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Research Article

Comparison between Ultrasound Guided Vs Blind Central Line Insertion and Related Complications

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Abstract

Background: Central venous catheters (CVCs) are widely used nowadays in critically ill patients. Nonetheless, CVCs insertion involves a high risks that increases morbidity and even mortality. This study compares the success rates and complications between Ultrasound Guided and Blind Insertion of CVCs.

Objectives: To analyze the clinical outcomes of Central Venous Line Ultrasound guided insertions versus blind insertion.

Methods: A quantitative analytical cross sectional retrospective study was conducted at King Abdulaziz Medical City in July - September 2019. The data was collected from the BEST CARE system and the hospital medical files. All adult patients receiving CVCs between January 2015 and January 2018 were included in the study, excluding motor vehicle accident patients and those who are under 18 years of age. After applying the inclusion and exclusion criteria, the data was statistically analyzed using Statistical Package for the Social Sciences (SPSS).

Results: A total of 379 patients were included in the study. Out of 379 patients, Ultrasound guided technique was used among 190 (50.1%) patients and Blind Central line technique in 189 (49.9%) patients. In 186 (49.1%) patients the site of insertion was the Right Internal Jugular Vein. Complication was observed in 19.3% patients with the maximum for the Blind Central Line insertion technique (72.6%) and was statistically significant with p value 0.001. The number of attempted punctures was more for Blind insertion (52%) than with Ultrasound guided technique (48.1%) with a p value > 0.05.

Discussion and Conclusion: Using ultrasound guided insertion of central line has decreased the number of punctures and complication rates compared to blind insertion, and this will help increase success rate and patient safety.

Keywords: *Central Venous Catheters (CVCs); Internal Jugular Vein; Subclavian Vein; Femoral Vein*

Introduction

Central venous catheters (CVCs) are specialized catheter that could be utilized in critically ill patients [1]. CVCs are usually used with patients who require continuous intravenous access, such as chemotherapies, kidney dialysis, continuous blood analysis, patients who require large amounts of fluids, and also in patients with difficult peripheral access [2,3]. It is also used to monitor right atrial pressure [4]. CVCs are inserted into central veins such as, Internal jugular vein, Subclavian vein and femoral vein [4]. The central venous catherization is a highly risk procedure which requires knowledge and experience, failing to have enough experience can lead to complications, such as,

air embolism, hematoma, infection, pneumothorax and thrombosis, as well as catheter malposition [5,6].

The blindly insertion procedure has higher risk of causing post procedure complications. According to Xia, 536 patients had ultrasound guided central venous lines. The success rate of central venous line guided ultrasound was 98.32% [7,8]. Furthermore, according to Pieper D, 1000 patients went through central venous lines without using ultrasound, the outcome showed that the complication rate is 135 per 1000, which is higher comparing to the ultrasound guided which was 39 per 1000 patient [9,10]. According to Fabrizio Brescia, a retrospective cohort study was conducted at Aviano national cancer institute in 2019 and 80 patients were involved [11]. Ultrasound guided cannulation was performed, and the success rate was 96% [12,13]. This study proves that using ultrasound guided technique will help decrease complications and increase the success rate [14,15].

Aim of the Study

The aim of this study is to analyze whether central venous line ultrasound guided will minimize the complications related procedure in comparison to blindly inserted central venous line.

Objectives of the Study

To analyze the clinical outcomes of central venous line guided ultrasound versus blind central venous line insertion in King Abdulaziz Medical City, Riyadh, Saudi Arabia.

Specific Objectives

The specific objective is to assess the effectiveness of central venous line ultrasound guided compared to blind insertion.

