Research Article

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A Prospective Study of Central Venous Catheterization in Lagos University Teaching Hospital, Nigeria

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Keywords
Central venous catheter, Pulmonary diseases, Tuberculosis.

Appendix I
COPD: Chronic Obstructive Pulmonary Disease; PTB: Pulmonary Tuberculosis.

Introduction
Central venous catheterization refers to insertion of a catheter into one of the large veins. It is done using the Seldinger's technique. This technique of venous access has been in use since the 50s, and can be performed using the internal jugular, subclavian, or femoral veins. The subclavian vein is usually preferred because of its distinct landmarks and low rates of complications associated with it. [1-5]. Femoral venous catheterization is not advised due to increased risk of infectious and thrombotic problems [1-3].

It is a routine procedure in the intensive care unit (ICU), and in accident and emergency (A & E) department. It is however also now commonly done in the wards especially in patient in whom peripheral access is difficult such as patients in shock, very obese patients etc. it is also routinely done in theatres in patients undergoing major surgical intervention where it is used for measurement of the central venous pressure and also makes available multiple ports for infusion of intravenous fluids, blood and drug administration.

The indications for Central venous catheterization include: Inability to obtain peripheral access, especially in critically ill patients, administration of Chemotherapeutic agent, total parenteral nutrition, pre-operative preparation of patients, intra operative monitoring of patients, administration of Ionotropic agents for cardiovascular support in critically ill patients, transvenous pacing wire introduction, hemodialysis and Pulmonary artery catheterization.

Central venous catheterization should be done by experienced physician especially the subclavian route, as complications associated with this procedure can be life threatening. However, even intern doctors can learn this skill be proficient at the technique. Strict asepsis is key to preventing associated infections and ultrasound guidance has been suggested in ensuring safety and reducing mechanical complications associated with central line insertion.

Though a very good option of venous access, significant morbidity and even mortality can occur. Several complications have been recorded which includes infectious (5-19%) [1,2,6], thrombotic (5-26%)[1] and technical or mechanical (2-26%) [7-9] complications. These include infection (catheter - related blood stream infection – CRBSI), arterial puncture, air embolism, hematoma, hemothorax, pneumothorax, bleeding (especially in patients with coagulation abnormalities, patients on anticoagulants and raised venous pressure), misplacement of guide wire, cardiac arrhythmias, puncture of the right atrium with subsequent cardiac tamponade, chylothorax (on the left) etc.

It is worth noting that complications arising from central venous line insertion can be very challenging and costly to manage. Measures aimed at reducing the rate of complications over the years included: ensuring sterility of the procedure[8], ensuring only adequately trained and experienced physicians carry out the procedure, use of ultrasound guidance [10,11], placement of patients in Trendelenburg position, adequate landmark identification, ensuring a post insertion chest X-ray, preference for the subclavian route than the internal jugular access (due to its

more consistent anatomy), removal of the catheters once no longer indicated and use of antibiotic impregnated catheters [12,13].

This prospective study was done to determine the bio-demography, diagnosis, indication, route and complications of central venous catheterization in our unit over a two-year period.

Materials and Methodology

Study design

The study was a prospective hospital based one, involving patients requiring central line insertion in Lagos University Teaching Hospital between the period of 2013 to 2014 (2 year period). These included patients in the Ward, adult and children emergency, theatre, intensive care unit (ICU) and private ward of the hospital.

Patients excluded from this study included

- Patients with bleeding disorders and actively bleeding

Consent

Informed consent wasobtained from the patients or parents (for children) before being enlisted for the study. Approval was also obtained from the managing consultant before enrolling the patients

Study Population

The study was conducted on patients including children requiring central line insertion, presenting at the Accident and Emergency centre (A/E), Children Emergency Room (CHER), consults from various wards in the hospital, intensive care unit and theatre, at the Lagos University Teaching Hospital (LUTH).

LUTH is a major referral centre in Lagos State. It is an 850-bed hospital with various out-patients' clinics and two emergency rooms - Accidents and Emergency room and Children's Emergency Room (CHER).

