recognised techniques: a landmark-based palpation technique and an ultrasound-assisted technique.

Landmark-based palpation techniques of placement are commonly used. There are several guidelines that have been published and used in this regard: The Advanced Trauma Life Support (ATLS) method, the European Trauma Course method and the British Thoracic Society guidelines method. According to these guidelines, the ideal area for ICD insertion in order to avoid ICD associated complications is the 4th intercostal space 1cm anterior to the mid-axillary line[9, 10]. In many patients it has been shown to be difficult to find the correct point by palpation alone[11]. Applying these guidelines in cadaveric studies found that more than 80% of the ICDs were being placed in the 6th intercostal space or below[10]. British Thoracic society guidelines refer to the 'triangle of safety' as the anatomical area in which an ICD should be placed. This triangle is defined as: an anatomical triangle bounded by the lateral border of the pectoralis major anteriorly, the fifth intercostal space inferiorly and the lateral border of latissimus dorsi laterally with the axilla as the apex[5].

The ultrasound-assisted placement technique has been used in a number of settings where non-emergent ICD placement occurs. Ultrasound-assistance has been shown to reduce the complication rate of pleural procedures in the critical care setting thus its use has been recommended in the British Thoracic Society pleural disease guidelines[5]. Ultrasound has also been shown to aid in prompt identification of a misinserted ICD[7].

Factors contributing to ICD misinsertion

A number of factors have been found to contribute to misinsertion of an ICD. These factors include patient factors and staff factors. Some of the patient factors include patient habitus (increased body mass index (BMI)); female biological sex; previous chest drain insertion; rib trauma; intra-abdominal pathology; and parenchymal respiratory disease[12]. A larger body habitus makes identification of the anatomical site for insertion more difficult and is noted to be associated with multiple types of complications related to insertion and position[12]. The use of the ATLS method of placement was shown in one study to cause a higher rate of insertional complications in women[10]. In patients who have had previous chest procedures or ICDs as well as those with significant anatomical distortion secondary to trauma or respiratory disease, ICD drain insertion may be more difficult. Staff factors include the level of experience of the particular individual, the quality of training received for the insertion of ICDs and prior ATLS accreditation[1, 13].

Summary

Misinsertion of ICDs occurs frequently in South Africa. This has significant patient as well as cost implications. There are a number of factors associated with misinsertion. The aim of this study is to describe the accuracy of palpation-based ICD insertion site identification by ED staff of varying levels of experience and to assess some of the factors associated with ICD misinsertion.

Study Objectives

- To describe the overall accuracy of landmark-based palpation techniques for site identification for ICD placement by ED staff of varying levels of

experience on the University of the Witwatersrand Emergency Medicine circuit.

- To compare the accuracy of site choice between staff of different levels of experience in two major groups: Junior doctors (second year interns and community service doctors) versus Senior doctors (medical officers and registrars)
- To compare the accuracy of site choice between a simulated patient with a normal BMI of 20-24 and a simulated patient with a BMI of more than 30
- To describe any other factors staff identify as potentially contributing to increased difficulty in site identification.

Study design

This is a prospective, cross-sectional observational study describing the accuracy of site choice and factors that influence the accurate siting of insertion of an ICD by ED staff from three university-affiliated academic hospitals in Johannesburg.

Study population and Sample

The study population will include registrars from the University of Witwatersrand Division of Emergency Medicine as well as the second-year medical interns, community service officers and medical officers working in three academic EDs in Johannesburg: Helen Joseph Hospital, Chris Hani Baragwanath Academic Hospital and Charlotte Maxeke Johannesburg Academic Hospital.

Inclusions: All doctors in the abovementioned EDs who consent to participate at the pre-arranged data collection sessions on an ad-hoc basis.

Sample size: A total of 60 participants will be assessed. There will be 30 participants in the junior category (second year interns and community service officers) and 30 participants in the senior category (medical officers and registrars)

Detailed Description of Methods and Techniques

Prearranged sessions will be held in each of the three EDs, as well as sessions attached to registrar teaching days. Two simulated patients will be used for each session – one with a normal habitus (BMI 20-24) and one with an obese habitus (BMI >30). The simulated patients will be positioned in a standard manner for ICD insertion: supine in a semi-recumbent position between 30 and 45 degrees, arms abducted and hands placed behind the head. The bed and patient position on the bed will be meticulously noted during ultrasound identification of anatomical structures so that the overlying skin markings are maintained in the correct position during participant recordings.