Methods

This study is a quantitative analytical cross-sectional retrospective study. It was conducted in King Abdulaziz Medical City (KAMC), Riyadh, Saudi Arabia during July - September 2019. KAMC is a tertiary hospital with a bed capacity of 1796 and 45 operating rooms. KAMC has passed the requirements for accreditation under the (JCI) Joint Commission International standards with excellent performance in December 2006. The research setting was conducted in the operating theatres that included the main operating theatres, cardiac operating theatres and the catheterization laboratory, liver and renal transplant theatres as well as the intensive care unit and the emergency department. The time frame of the study was during (January 2015 - January 2018).

All adult patients that received central venous lines at King Abdulaziz Medical City, including central venous line blindly and ultrasound guided insertions, were subjects of this study. The included subjects' data were collected from the main operating theatres, cardiac operating theatres and the catheterization laboratory, liver and renal transplant operating theatres, intensive care unit and the emergency department. The Exclusion criteria were motor vehicle accident patients, and patients under 18 years old. According to King Abdulaziz Medical City, the roughly estimated population of patient's receiving central venous line per year is 3000. The minimum sample size calculated was 369 patients. Calculated using Raosoft online sample size calculator. A total of 379 patients were included in the study. Population size is 9000. Confidential level is 95% and the margin of error is 5%. The minimum Sample size is 369, and 379 patients were included in the study.

The sampling technique used in this research was the non-probability convenience method. The instrument that was used to collect the data is the patient's medical file and electronic medical files, which is known as the best care system at the King Abdulaziz Medical City. We went through the anesthesia charting, nursing notes, and the patient's file to collect the data using a data collection sheet. The Institutional Review Board Approval from King Abdullah International Medical Research Center (KAIMRC) was sought before the initiation

of the study. The confidentiality and anonymity of the subjects in this study was maintained through a password protected excel sheet. After applying the inclusion and exclusion criteria, the collected data was entered in Microsoft Excel and then was exported to one of the statistical programs, which is SPSS for analysis. Chi square test was used to compare different study groups.

Results

A total of 379 patients who had central venous lines inserted were included in the study. The majority were males (57%) with a mean of 58 (SD ± 18.2) years. The majority of patients were ASA 4 with a percentage of 50.7%. Out of 379, Ultrasound guided technique was used among 190 (50.1%) patients and Blind Central line technique in 189 (49.9%) patients. In 186 (49.1%) patients the site of insertion was the Right Internal Jugular Vein (Table 1 and 2).

Variable	Frequency %
Gender	
Male	216 (57%)
Female	163 (43%)
Department	
ICU	77 (20.3%)
ANGIO	138 (36.4%)
ER	24 (6.3%)
OR	66 (17.4%)
OR (transplant)	74 (19.5%)
Techniques	
Ultrasound guided	190 (50.1%)
Blind central line	189 (49.9%)
Total	379 (100%)

Table 1: *Demographic details of subjects.*

Site of insertion Ultrasound guided		Technique (blind or US)		Total
		Blind Central line		
Site of insertion	Left Internal Jugular Vein	21(11.1%)	13 (6.9%)	34 (9.0%)
	Right Internal Jugular Vein	105 (55.3%)	81 (42.9%)	186 (49.1%)
	Left Subclavian Vein	3 (1.6%)	9 (4.8%)	12 (3.2%)
	Right Subclavian Vein	4 (2.1%)	20 (10.6%)	24 (6.3%)
	Left Basilic Vein	4 (2.1%)	2 (1.1%)	6 (1.6%)
	Right Basilic Vein	28 (14.7%)	6 (3.2%)	34 (9.0%)
	Left Femoral Vein	5 (2.6%)	12 (6.3%)	17 (4.5%)
	Right Femoral Vein	10 (5.3%)	44 (23.3%)	54 (14.2%)
	Left Brachial Vein	1 (0.5%)	2 (1.1%)	3 (0.8%)
	Right Brachial Vein	9 (4.7%)	0 (0.0%)	9 (2.4%)
Total		190 (100.0%)	189 (100.0%)	379 (100.0%)