Data collection

All patients who met the inclusion criteria presenting between 2014 and 2015 in Accident and Emergency centre, Children Emergency Room, consults from various wards in the hospital, ICU and theatre, were administered with the Proforma after obtaining informed consent. Data was collected in such areas as biodata, indication and purpose of central line insertion, diagnosis, complication and duration of catheters in-situ.

Data analysis

Data collected was collated and analysed using statistical package for social science (SPSS) version 21. Results were presented using tables, charts and diagrams. Test of significance was used where necessary.

Results

A total of 106 central venous cannulation was done. The result analysis is as shown in the tables and charts below.

Majority of the procedure was done in the Accident and Emergency (21.7%) and medical ward (A, E {Medical}) - (18%). In the surgical wards (B, E{Surgical}), 11 patients (11.6%) had the procedure. 7.5% were done in the intensive care unit with the least in children emergency (0.9%). This is illustrated table 1 below.

Table 1: Distribution of Wards.

Ward	Frequency	Percentage
A	11	10.4
B	8	7.5
C	2	1.9
D	16	15.1
E (Surgical)	3	3.7
E (Medical)	9	7.6
A/E	23	21.7
CHER	1	0.9
Theatres	18	17.0
ICU	8	7.5
E8	7	6.6
Total	**106**	**100.0**

The age range of patients was between 10 months and 82 years, with a mean of 37.35 years. 10.3% of the patients were elderly (>65 years), while 18.9% were 5 years and below. Majority of the patients were middle aged (45-64years). These made up 34%.

The male female ratio was 1:1.4 with females making up 58.5% of the cases.

Table 2 shows the indication for insertion of central lines in these patients. A vast majority were for inability to obtain venous access (71.7%). Another 14.2% was pre-operative, while only 1.9% was for ionotropic support.

Table 2: Indications for Central line insertion.

Indication	Frequency	Percentage
Inability to obtain peripheral access	76	71.7
Chemotherapy	4	3.8
Total parenteral nutrition	9	8.5
Pre operative	15	14.2
Ionotropic support	2	1.9
Total	**106**	**100.0**

Figure 1 below shows that majotiry of the patients were diagnosed with medical conditions, accounting for 42.5% of the cases, while surgical conditions followed closely with 33%. Only 2.8% were patients with traumatic condition and 5.7% oncological. Sepsis was the leading cause of central venous cannulation (15.1% - 13.2% medical and 1.9% Obstetric/Gynaecological conditions), followed by intestinal obstruction (6.6%), as demonstrated by Table 3. Of the medical conditions, Sepsis was the leading cause of central venous cannulation (13.3%), then, heart failure and stroke (5.7% each), making up 31.1%, 13.3% and 13.3% of the medical conditions respectively. However, Intestinal obstruction, Peritonitis and Burns were responsible for 20.0%, 11.4% and 11.4% of surgical conditions respectively (6.6%, 3.8% and 3.8% of central venous cannulation respectively).

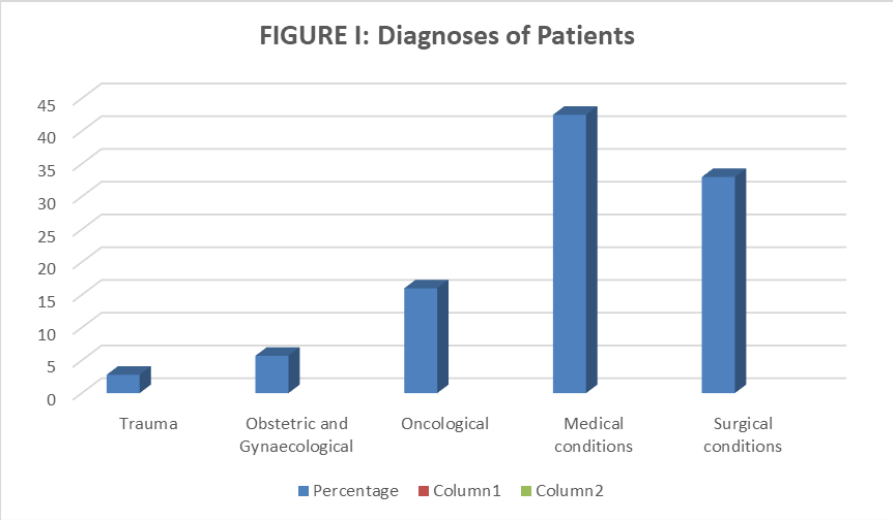

Table 3: Diagnoses of patients who had Central Venous Cannulation done.