Prior to each session the fourth intercostal space, the triangle of safety and pertinent thoracic structures on the left and right will be located using an ultrasound machine. The available ultrasound in each ED will be used to delineate the appropriate landmarks as follows: The linear probe with the marker pointing in a cranial direction will be used to identify the clavicle and then the second rib, which correlates to the first rib shadow below the clavicle. Thereafter the second rib space between the second and third rib shadows will be identified, the probe will then be moved in a caudal direction, perpendicular to the skin, until the fourth intercostal space is identified. The fourth intercostal space will then be followed to the mid-axillary line. The UV marker will be used to mark the 4th and 5th intercostal spaces, smaller

secondary marks will be drawn in the other intercostal spaces along the mid-axillary line so they may be identified more easily. The triangle of safety will be delineated with the UV marker (lateral border of pectoralis major, anterior border of latissimus dorsi, 5th intercostal space) and marked with an “8280 Special Securitas UV Marker” (Edding, Germany) that will be invisible to the participants. The diaphragmatic border will be marked in both inspiration and expiration. This will be performed on each simulated patient. Once all of the relevant thoracic structures have been marked the lateral thoracic wall will be divided into four quadrants: a line will be drawn 1cm anterior to the midaxillary line in cranial to caudal direction. This line will be intersected by a line drawn along the inferior border of the fifth intercostal space to form the four quadrants labelled A, B, C and D as seen in *figure 1.*

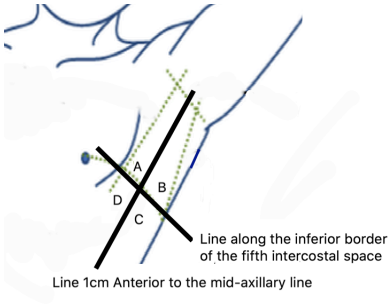

Figure 2 Quadrants as Drawn on the lateral chest wall

Once consent has been signed, the participants will have an 4-minute period during which they will be asked to place four stickers (2 per simulated patient). One sticker will be placed on each side of each patient to indicate the participant’s chosen ICD insertion site according to their usual palpation-based method for site identification.

After marking the simulated patients, each participant will also be given a short questionnaire (Appendix A) to complete.

After each participant has placed their four stickers, photographs will be taken using a “Canon 800d” (Canon, Japan) single lens reflex camera and a tripod. The camera will be set up prior to each session ensuring the lens (18-55mm) is at the same height as and perpendicular to the simulated patients mid-lateral thorax. A “ZA-490 UV Flashlight, 9 LED” (Zartek, South Africa) black light will be used to illuminate the pre-marked ideal point, this will be photographed along with the participant sticker, a standardised scale marker, and an information marker indicating the unique study number, group designation (junior/senior), side (left/right) and body habitus category for each photograph.

A participant sticker will be regarded as accurately placed if it is in the fourth or fifth intercostal space anterior to the mid-axillary line and posterior to the lateral border of the pectoralis major muscle within ‘quadrant A’.

The intercostal space closest to the participant sticker will be recorded on the data collection sheet (Appendix B). The quadrant within which the participant sticker is placed will also be recorded.

Variables

The quadrant within which the participant sticker falls.

The closest intercostal space to each sticker will be recorded.

Variables collected using the data sheet will include the participant’s current rank and approximate number of ICD’s previously inserted.

Statistical Analysis

The overall accuracy according to distance from correct ICD placement site for all participants will be described using medians and inter-quartile ranges.

ICD placement will be categorised into correct and incorrect placement. The following will then be compared in order to check for differences:-

- doctor experience (junior/senior group)
- patient body habitus category (normal/obese)
- side (left/right)

The answers to the open question at the end of the questionnaire will be categorised and described.

The actual placements will be superimposed and presented as a figure for each simulated patient.

Limitations

Ideally a larger array of simulated patients with different factors influencing difficulty of ICD insertion should be studied e.g. Female with large breasts, tall vs short, geriatric patients etc.

