

# Outcomes of Tunneled and Nontunneled Internal Jugular Catheters for Hemodialysis at Zenith Medical and Kidney Centre, Nigeria

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## Abstract

**Objectives:** Tunneled and nontunneled jugular access routes are the most widely used routes for hemodialysis (HD) in developing countries. This study was a retrospective review of the utility, safety, and outcomes of both tunneled and nontunneled curved internal jugular catheter use in patients with end-stage renal disease (ESRD) in Zenith Medical and Kidney Centre, Abuja, Nigeria. **Materials and Methods:** This is a retrospective study of 100 ESRD patients on maintenance HD at the center between June 2019 and December 2019. All patients on maintenance dialysis with tunneled and nontunneled curved internal jugular catheter were observed for immediate and short-term complications associated with the catheter. **Results:** Among the patients, 90 (90.0%) had tunneled dialysis catheters placement and dialyzed with it, while 10 (10%) patients had nontunneled dialysis catheters use. While 90 (90%) of the patients with the dialysis catheters developed no complications, ten (10%) patients had catheter-related complications either during catheter insertion or while it was being used for dialysis. The most common in this study was reactionary hemorrhage which occurred in 5% of the patients evaluated. Ten (10%) of the patients with catheter placement required ultrasonic guidance. No death was recorded during catheter placement. **Conclusion:** Internal jugular tunneled and Non tunneled dialysis catheters (NTDCs) are safe with good outcomes among our ESRD patients.

**Keywords:** Catheters, hemodialysis, Nigeria, outcome, tunneled and nontunneled dialysis catheters, Zenith Medical

## INTRODUCTION

Among the three types of vascular access for performing hemodialysis (HD), the most ideal route in patients requiring chronic dialysis is the arteriovenous (AV) fistula.<sup>[1]</sup> The benefits of AV fistulae include its longevity; low rates of central venous line sepsis, thrombosis, stenosis, and re-intervention; as well as a reduction in overall morbidity and mortality.<sup>[2,3]</sup> Despite the success of the fistula-first movement in ensuring that majority of patients with end-stage renal disease (ESRD) commence HD with AV fistula *in situ*, the use of central venous catheters (CVCs) both tunneled and nontunneled is on the rise worldwide because prior to the maturation of the fistula, dialysis will have to be performed using a CVC.<sup>[4,5]</sup>

Dialysis catheter use for HD was not originally designed for long-term management of patients requiring chronic HD and it is often discouraged due to the attendant complications associated

with its use. Such complications include catheter-related infections, increase rates of readjustment, jugular vein stenosis, thrombosis, inadequate dialysis, and poor quality of life.<sup>[6,7]</sup> Furthermore, all-cause mortality is higher among ESRD patients dialyzing with dialysis catheters compared with patients undergoing dialyses through AV fistulae.<sup>[8]</sup> In spite of its many challenges, the use of nontunneled dialysis catheters (NTDC) and tunneled dialysis catheters (TDC) is particularly common in the low- and medium-income countries (LMICs) where patients present with late stages

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of kidney disease and vascular surgeons skilled in AV fistula creation are not readily available.<sup>[9]</sup>

Another group of patients who require NTDC and TDC are ESRD patients with peripheral arterial disease, who are unsuitable for either of AV fistula or graft. Originally, NTDC and TDC were designed as a short- or medium-term means of HD or long-term vascular access pending the maturation of AV fistula or graft, or early kidney transplantation, but there is currently an upsurge in its use as permanent vascular access in resource-limited settings.<sup>[10]</sup>

Nigeria, with a population of over 180 million, has an increasing population of individuals with chronic kidney disease and ESRD. For a myriad of reasons, the majority of patients with these kidney diseases present belatedly to the hospital and usually commence HD with temporary HD vascular access.<sup>[11,12]</sup> For the maintenance of HD, the tunneled curved internal jugular catheter has progressively become the more popular means of vascular access.<sup>[13,14]</sup>

Regardless of this increased use of NTDC and TDC in the country, to the best of our knowledge, there has not been any comprehensive report on the safety, complications, and economic cost of NTDC and TDC. Hence, this study was designed to assess the utility, safety, and outcome of both nontunneled and tunneled curved internal jugular catheter use in patients with ESRD in Zenith Medical and Kidney Centre (ZMKC), Abuja.

## MATERIALS AND METHODS

### Study location

This study was carried out at the renal unit of ZMKC, Abuja, North-Central, Nigeria, with a highly active renal transplantation expertise. The patient pool comes from all over Nigeria.

### Participants

This is a retrospective review of 100 ESRD patients either on maintenance HD or patients desirous of early kidney transplantation at the center. We reviewed our electronic database records of all patients on chronic dialysis over six months (June 1, 2019–December 31, 2019). Information obtained include sociodemographics, etiology of renal failure, types of vascular access, number of attempts at creating the vascular access, duration of the procedure, observed complications, and outcomes. All patients on maintenance dialysis with nontunneled and tunneled curved internal jugular catheter were observed for immediate and short-term complications associated with the catheter use. Patients with femoral catheters were excluded from the study. The protocol used by our center is as highlighted below.

### Procedure protocol

#### *Dialysis catheter placement*

The nontunneled and tunneled internal jugular dialysis catheters were placed by the nephrologist. The right internal

jugular vein was the preferred site of placement except where there were technical difficulties. The procedures were strictly aseptic and carried out in the theatre suite of the hospital. The approach for catheter insertion was the modified Seldinger's technique,<sup>[15]</sup> while ultrasonography guidance was only used in those in whom technical difficulty was encountered during the use of anatomical landmarks.