Diagnosis	Frequency	Percent
Achalasia	3	2.8
Advanced bladder cancer	1	.9
Advanced osteosarcoma of right thigh	2	1.9
Ante-patum haemorrhage	1	.9
Appendicitis	1	.9
Breast cancer	1	.9
Burns	4	3.8
Cervical cancer	1	.9
Chronic inflammatory demyelinating Polyneuropathy	1	.9
Chronic liver disease	1	.9
Colonic cancer	2	1.9
COPD	1	.9
Corrosive stricture	2	1.9
Duodenal atresia	1	.9
Ectopic pregnancy	1	.9
Endometrial cancer	1	.9
Enterocutaneous fistula	1	.9
Erythema multiformis	1	.9
Heart failure	6	5.7
Hirschsprung's disease	1	.9
Intestinal obstruction (adhesive)	2	1.9
Intestinal obstruction (colonic cancer)	2	1.9
Intestinal obstruction (intususception)	2	1.9
Intestinal obstruction (Volvulus)	1	.9
Lung cancer	3	2.8
Lymphoma	2	1.9
Meningoencephalitis (viral)	1	.9
Nephrotic syndrome	1	.9
Oesophageal cancer	2	1.9
Ovarian cancer	3	2.8
Patent ductus arteriosus	2	1.9
Penetrating chest injury	2	1.9
Peritonitis	4	3.8
Pneumonia	3	2.8
Pre-eclampsia	1	.9
Prostate cancer	2	1.9
Pulmonary tuberculosis	5	4.6
Renal abscess	1	.9
Renal failure	1	.9
Retained product of conception	1	.9
Road traffic accident	1	.9
Sepsis	11	10.4
Sepsis(meningitis)	3	2.8
Sepsis (Septic abortion)	2	1.9
Severe traumatic brain injury	1	.9
Soft tissue sarcoma of the right thigh	1	.9
Stephen Johnson syndrome	1	.9
Stroke	6	5.7
TB meningitis	1	.9
Transverse colon adenoma	2	1.9
Trapped lung (PTB)	1	.9
Urinary tract infection	1	.9
Viral encephalitis	1	.9
Total	106	100.0

Majority of the patients had subclavian vein cannulated as shown in figure 2 below, with 97.2%. Only 2.8% had femoral vein cannulation done.

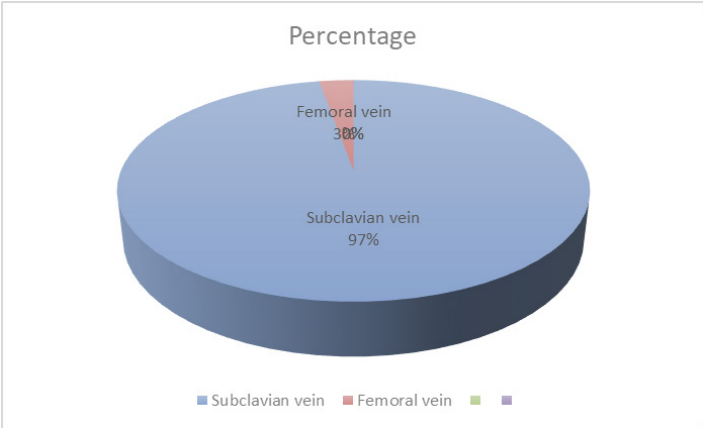

Figure 2: Type of Cannulation.

In all, 90 of the patients (84.9%) had right sided cannulation while the other 15.1% had a left sided cannulation, as depicted in Table 4 below.

Table 4: Side of Cannulation.

	Frequency	Percent
Left	16	15.1
Right	90	84.9
Total	106	100.0

Among the adults, a huge percentage, 67%, had size 7F inserted, while 3.8% had a larger size, 8.5F cannula inserted. In the paediatric range, size 4F was mostly used making up 11.3%. The least size of cannula used was 2.5F, making up only 4.7% of the patients. These are depicted in Figure 3 below.