Ethics and Permissions

An application will be made to the University of the Witwatersrand Human Research Ethics Committee (Medical) for approval. Permission will be requested from the relevant authorities and heads of department at the aforementioned hospitals.

Timing

	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
LIT. R/V																				
PROTOCOL PREP																				
PROTOCOL ASSESSMENT																				
ETHICS APPROVAL																				
DATA COLLECTION																				
DATA ANALYSIS																				
WRITE UP THESIS																				

Funding

The study will be self-funded. A predicted budget including a UV light and pen as well as subsidizing transport for simulation patients is approximately R2500.

UV Light: R300

Batteries: R80

UV markers: R171 (3)

Paper and Printing: R180

Simulated patient subsidy: 6 sessions x R150 x 2 = 1800

References

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APPENDIX A
QUESTION SHEET

STUDY PARTICIPANT NUMBER_____

1) PLEASE TICK APPROPRIATE BOX:

   REGISTRAR ☐
   MEDICAL OFFICER ☐
   COMM. SERVICE ☐
   INTERN ☐

2) APPROXIMATE NUMBER OF ICDs PLACED
   <30 ☐
   >30 ☐
   ☐

3) HAVE YOU EVER MISPLACED OR WITNESSED AN INTERCOSTAL DRAIN BEING MISPLACED?
   YES ☐
   NO ☐

   IF YES, IS THERE ANY FACTOR THAT YOU RECALL MAKING THE PROCEDURE MORE DIFFICULT THAN USUAL

   _____

   _____

   _____

   _____

APPENDIX B
DATA COLLECTION SHEET

STUDY PARTICIPANT NUMBER_____

MEASUREMENTS:

Left - normal

WITHIN TRIANGLE OF SAFETY: Y/N
CLOSEST RIB SPACE/RIB SPACE:_____
ACCURATE PLACEMENT:_____
QUADRANT:
OVERLYING ANY MARKED STRUCTURES:

Right - normal

WITHIN TRIANGLE OF SAFETY: Y/N
CLOSEST RIB SPACE/RIB SPACE:_____
ACCURATE PLACEMENT:_____
QUADRANT:
OVERLYING ANY MARKED STRUCTURES:

Left – high BMI

WITHIN TRIANGLE OF SAFETY: Y/N
CLOSEST RIB SPACE/RIB SPACE:_____
ACCURATE PLACEMENT:_____
QUADRANT:
OVERLYING ANY MARKED STRUCTURES:

Right – high BMI

WITHIN TRIANGLE OF SAFETY: Y/N
CLOSEST RIB SPACE/RIB SPACE:_____
ACCURATE PLACEMENT:_____
QUADRANT:
OVERLYING ANY MARKED STRUCTURES:

Annexures

Annexure A – HREC clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Tessa Korda

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M1911137

NAME: (**Principal Investigator**)	Dr Tessa Korda
DEPARTMENT:	Emergency Medicine Chris Hani Baragwanath Academic Hospital Charlotte Maxeke Johannesburg Academic Hospital Helen Joseph Hospital
PROJECT TITLE:	A descriptive study of the accuracy of intercostal drain placement and factors influencing placement
DATE CONSIDERED:	29/11/2019
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof L Goldstein and Dr T Baillie-Stanton
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	01/06/2020

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions.Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.** The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **November** and will therefore be due in the month of **November** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

06/06/2020
Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Annexure B – Turn-it-in plagiarism report

Turnitin Originality Report

Processed on: 22-Mar-2022 9:46 PM SAST
ID: 1790353239
Word Count: 4222
Submitted: 1

433192:turnitin_manuscriptv1.docx By Tessa Korda

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	Student Papers:	3%

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"Level 3 guideline on the treatment of patients with severe/multiple injuries", European Journal of Trauma and Emergency Surgery, 2018

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https://bmcsportsscimedrehabil.biomedcentral.com/articles/10.1186/s13102-019-0152-6

< 1% match ()
Kero, Mia, Raunio, Anna, Polvikoski, Tuomo, Tienari, Pentti J., Paetau, Anders, Myllykangas, Liisa. "Hippocampal Sclerosis in the Oldest Old : A Finnish Population-Based Study", 'IOS Press', 2018