Table 2: *Site of insertion and technique.*

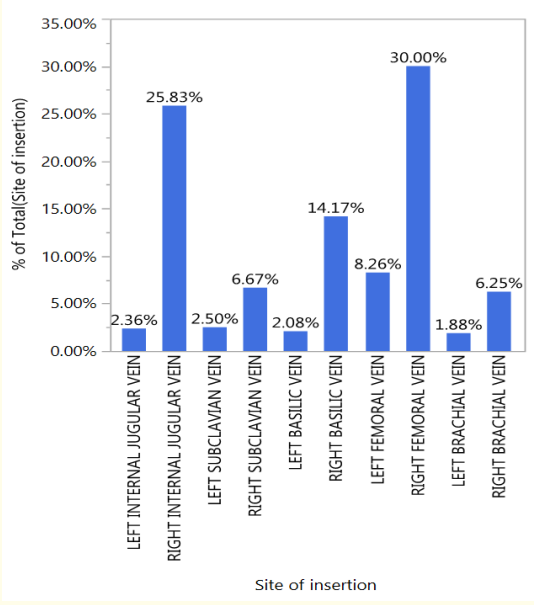
Complication was observed in 19.3% patients with the maximum for the Blind Central Line insertion technique (72.6%) and was statistically significant with (p = 0.001). The number of attempted punctures was more for Blind insertion (52%) than with Ultrasound guided technique (48.1%) with a p value > 0.05 (Table 3).

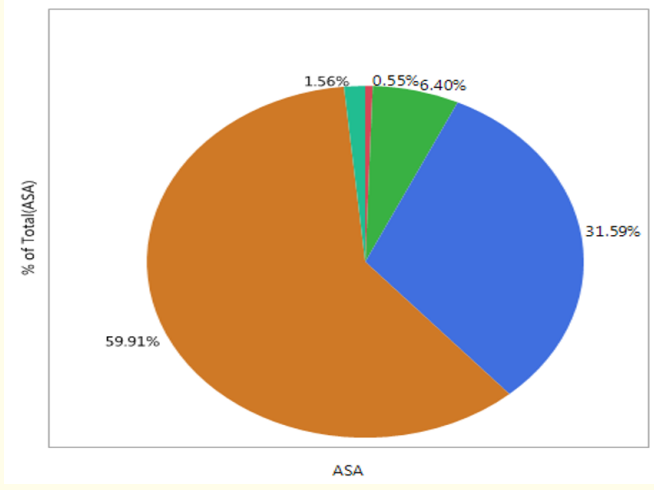
Variable	Technique used		Total	Test Statistic	P value
	Ultrasound guided	Blind Central Line			
	No. (%)				
Complication				Chi square = 18.693	0.001*
Yes	20 (27.4)	53 (72.6)	73 (100)		
No	170 (55.6)	136 (44.4)	306 (100)		
Total	190 (50.1)	189 (49.9)	379 (100)		
No. of attempts				Chi square = 0.165	0.685
One attempt	152 (80)	148 (78.3)	300 (79.2)		
>=2	38 (20)	41 (21.7)	79 (20.8)		
Total	190 (100)	189 (100)	379 (100)		

Table 3: *Type of techniques used with the complication and No. of attempts.*

**: Statistically significant at 5%.*

The findings of our study show that by using ultrasound guided insertion of central line, the number of punctures and complication rate decreased compared to blind insertion, this lead to that the use of ultrasound guided central line insertion increases the success rate and patient safety.