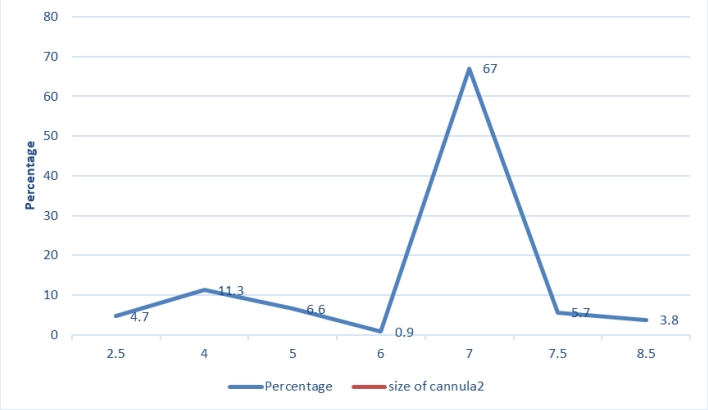

Figure 3: Sizes of Cannula.

Table 5 showed that central catheters with 3 ports were more popular (71.7%). Only 3.8% of them had 4 port. Table V below demonstrated that there was a correlation between size of Catheters and number of ports. All the catheters with 4 ports were 8.5Fr.

Table 5: Number of Ports.

	Frequency	Percent
2	26	24.5
3	76	71.7
4	4	3.8
Total	106	100

		Number of Ports			Total
		2	3	4	
Size (Fr)	2.5	5	0	0	5
	4	12	0	0	12
	5	7	0	0	7
	6	1	0	0	1
	7	1	70	0	71
	7.5	0	6	0	6
	8.5	0	0	4	4
Total		26	76	4	106

Figure 4 below depicts the rate of complications recorded during this study. In a vast majority of patients, there were no complications. This was noted in 89.6%. Only 0.9% of the patients had pneumothorax following the procedure. Surgical site infection and arterial cannulation each occurred in 2.8% of patients.

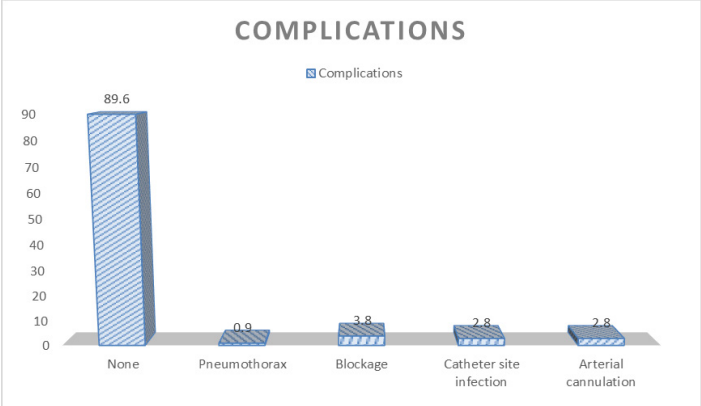

Figure 4: Complications of Central Venous Cannulation.

Table 6 below demonstrates the various reasons for which the central lines were removed. A vast majority was due to the fact that the lines were no more needed, accounting for 71.1% of cases. In another 20.8%, the lines were removed following the demise of the patients. Only 0.9% were removed as a result of dislodgement of the line.

Table 6: Reason for removal of Central line.

	Frequency	Percent (%)
Blocked (Thrombosed)	4	3.8
Dislodged	1	.9
No more indicated	76	71.7
Infected	3	2.8
Death of Patient	22	20.8
Total	106	100.0

Discussion

The results revealed that most of the central line insertions were done in the Accident and Emergency, due most likely to patients presenting in Shock. The medical Wards also had significant percentage (18%). This can be adduced to the fact that these Wards admit very ill patients with chronic illnesses such as heart failure, end stage renal disease (ESRD), stroke etc, and some patients in shock. Many of these patients often time have prolonged stay on admission and many times on intravenous (IV) medications and infusions. Repeated IV lines often can lead to thrombosis, especially in patients with ESRD. More so, many of these patients have oedematous limbs from heart or renal failure, making assessing their peripheral veins difficult. In the theatres, many of our patients for Thoracotomy have central line insertions done as a pre-operative modality, hence, the high percentage also (17%).