Annexure C – Certificate of submission signed by student

CERTIFICATE OF SUBMISSION FOR EXAMINATION OF MASTERS RESEARCH REPORT / DISSERTATION OR PHD THESIS SIGNED BY HIGHER DEGREES CANDIDATES

Full name	Tessa Korda		
Student number	433192		
Title of submitted Research Project: A descriptive study of the accuracy of intercostal drain placement and factors influencing placement. *NB: If this title is different to your previously approved title, no further action can be taken by the Faculty Office until a change of title has been approved.*			
Contact no	0837449203	E-mail	tessakorda@gmail.com

1. If you are likely to move in the next 6-12 months, please give the anticipated date of move: N/A
2. I hereby submit my **Masters (research report)**
3. I have checked all copies of my research report / dissertation / thesis and declare that no pages are missing or poorly reproduced.
4. I have submitted an electronic copy

5. **I confirm that I have:**
   a) A signed declaration indicating my understanding of the concept of plagiarism and a denial of plagiarism in my research document.
   b) A report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document included as an annexure.

6. **I confirm that I have:**
   a) Not used either human or animal tissue or records **No**
   b) If yes: I have included the ethics waiver letter pertinent to my research as an appendix **N/A**
   c) Done research using animals **No**
      If yes: I have included a copy of the animal ethics committee clearance certificate as an appendix in this document **N/A**
   d) Done research using human subjects, human tissue or patient records **Yes**
      If yes: I have included a copy of the human ethics clearance certificate as an appendix to the research document **Yes**

7. I understand that I may not graduate unless my University fees have been paid in full.
8. My Supervisor(s) names, departments, telephone numbers and email addresses are as follows:

Name	Dr T Baillie Stanton		
Department	Emergency Medicine, Rahima Moosa Mother and Child Hospital		
Telephone	0824527137	E-mail	tammy.baillie.stanton@gmail.com
Name	Prof LN Goldstein		
Department	Specialist Emergency Physician & Intensivist, Visiting Associate Professor, University of Johannesburg, Honorary Associate Professor, University of the Witwatersrand		
Telephone		E-mail	drg666@gmail.com

List all publications, which you have published in peer-reviewed journals from your postgraduate research report/dissertation/thesis during the course of your studies in the Faculty of Health Sciences (Include authors, year, title of paper, name of journal, volume number and page numbers). This information is mandatory.

None at time of MMED submission, manuscript submitted to journal but still pending peer review.

Signature of candidate:  Date: 13 May 2022

Annexure D – Study site permissions

Dr Tessa Korda
Department of Emergency Medicine
University of the Witwatersrand
tessakorda@gmail.com
+27 837449203

January 2020

Attn: Clinical Head CMJAH Emergency Department

RE: MMed (Emergency Medicine) Research Site Permission

Dear Prof. Motara

I am a registrar in the Department of Emergency Medicine. I am conducting a study as part of my Master of Medicine in Emergency Medicine, which is titled: A DESCRIPTIVE STUDY OF THE ACCURACY OF INTERCOSTAL DRAIN PLACEMENT AND FACTORS INFLUENCING PLACEMENT

The study will include second year interns, community service officers, medical officers and registrars working in the emergency department. Two simulated patients will be brought in in order to carry out the study.

The study has received provisional ethics approval from the Human Ethics Research Committee (Medical) of the University of the Witwatersrand. Please see the attached letter.

The study will not result in additional cost to the department. The use of one of the departmental ultrasound machines will be required during data collection.

I hereby request permission to conduct research at CMJAH emergency department between January 2020 and December 2020. The length of time may be extended if the minimum number of participants have not been recruited in this time.

I have attached the proposal. Please do not hesitate to contact me for further information.

