# Comparative Study between an Ultrasound-Guided Techniqueversus Landmark-Guided Technique for Internal Jugular Vein Cannulation in end stage renal disease with regular dialysis who exposed to previous cannulations

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**Abstract:** Central venous cannulation is a commonly used procedure in anesthesia and critical care medicine. **The aim of this study** was to illustrate which is better in IJV catheterization ultrasound or conventional landmark method. **Methods** of this study was performed on 20 patients by ultrasound and another 20 patients by land mark method. **Results** of study reveal better success by ultrasound by90% and in land mark 50% and lesser complications by 35% for ultrasound and 70% for landmark method. **The conclusion** is that using US reduces the c0mplications rate and provides high success rate, gurantees short duration of the procedure.

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## 1. Introduction

Internal jugular vein (IJV) catheterization uses are multiple such as obtaining hemodynamic monitoring, administration of fluids, total parenteral nutrition, and hem dialysis. Complications are associated by many factors such as B0dy Mass Index (BMI) [**1, 2**]. Ultrasound is associated with better success rate and lesser complications than conventional landmark method [**3**]. The ultrasound method has priority compared to the landmark technique, IJV is better to be chosen because of its anatomical position and easy accessibility and large diameter especially in the Trendelenburg position [**4,5**]. This study is aiming to compare between ultras0und and landmark meth0d in canuulation of IJV in ESRD patients who were exposed to previous cannulations as these patients may have fibrosis and distorted anatomy in IJV course regarding success rate, duration of cannulation and complications.

**Aim of the work**

The aim of this study is comparative between ultrasound and the landmark method in internal jugular vein catheterization in end stage renal disease patient who had exposed to previous internal jugular vein cannulation (s) making further attempt very difficult due to distorted anatomy

## 2. Materials and Methods

Our study was conducted in Benha university hospitals, from March 2016 to April 2017. During the study period we enrolled 120 patients. all patients were received many central venous catheters previously for aim of hemodialysis. All patients were allocated in two groups each group Contained 60 cases.

**Group A**: 60 patients operated by landmark technique.

**Group B**: 60 patients operated by ultrasound technique.

Data from the study population included the following: .

Patient's age, gender, BMI, site of cannulation, duration of procedure (time from skin disinfection to correct cannulation confirmed by chest x ray), success rate, number of attempts and complications recorded. .

Inclusion criteria.

Adult patients ages were more than 18 years old and ESRD on regular dialysis as they were exposed to previous IJV cannulations leaving neck fibrosis and distorted neck anatomy..

**Exclusion Criteria**

Severe coagulopathy (prolonged prothrombin time, platelets less than 50000/cmm, history of anticoagulant therapy, DIC and documented inherited

coagulation disorder), hemodynamicaly unstable patient and local infection at site of cannulation.

For both groups basic monitoring was done. The basic monitoring includes blood pressure, heart rate, SPO2 and ECG.

All patients in the study were subjected to the following:

1. Complete history taking.
2. Full clinical examination.
3. Labs (platelets count, PT, PTT, INR and PC).

**Preparation before procedure:**

Trendelenberg was better for internal jugular vein cannulation. The sterile technique included the operator wearing sterile gown, mask, cap, and sterile gloves. The area was prepared with provide one iodine. Lidocaine 2% was used to anesthetize by 3cc syringe the venipuncture area as well as the suture area. The venipuncture area located in anterior triangle of the neck which was determined by two heads of sternomastoid muscles and clavicle. The venipuncture area was the apex of the anterior triangle. The 26-gauge needle was advanced while applying negative pressure to the syringe until flow of blood was visualized. The Seldinger technique was used to insert the catheter. After catheter insertion 2/0 Silk suture used to fixate the catheter in place then sterilized dressing was used to cover catheter. Chest x ray was done for each patient to confirm placement of the catheter. The catheter used was non tunneled hemodialysis catheter with double lumen..

**Landmark technique (Anatomical method**

We used anterior approach for internal jugular vein catheterization the apex of the anterior triangle was identified by location between two heads of sternomastoid muscle and clavicle. The IJV was placed in deep position in that space. The carotid pulse was identified and the puncture was performed through anterior triangle apex, directing the needle towards the ipsilateral nipple. Once blood aspiration was confirmed, the CVL was placed using Seldinger's technique. Control of the central catheter position was performed by chest x-ray.

**Ultrasound guided Technique**

The ultrasound device used was Philips HD11 XE in (2D) mode with a linear transducer of 8 MHz was used in all procedures. The transducer was covered with ultrasound gel and wrapped in a sterile plastic bag. Sterile physiological saline solution was spread on the patient's skin to eliminate the air interface between the skin and the plastic bag. The transducer was placed in a transverse position to the patient's neck axis, also the transducer was longitudinally. The ICA was identified as a round and incompressible structure. The IJV was identified because it is placed in front and outwards with respect to the ICA, it is compressible. In longitudinal view the vessels appeared as tubes like structures and vein was compressible and artery non compressible. In case of finding a non-compressible vein (intraluminal thrombus), catheterization was attempted through the contralateral side. Each procedure was carried out by a single operator, who performed the ultrasound scan and the puncture simultaneously. Vein penetration was confirmed objectively when the tip of the puncture needle was visualized inside the vein or when blood return was obtained. Once inside the vein, the CVL was placed using seldinger's technique. Control of the central catheter position was performed by thorax radiography in all cases.

**Statistical Methods**

Data management and statistical analysis were performed using Statistical Package for Social Sciences (SPSS) vs. 23.