The age range of patients was between 10 months and 82 years, with a mean of 37.35 years. This was comparable to a prospective review of 421 patients with liver disease by Shweta et al. [14], the mean age of the patients was 42.1 ± 11.6 years. Al Sofyani Khouloud et al. [15], in a study of 20 neonatal and paediatric

patients in ICU, median age was 9 months and weight 9.3 (1.9–60 kg). Our findings varied from those of Daniel Theodoro et al. [16], who reviewed 282 patients with central venous cannulation and found the median age to be 60 years (49 to 75 years).

Our study showed that the male: female ratio was 1:1.4 with females making up 58.5% of the cases. However, in a retrospective clinical audit of 696 central venous catheterizations at a tertiary care teaching hospital in India, Sanjay et al. [17] noted that, of the 696 catheters inserted, 467 (67%) were in males. This is congruent with findings of Mehdi et al. [18], who analysed 321 adult patients undergoing cardiac surgery who had been admitted to a general hospital, during a 4-month period. 36.1% were females, while 63.9% were males.

From our review, the indications for insertion of central lines in these patients varied from inability to obtain venous access (71.7%), to pre-operative in 14.2%. Only 1.9% was for ionotropic support (Resuscitation). 3.8% was for Chemotherapy while 8.5% was for TPN. These findings contrasted with those of Mark E. Thompson [19]. In his study of 49 children who had central venous cannulation done, 18.4% were placed for resuscitation during emergency surgery, 30.6% were placed for known or encountered difficult intravenous access or no intravenous access status. The rest of the catheters (51.0%) were placed for craniotomy, thoracic, major abdominal or major orthopaedic surgeries (Pre-operative). Daniel Theodoro et al. [20] in the review of 729 patients, 254 (69%) were inserted for shock, 97 (26%) were inserted for lack of peripheral access, and 17 (5%) were inserted for cardiopulmonary resuscitation (ACLS or ATLS). Another review of 282 patients, Daniel Theodoro et al. [16] indicated they placed 203 (70%) central lines for hypovolemia or sepsis resuscitation, 74 (26%) for lack of obtaining peripheral access and 12 (4%) during active cardiopulmonary resuscitation (ACLS/ATLS). In our institution, inability to obtain peripheral access is the major reason why central venous cannulation is done, as shown above. Many of these patients are in shock, either cardiogenic, hypovolaemic or septic shock. Majority of the patients were diagnosed with medical conditions, accounting for 42.5% of the cases. The surgical conditions followed with 33%. Traumatic conditions accounted for 2.8% and 5.7% oncological. Sepsis was the leading cause of central venous cannulation (15.1% - 13.2% medical and 1.9% Obstetric/Gynaecological conditions), followed by intestinal obstruction (6.6%), as demonstrated by Table III. Of the medical conditions, Sepsis was the leading cause of central venous cannulation (13.3%), then, heart failure and stroke (5.7% each), making up 31.1%, 13.3% and 13.3% of the medical conditions respectively. However, Intestinal obstruction, Peritonitis and Burns were responsible for 20.0%, 11.4% and 11.4% of surgical conditions respectively (6.6%, 3.8% and 3.8% of central venous cannulation respectively), as shown from the result.

Virtually all the patients had subclavian vein cannulation done accounting for 97.2%. as against 2.8% femoral vein cannulation. The anaesthetist in our hospital usually would do internal jugular vein cannulation, but the cardiothoracic surgery unit are accustomed to the subclavian vein cannulation. In this study, the femoral cannulation done was as a result of the subclavian not being suitable for the procedure. One of the patients had infection of the skin all over the chest and the other patient was being managed for burns injury, which involved the anterior chest wall. In all, 90 of the patients (84.9%) had right sided cannulation while the other 15.1% had a left sided cannulation. The right side is preferred by our unit because the left side is prone to more complications as the apex of the left lung is higher on the left, predisposing patients to pneumothorax. More so, the brachiocephalic vein forms a more acute angle on the left, which can make the procedure more difficult or predispose to more incidence of iatrogenic vessel injury. Furthermore, the thoracic duct can be injured on the left. We use the left side mainly when it is difficult to cannulate the right side after several attempts or when the right side is not suitable especially when the area is infected or burnt. In a retrospective review of 696 central venous catheterizations by Sanjay et al. [17], the IJV was cannulated in 64.73%, subclavian vein cannulated 23%, the basilica vein cannulated 11.46%, while the femoral vein was cannulated 0.43%. The very low rate of femoral cannulation is congruent to our study. They cannulated the right side in 94.8% of times, while the left side was cannulated only 5.2%.