Thanking you in advance

Yours truly,
Dr Tessa Korda

Registrar – Emergency Medicine
MBBCh (Wits), DipPEC (SA)

Approved / **Declined**

Prof. Motara
Head: Clinical unit – Emergency Department
CMJAH

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

University of the Witwatersrand

Department of Surgery: Charlotte Maxeke Johannesburg Academic Hospital

Post net Suite #235, Private Bag x2600, Houghton 2041 • Telephone +27 (0)11 488-3373 • Fax +27 (0)11 488-4322 • Email: Thembekile.mthembu@wits.ac.za

4th March 2020

To: The CEO
Charlotte Maxeke Johannesburg Academic Hospital
Jubilee Road
Parktown
Johannesburg

Dear CEO

Re: Support of research project of Dr. Tessa Korda (Department of Emergency Medicine).

Good day. This is to confirm that the Department of Surgery of Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) is aware of the research project which Dr. Tessa Korda is planning to perform for her MMed. The title of the study is: ***"A descriptive study of the accuracy of intercostal drain placement and factors influencing placement"***. We support the study. There are no costs or ethical implications to the hospital.

Yours faithfully

Dr. T E Luvhengo
Clinical Head of Department of Surgery
Charlotte Maxeke Johannesburg Academic Hospital

Dr Tessa Korda
Department of Emergency Medicine
University of the Witwatersrand
tessakorda@gmail.com
+27 837449203

January 2020

Attn: Clinical Head CHBAH Emergency Department

RE: MMed (Emergency Medicine) Research Site Permission

Dear Prof. Mahomed

I am a registrar in the Department of Emergency Medicine. I am conducting a study as part of my Master of Medicine in Emergency Medicine, which is titled: A DESCRIPTIVE STUDY OF THE ACCURACY OF INTERCOSTAL DRAIN PLACEMENT AND FACTORS INFLUENCING PLACEMENT

The study will include second year interns, community service officers, medical officers and registrars working in the emergency department. Two simulated patients will be brought in in order to carry out the study.

The study has received provisional ethics approval from the Human Ethics Research Committee (Medical) of the University of the Witwatersrand. Please see the attached letter.

The study will not result in additional cost to the department. The use of one of the departmental ultrasound machines will be required during data collection.

I hereby request permission to conduct research at CHBAH Medical emergency unit between January 2020 and December 2020. The length of time may be extended if the minimum number of participants have not been recruited in this time.

I have attached the proposal. Please do not hesitate to contact me for further information.

Thanking you in advance

Yours truly,
Dr Tessa Korda

Registrar – Emergency Medicine
MBBCh (Wits), DipPEC (SA)

Approved / Declined

Prof. Mahomed
Head: Clinical unit – Emergency Department
CHBAH

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PERMISSION TO CONDUCT RESEARCH

Date: 4th March 2020

TITLE OF PROJECT:

A Descriptive Study of the Accuracy of Intercostal Drain Placement and Factors Influencing Placement.

UNIVERSITY: Witwatersrand

Principal Investigator: Dr T Korda

Department: Emergency Medicine

Supervisor : Dr T Baillie

Permission Head Department (where research conducted): Yes

The Medical Advisory Committee recommends that the said research be conducted at Chris Hani Baragwanath Academic Hospital. The CEO / management of Chris Hani Baragwanath Academic Hospital is accordingly informed and the study is subject to:-

- **Permission having been granted by the Committee for Research on Human Subjects of the University of the Witwatersrand.**
- The Hospital will not incur extra costs as a result of the research being conducted on its patients within the hospital
- The MAC will be informed of any serious adverse events as soon as they occur
- Permission is granted for the duration of the Ethics Committee Approval.

.....
Recommended
(On behalf of the MAC)
Date: 4/3/2020

.....
Approved/~~Not Approved~~
Hospital Management
Date: 06/03/2020

Dr Tessa Korda
Department of Emergency Medicine
University of the Witwatersrand
tessakorda@gmail.com
+27 837449203

January 2020

Attn: Clinical Head Helen Joseph Hospital Emergency Department

RE: MMed (Emergency Medicine) Research Site Permission

Dear Dr Saffy

I am a registrar in the Department of Emergency Medicine. I am conducting a study as part of my Master of Medicine in Emergency Medicine, which is titled: A DESCRIPTIVE STUDY OF THE ACCURACY OF INTERCOSTAL DRAIN PLACEMENT AND FACTORS INFLUENCING PLACEMENT

The study will include second year interns, community service officers, medical officers and registrars working in the emergency department. Two simulated patients will be brought in in order to carry out the study.