Numerical data were summarized using means and standard deviations. Categorical data were summarized as numbers and percentages. Comparisons between the 2 groups were done using independent t test. For categorical variables, differences were analyzed with $\chi^2$(chi square) test and Fisher's exact test when appropriate.

All p-values are two-sided. P-values < 0.05 were considered significant.

## 3. Results

**Table (1) demographic data**

| | | U.S | Landmark | P value |
|---|---|---|---|---|
| **Age ( Years)** | Mean ±SD | 51 ±13 | 50 ±11 | 0.7 |
| **Sex** | Male n (%) | 33 (55.0) | 33 (55.0) | 1 |
| | Female n (%) | 27 (45.0) | 27 (45.0) | |
| **BMI** | Mean ±SD | 23.8 ±2.8 | 23.5 ±3.8 | 0.593 |

**Table (2) number of attempts and duration of cannulation**

| | | U.S | Landmark | P value |
|---|---|---|---|---|
| **Number of attempts** | Mean ±SD | 1 ±0 | 4 ±1 | <0.001 |
| **Duration of cannulation (Minutes)** | Mean ±SD | 11 ±1 | 13 ±4 | <0.001 |

**Table (3)**

| | | U.S | | Landmark | | |
|---|---|---|---|---|---|---|
| | | N | % | N | % | P value |
| **Complications** | Arterial puncture | 0 | 0.0 | 12 | 40.0 | NA |
| | Hemothorax | 0 | 0.0 | 3 | 10.0 | |
| | Pneumothorax | 0 | 0.0 | 6 | 20.0 | |
| | Puncture hematoma | 0 | 0.0 | 9 | 30.0 | |

**Table (4)**

| | | U.S | | Landmark | | |
|---|---|---|---|---|---|---|
| **Success rate** | Success | 54 | 90.0 | 30 | 50.0 | <0.001 |
| | Fail | 6 | 10.0 | 30 | 50.0 | |

## 4. Discussion

Central venous catheters (CVCs) are used in application of parenteral nutrition, long-term antibiotics, chemotherapy, intravenous fluids, blood components and are also used for repetitive blood sampling, hemodialysis, plasmapheresis and in the case of shortage of a peripheral access [(6)].

Complications include the pneumothorax, hemothorax and Mal-positioning is the most common problem with migration of the catheter to the contralateral subclavian vein or more frequently to one of the internal jugular veins [(7)]. Ultrasound guidanceisbetter than conventional landmark of central venous catheter (CVC) insertion as improving success rates and reduces complications [(8)].

In 1984 by *Legler and Nugent*, are the first users of ultrasound in CVC insertion [9].

In table (1) 120 patients, 55% were male and 45% were female. The demographic findings of our patients were including age, gender, BMI. In terms of demographic data, no significant difference was noted between the groups.

. In table (2) less numberof trials and less duration of procedure used in ultrasound operated group in comparison to landmark group

. In a study by *Denny* [10] and colleague's including 1,230 patients, IJV catheterization was applied by the anatomic landmarks technique in 302 patients, and ultrasound was used in 928 patients. In this study *Denny* compared the duration, cannulation time started when needle is contact to the skin and ended with the aspiration of blood from the central venous catheter, but in our study we asses duration from skin disinfection till confirmation by chest x ray. More time consumed to obtain access (44.5 seconds; range, 3-1,000 seconds; p<0.001), more trials (2.5 seconds; range, 1-28 seconds; p<0.001), and successful catheterization on the first attempt occurred in only 116 patients. Venous access was not achieved in 36 patients (ll.9%, p<0.001), and the complication rate was significantly higher (p<0.001). Also, ***Nadig*** 1998[11] reported significantly less time required for successful vein puncture from the time the skin was anaesthetized with real-time ultrasound guidance. ***Pozzoli M et al*** found the time to perform cannulation was not significantly different using either two methods [12].

In table (3) no complications detected in patients operated by ultrasound and most common complication in landmark group is arterial puncture and least found complication is hemothorax CVCs insertion may be associated with complications that very risky to patients [13]. Mechanical complications such as arterial puncture, pneumothorax and haemothorax are reported to occur in 5% to 19% of patients but infectious complications in 5% to 26%, and thrombotic formation in 2% to 26% [14, 15]. Factors influencing occurrence of these complications include patient anatomy as morbid obesity, or local scarring from surgery and central vein stenosis [4, 16-18]. Real-time ultrasound guidance of CVC insertion provides better visualization of IJV and adjacent structure. Ultrasound method has superiority in decreasing complications and provides better success rate [4, 10, and 19].

In table (5) as regard success rate in ultrasound operated patients is 90%and in landmark operated patients 50% and p value (.006) also significant. Mallory *et al*. and Denys *et al*. showed statistically difference between ultrasound and anatomical landmark [10,19]. Similarly, Chuan*et al*. also showed superiority of using ultrasound versus landmark (80% vs. 100%) in their study, in infants' [20].

In a study by *milling* there was no difference in success rate or complications when 2persons perform the procedure versus one person [21].

In our study all interventions were performed by a single person. Our study showed superiority of use ultrasound in IJV cannulation in decreasing duration limiting complications providing better success rate, a study with a larger number of patients might be more determinant on complication rates.

## 5. Conclusion

Our prospective study including 120 patients ESRD previously cannulated demonstrated that during

IJV cannulation using in-plane technique with US guidance is better than the landmarks technique regarding to success rate of the first trial. There was statistical difference found between the two groups for total complications. Also using US should reduce the number of arterial punctures and required invasive interventions shorten the duration of the procedure.

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