Among the adults, a huge percentage, 67%, had size 7F inserted. This adult size was readily available. 3.8% had a larger size, 8.5F cannula inserted. This was the size made available by the patient in whom it was used. In the paediatric range, size 4F was mostly used making up 11.3%. This sufficed for children aged 2-6 years. The least size of cannula used was 2.5F, making up only 4.7% of the patients, used in infants. The central catheters with 3 ports were more popular (71.7%). All the 8.5F cannulas had 4 port while all the paediatric ones had just 2 ports.

Our study revealed that in a vast majority of patients, there were no complications, as noted in 89.6%. Only 0.9% of the patients had pneumothorax following the procedure. Surgical site infection and arterial cannulation, each occurred in 2.8% of patients. Thrombosis was noted in 3.8%. 75% of the patients whose catheters got thrombosed were in medical patients. Surgical patients are usually anticoagulated after surgery. This may be responsible for the non-record of thrombosis among surgical patients. Femoral cannulation is a predisposition to thrombosis [1,15]. In an observational study, the risk of thrombosis associated with internal jugular insertion was approximately four times the risk associated with subclavian insertion [21]. Obesity, hyperinflation, and coagulopathy are commonly cited risk factors for adverse events related to central venous cannulation [22,23] but these were not noted in our study. The patient who developed pneumothorax had to have a chest tube inserted, while those with catheter site infections were treated with antibiotics. The arterial cannulation did not require any intervention other than application of pressure for about 5 mins. Results obtained by Daniel Theodoro et al. [20] were similar to our findings. A total of 2% pneumothoraces occurred, requiring thoracostomy; 11% hematomas, 4% arterial punctures and 1%

catheter misplacement in the soft tissues. Complications noted by Sanjay et al. [17] included arterial puncture, 6%, (much lower in our study) and pneumothorax, 0.3% (congruent with our study). Our results were however at variance with those obtained by Shweta et al. [14], who noted arterial puncture of 1.3%, hematoma formation of 0.3% and 3.3% of misplacement.

There were various reasons for which the central lines were removed. A huge percentage was due to the fact that the lines were no more needed, accounting for 71.1% of cases. In another 20.8%, the lines were removed following the demise of the patients. This is in keeping with a prospective review by Daniel Theodoro et al. [16], who noted 18.4% of removal of the catheters following demise of the patients. Only 0.9% were removed as a result of dislodgement of the line. The catheter was dislodged into the subcutaneous tissue. Infection was the reason for removal of the catheters in 2.8%. These were infections at the site of the cannulation, and not sepsis. Infection is a main cause for removal of central lines [19].These resulted from infrequent change in dressing due to limited dressing packs, especially in the medical wards. The catheters were removed in order to prevent sepsis and the patients administered antibiotics. Thrombosis accounted for another 3.8% of reasons for removal of the catheters. In some of the catheters, we noted that the lines were not being flushed with heparinized saline as recommended, especially after taking blood samples. Some of the ports that were not being used were also not kept clear by flushing with heparinized saline. These could have predisposed to blockage of the catheters. A study by Mark [19] showed 6.1% removed due to infection, which is higher than the results we obtained; 79.6% removed at discharge when the catheters were no more needed and this agrees with our results.

Conclusion

The subclavian approach is the favourite method of central venous cannulation of our unit in our institution, and inability of obtaining a peripheral venous access is the commonest indication for insertion of central lines in our institution. Rate of complication is low and, in most patients, the central lines are removed when they are no more needed.

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