The study has received provisional ethics approval from the Human Ethics Research Committee (Medical) of the University of the Witwatersrand. Please see the attached letter.

The study will not result in additional cost to the department. The use of one of the departmental ultrasound machines will be required during data collection.

I hereby request permission to conduct research at Helen Joseph Emergency department between January 2020 and December 2020. The length of time may be extended if the minimum number of participants have not been recruited in this time.

I have attached the proposal. Please do not hesitate to contact me for further information.

Thanking you in advance

Yours truly,
Dr Tessa Korda

Registrar – Emergency Medicine
MBBCh (Wits), DipPEC (SA)

Approved / ~~Declined~~

Dr P Saffy
Head: Clinical unit – Emergency Department
Helen Joseph Hospital

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Gauteng Department of Health
Helen Joseph Hospital
Enquiries: Dr. R .Masilela
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Date: 23 March 2020

Dear Dr Tessa Korda

STUDY: A Descriptive study of the accuracy of intercostal drain placement and factors influencing placement.

RESEARCHERS: Dr Tessa Korda
GP_202003_028
Ethics Number : M1911137

Above the study was discussed at the Research Committee meeting. We recommend that permission be granted for Helen Joseph Hospital to be used as a site for the above research, However , since this is individual /Patients.

Upon completion of the study, copy thereof should be submitted to Helen Joseph Hospital. It is duty of the researcher to collect the data to the relevant department after the Research Committee approved the study.

Thank you

Dr. M Mukansi
Helen Joseph Hospital
Chairperson
DATE:

Approved

Dr. R. Masilela
Helen Joseph Hospital
Acting CHIEF EXECUTIVE OFFICER
DATE: 25/03/2020

Annexure E – Separate copy of abstract

Abstract

Background

South Africa's significant burden of trauma and respiratory disease requires a high rate of intercostal drain (ICD) insertions by emergency centre practitioners. ICD misplacement is associated with significant complications. The aim of this study was to assess ICD insertion site accuracy and the factors affecting accuracy by emergency centre doctors.

Methods

This was an observational simulation-based study. Using ultrasound and an invisible ultraviolet marker, the chest wall structures of two simulated patients of different BMI categories (low and high) were marked. Participants placed stickers bilaterally on both patients at their intended ICD insertion site. Sticker placements were photographed under ultraviolet light and analysed. Accurate placement (within the area above the 6th rib, posterior to pectoralis major and 1cm anterior to the mid-axillary line) and within the British Thoracic Society's 'triangle of safety' was noted. Comparisons of accuracy were made between participant rank (junior vs senior), participant experience (<30 vs >30 ICDs placed), BMI category (low vs high) and placement side (left vs right).

Results

Insertion site was accurate in 47% of placements and within the 'triangle of safety' in 51% of placements. Accuracy was associated with greater participant experience (61% vs. 37%, $p<0.01$), and left-sided placement (54% vs 40%, $p = 0.02$). No difference was found when comparing patient BMI category (low vs high, 43% vs 51%, $p=0.18$) or participant rank (junior vs senior, 41% vs 51%, $p=0.10$). Of all placements, 13% were over muscle or the diaphragm.

Conclusion

Overall accuracy of ICD insertion site was low, and accuracy was only associated with greater participant experience and left sided placement. Further studies to determine methods to improve ICD placement accuracy are needed.

Annexure F – Supervisor submission form

CERTIFICATE OF FINAL SUBMISSION FOR GRADUATION SIGNED BY SUPERVISORS OF HIGHER DEGREES CANDIDATES

Full name	Tessa Korda		
Student number	433192		
Candidate for the degree of: MMed Emergency Medicine _____ *has submitted his/her thesis/dissertation/research report* Entitled: A descriptive study of the accuracy of intercostal drain placement and factors influencing placement.			
Contact no	0837449203	E-mail	tessakorda@gmail.com

Mark with an X on appropriate box	**Yes**	**No**
Has this thesis/dissertation/research report been submitted with the acquiescence of the supervisor?	X	
To the best of your knowledge are you able to verify that: This is the candidate's work except as otherwise stated by the candidate?	X	
The substance (nor any part of it) has not been submitted in the past nor is being submitted for a degree in any other university	X	
The candidate has acknowledged wherever any information used in the thesis, dissertation or other work has been obtained by him/her while employed by, or working under the aegis of, any person or organization other than the University or its associated institutions	X	