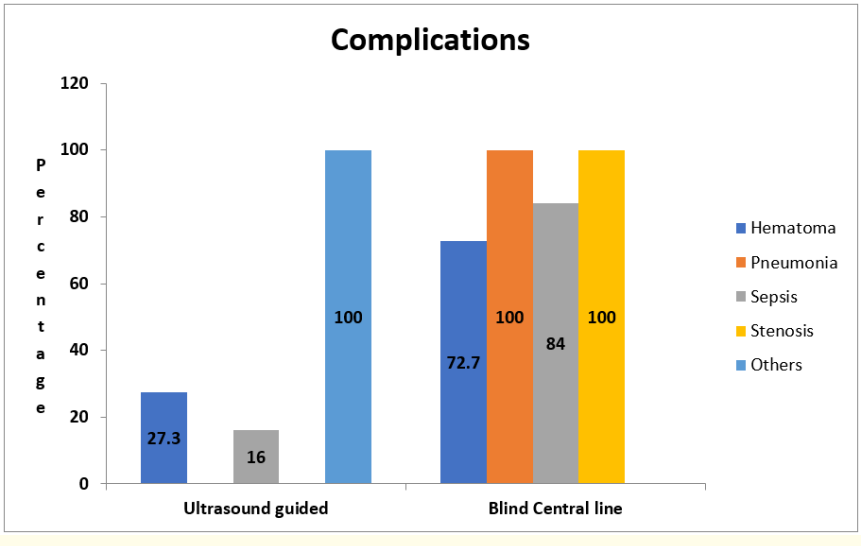


Figure A

Discussion

The results of our study demonstrates that by using ultrasound guided insertion of central line, the number of punctures and complication rate will decrease by more than fifty percent compared to blind insertion and this will help increase success rate and patient safety. The findings of our study shows that by using blind insertion of central line, the number of attempts to insert the central line will increase to more than one puncture and those patients were exposed to infection. Success rate in the ultrasound-guided group in this study was found to be consistent with findings of previous studies using a similar technique. A study that was conducted at the Washington university school of medicine, 333 patients were included [16]. Complications for blind insertion of central line were 74% [16]. A prospective study done during the period of 2015 and 2016 at the Sistina Clinical Hospital in Macedonia, 400 patients were included and divided into two groups [16]. Ultrasound guided vs blind insertion. In the ultrasound group the success on the first attempt was 77% [16]. Blind insertion of central line has shown high complication rates and low success rates in the matter of number of punctures [16]. This method is

associated with complications that result in increased morbidity, longer hospital stay, increased expenses and mortality [16]. The use of direct ultrasound for central venous catheterization enables direct visualization of the targeted vein and surrounding structures before and during the catheterization. Studies show increased success and reduced complication rate with the use of direct ultrasound insertion.