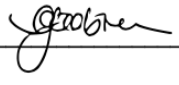
I certify that this thesis/dissertation/research report has the approval of the Animal Ethics Committee / Committee for Research on Human Subjects and the Number of the Certificate of Approval is: ____M1911137_____

List all publications, which your student has published in peer-reviewed journals from his/her postgraduate research report/dissertation/thesis during the course of his/her studies in the Faculty of Health Sciences (Include authors, year, title of paper, name of journal, volume number and page numbers). This information is mandatory.

_____

_____

Name of Supervisor 1: Professor LN Goldstein Telephone: +15614766964

Signature:  E-mail: drg666@gmail.com

Date: 21 September 2022

Name of Supervisor 2: Dr T Baillie-Stanton Telephone: 082 452 7137

Signature: _____ E-mail: tammy.baillie.stanton@gmail.com

Date: 21 September 2022

26/05/2015

Annexure G – ETD Form

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FINAL SUBMISSION OF THESIS, DISSERTATION OR RESEARCH REPORT/PROJECT
(Bound and Electronic Copies)

Faculty of Health Sciences

School of Medicine

Submission of M_____**Dissertation or M** Med **Research/Project or PhD Thesis**
(Note: This form should only be completed at final submission of Dissertation or Research/Project or Thesis)

Payment and submission are for submissions, which have research weighting of 50% or more – so reports where the weighting in relation to the rest of the course work is less than 50% do not have to submit the document.

PLEASE WRITE CLEARLY IN BLOCK LETTERS (If completing form by hand)

1. Name (in full): Tessa Korda
2. Person Number: 433192
3. Present mailing address: 31 Cedarwood, 1076 Cornelius Street, Weltevredenpark

   Postal code: 1709 Fax: Text

   E-mail: tessakorda@gmail.com Cell: 0837449203

   Home tel: Work tel:

4. If you are likely to move in the next 6-12 months please provide the mailing address and effective date of a change in address: N/A

   Effective date:

   Contact telephone numbers:

5. I hereby submit my M_____dissertation or M Med research/project report or PhD thesis.
   (Delete whichever is NOT applicable)

   5.1 If this is research for a Masters by Dissertation or PhD thesis, please provide your ORCID number:

   (*Open Research and Contributor ID (ORCID) – is an alphanumeric code to uniquely identify academic authors and contributors, it is highly recommended that you register and provide this ID. To register or read more see http://orcid.org*)

6. Number of unbound copies: N/A
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"Number of CDs: (Please note: an electronic version must be supported by a copy on CD for submission into the Electronic Theses and Dissertation System (ETD): *ETD Submission Form*

A payment of **R200** must be made at any one of the two beneficiaries below:

Wits University Cashiers Office	**First National Bank** (A copy of the payment receipt must be submitted to the Faculty with the thesis/dissertation)
Account Code: 001.152.4221103.5122609	Branch: Braamfontein Account number: 51360056499 Branch Code: 251905 Swift Code: firnzajja950

7. Declaration:

7.1 I have checked all copies of my dissertation or research/project report or thesis and no pages are missing or poorly reproduced;

7.2 All revisions have been completed in accordance with the recommendations of the examiners and such revisions have been duly approved;

7.3 The electronic copy is identical to the printed copy approved by the Faculty;

7.4 The dissertation or research/project report or thesis complies with the rules relating to abstract and style, copies and formal declaration, duly signed by me, as shown in the General Rules of the University;

7.5 Where any document of which I am not the owner is included in my work, I have obtained and attach hereto the written consent of the holder of the intellectual property rights in such a document allowing distribution as specified in 7.5.1 below;

7.5.1 In the event of copyright permission not being obtainable for visual images or other works, I will not include the full works(s) in my online thesis/dissertation/research report on the ETD system, but undertake to point only to the source (by URL or other means) for such work(s);

7.6 I confirm that I have not used any confidential information in my work without the required permission;

7.7 I have properly acknowledged all sources; and

7.8 I have noted the rules relating to intellectual property and acknowledgement of the award of the programme as shown in the General Rules of the University and the University's Intellectual Property Policy. Insofar as I hold intellectual property rights in my dissertation or research/project report or thesis, and to that extent only, I agree that the University and its agents may archive and make accessible to the public, upon such conditions as the University may determine, my dissertation or research/project report or thesis in its entirety in all forms of media, now or hereafter known.