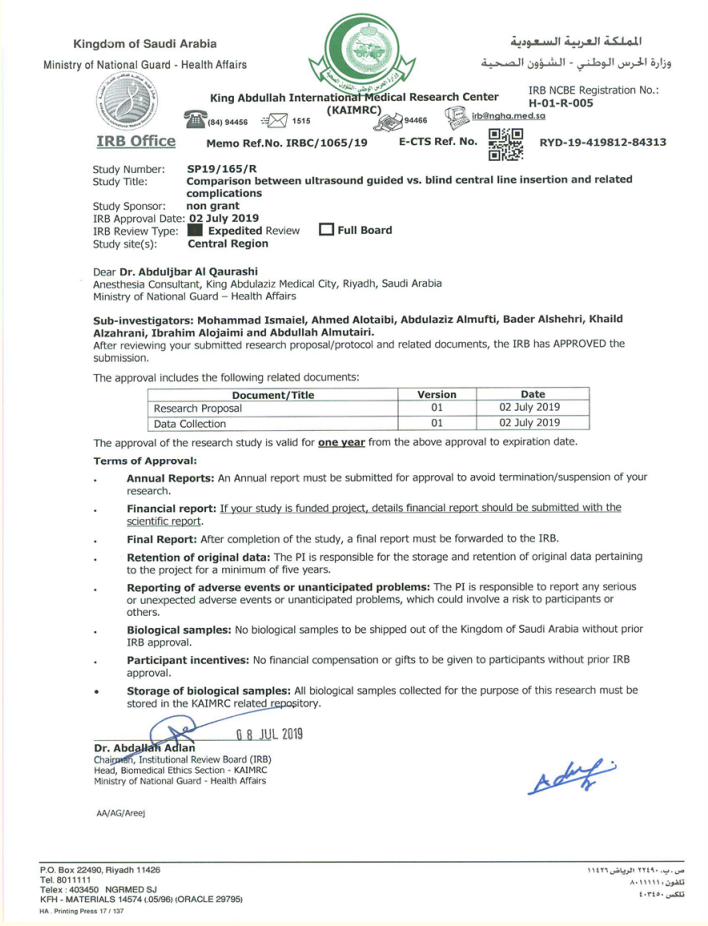
Conclusion

Ultrasound guided central line insertion can improve patient safety and quality. The results of our study demonstrates that by using ultrasound guided insertion of central line, the number of punctures and complication rate will decrease compared to blind insertion and this will help increase success rate and patient safety. The department of anesthesia in King Abdulaziz Medical City, Riyadh, Saudi Arabia has made a policy that all central venous line insertions must be ultrasound guided.

Limitations of the Study

The healthcare provider and the puncture timing are two of the variables in our data collection sheet that could not be found, because they were not documented on either the nursing notes or the medical records. They did not affect our study objectives and were excluded.

Appendix



Kingdom of Saudi Arabia
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King Abdullah International Medical Research Center (KAIMRC)
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IRB Office
Memo Ref.No. IRBC/1065/19
E-CTS Ref. No. RYD-19-419812-84313

Study Number: SP19/165/R
Study Title: Comparison between ultrasound guided vs. blind central line insertion and related complications
Study Sponsor: non grant
IRB Approval Date: 02 July 2019
IRB Review Type: ■ Expedited Review ☐ Full Board
Study site(s): Central Region

Dear Dr. Abduljbar Al Qaurashi
Anesthesia Consultant, King Abdulaziz Medical City, Riyadh, Saudi Arabia
Ministry of National Guard – Health Affairs

Sub-investigators: Mohammad Ismaiel, Ahmed Alotaibi, Abdulaziz Almufti, Bader Alshehri, Khaild Alzahrani, Ibrahim Alojaimi and Abdullah Almutairi.
After reviewing your submitted research proposal/protocol and related documents, the IRB has APPROVED the submission.

The approval includes the following related documents:

Document/Title	Version	Date
Research Proposal	01	02 July 2019
Data Collection	01	02 July 2019

The approval of the research study is valid for one year from the above approval to expiration date.

Terms of Approval:

- Annual Reports: An Annual report must be submitted for approval to avoid termination/suspension of your research.
- Financial report: If your study is funded project, details financial report should be submitted with the scientific report.
- Final Report: After completion of the study, a final report must be forwarded to the IRB.
- Retention of original data: The PI is responsible for the storage and retention of original data pertaining to the project for a minimum of five years.
- Reporting of adverse events or unanticipated problems: The PI is responsible to report any serious or unexpected adverse events or unanticipated problems, which could involve a risk to participants or others.
- Biological samples: No biological samples to be shipped out of the Kingdom of Saudi Arabia without prior IRB approval.
- Participant incentives: No financial compensation or gifts to be given to participants without prior IRB approval.
- Storage of biological samples: All biological samples collected for the purpose of this research must be stored in the KAIMRC related repository.

08 JUL 2019

Dr. Abdallah Adlan
Chairman, Institutional Review Board (IRB)
Head, Biomedical Ethics Section - KAIMRC
Ministry of National Guard - Health Affairs

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RYD-19-419812-84313

KAIMRC APPROVED IRB

Data Collection Sheet

Encrypted identification	Age	Gender	Department (e.g. ICU, OR)	Technique (Ultrasound or Blindly)	Complications
Healthcare provider (e.g. Consultant, Resident)	Number of attempts	Duration of insertion	Site of insertion	ASA	

Figure A

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