8. Title of submitted dissertation/research report/thesis:

A descriptive study of the accuracy of intercostal drain placement and factors influencing placement.

(*Please note: if due to unforeseen circumstances, the above title has changed from your previously approved title, no further action can be taken by the Faculty Office until the amendment has been approved by the Faculty).*

8.1 Keywords:

9. Acknowledgement:

I acknowledge that my dissertation or research/project report or thesis may be placed in the archive of electronic theses and dissertations. I acknowledge that it may be made electronically available in its entirety on the ETD system from four months after the date of submission unless permission for further embargo has been approved by Senate and communicated in writing by myself to the University Research Office, Library and Central Records Office.

The following files are on this CD (*please specify format*):

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The following parts of the work may be released immediately for electronic access worldwide:
(Only if an official embargo has been agreed to in terms of General Rule G19 will your abstract not be made available for the agreed period).

Abstract and key bibliographic data (i.e. from submission form)

I acknowledge that I am not entitled to the return of the copies of the dissertation or research/project report or thesis or other work I have submitted for the programme.

10. Did your research involve animal experimentation or the use of human subjects, human tissue or other material, or patient records?

- [X] Yes
- [ ] No

If yes, please certify that clearance was obtained from the relevant, approved, University ethics committee:

Clearance number(s): M1911137

11. I understand that I will not graduate unless my University fees have been paid in full.

12. I understand that if I am in material breach of any of the rules, term and conditions governing the submission of a dissertation or research/project report or thesis at the University I may not graduate or it may result in the revocation of the awarded award.

13. The University is not responsible for the safekeeping of the information constituting a dissertation or research/project report or thesis. Should a student use the University ETD system for keeping of a dissertation or research/project repot or thesis in progress responsibility for the maintenance, security and back-up of such work lies with the student. The student absolves the University of any liability whatsoever for any loss or damage to a dissertation or research/project report or thesis and/or information contained in them howsoever it occurs. The student indemnifies and hold the University harmless against any claims or liability whatsoever for any loss or damage to a dissertation or research/project report or thesis and/or information gathered for that purpose or contained in any dissertation or research/project report or theses howsoever it occurs.

14. Candidate:

14.1 The candidate must attach an original "Certificate to Accompany Higher Programmes Research Report" from his/her supervisor(s).

14.2 Is this dissertation or thesis supported by funding from *(please tick):*

☐ DST – NRF (e.g. CoE's; SARCHi Chairs; Innovation; African Origins Platform; Knowledge, Interchange and Collaboration; etc.) [*Please underline the programme that applies]*

☐ DST – CSIR (e.g. NEPTTP e-Research; etc.)

☐ Other (*Please list the full name of the funder*): N/A

Signature of candidate: _____ Date: 16/09/2022

15. Supervisor(s):

I confirm that I provided academic oversight as supervisor during the completion of the degree

Name of supervisor: Professor LN Goldstein

Discipline: Emergency Medicine

School: Clinical Medicine

Signature of Supervisor: _____ Date: 21 September 2022

I confirm that I provided academic oversight as supervisor during the completion of the degree

Name of second Supervisor (*if more than one*): Dr Tamsyn Baillie-Stanton

Discipline: Emergency Medicine

School: Clinical Medicine

Signature of Supervisor: _____ Date: 3 October 2022

FOR FACULTY OFFICE USE

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- ☐ An electronic copy of the abstract of the dissertation or research report or thesis and receipt for the ETD payment submitted and forwarded to CENTRAL Records Office (refer to section 6)

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2. Please tick the appropriate box below to indicate the percentage of the research component award:

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- ☐ Ethics Committee clearance number indicated – if applicable (refer to section 10)
- ☐ Copy of this submission form and attachments included with copies sent to Central Records Office – for forwarding to Library. **Originals placed on student file.**

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