#### *Immediate complications post catheter insertion*

The patients were observed for 1–2 h after the catheter placement to assess the occurrence of immediate complications, and in addition to carrying out post catheter placement chest radiography. The latter was to ascertain the exact location of the catheter and exclude complications such as pneumothorax, hemothorax, or lung contusion.

#### *Care of hemodialysis catheter*

Aseptic technique for catheter insertion (barrier maximum precautions), all patients had care of the NTDC and TDC instituted before and after every dialysis with the removal of blood clot and flushing of the catheter ports. The catheter arterial and venous ports were locked with heparinized saline (500 units/ml of unfractionated heparin). Those who developed catheter exit infections (defined by the development of cellulitis or purulent exudate at the site of insertion) were treated with topical antibiotics while those with tunnel infection and sepsis (defined as fever  $\geq 38.5^{\circ}\text{C}$  with the isolation of an identical microorganism from cultures of blood and the catheter tip in the absence of an alternative source) had courses of systemic antibiotics, in addition to premature removal of the catheter.<sup>[16]</sup>

#### *Statistical analysis*

Data were analyzed using the IBM statistical package for the social sciences (SPSS) for Windows version 20.0, New York (IBM Corp, NY). Estimates were expressed as mean values with standard deviation for continuous variables, while categorical variables were expressed as proportions (percentage). Comparison for statistical significance was by independent Student's *t*-test for continuous variables or Chi-square for categorical variables. The level of statistical significance was set at  $P \leq 0.05$ .

#### *Informed consent*

Informed consent was obtained from all patients prior to the procedure on why it was needed, possible complications that might arise from it and the post catheter care required.

## RESULTS

A total of 6063 sessions of HD were conducted during the period under review, with an average of 216.5 sessions of HD/patient per month. Forty-eight (48%) were male while 52 (52%) were female. The mean age was  $45.98 \pm 13.91$  years [Table 1].

Among the patients, 90 (90.0%) had TDC placement and dialyzed with it, while 10 (10%) patients had NTDC [Table 2].

While 90 (90%) of the patients with the dialysis catheters developed no complications, ten (10%) patients had catheter-related complications either during catheter insertion or while it was being used for dialysis.

Intra-procedural and post-procedural complications were observed in 1 (1%) and 2 (2%) patients, respectively [Table 3]. The intra-procedural complications recorded were chest pain and dense fibrosis intra-cannulation while the post-procedural complications were reactionary hemorrhage, hemothorax, catheter site infection, and catheter dislodgement. The most common in this study was reactionary hemorrhage which occurred in 5% of the patients evaluated. Ten (10%) of the patients with catheter placement required ultrasonic guidance. No death was recorded during catheter placement.

The most common indications for catheter removal were kidney transplantation in 45 (45%) while death accounted for 5 (5%) of the patients requiring removal of their dialysis catheters [Table 3].

The duration of the procedure was <30 min in 55 (55%) of the cases and the use of ultrasound prolonged the procedure duration [Figure 1 and Table 4].

**Table 1: Demographic details**

Variable	Frequency (%)
Gender	
Male	48 (48)
Female	52 (52)
Ethnicity	
Yoruba	27 (27)
Hausa	28 (28)
Igbo	45 (45)
Age, mean±SD	45.98±13.91
SD: Standard deviation	

**Table 2: Vascular access types and their distribution**

	n (%)
Weekly dialysis requirement	
Twice	50 (50.0)
Thrice	50 (50.0)
Previous vascular access	
Yes	80 (80)
Femoral	60 (60)
Femoral access, simple neckline	10 (10)
Femoral line, tunneled CVC	5 (5)
Tunneled CVC	5 (5)
No	20 (20)
Current choice of vascular access	
Tunneled CVC	90 (90)
Nontunneled CVC	10 (10)
Ultrasound guidance	
Yes	10 (10)
No	90 (90)

CVC: Central venous catheters

## DISCUSSION

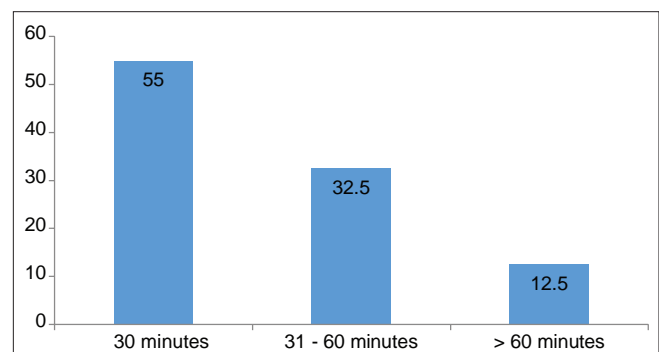
The study showed that NTDC/TDC is a popular vascular access route for maintenance HD in our hospital notably due to the number of kidney transplants done in our facility and their late stage of presentation.

An equal number of our patients have their dialysis sessions two times and three times weekly. This can be attributed to the fact that almost all of them are patients with ESRD who are on maintenance dialysis. Most of our patients have had previous vascular access (mostly femoral) which became dysfunctional with time. This is not uncommon in patients undergoing long-term dialysis as reported by Kumar *et al.*,<sup>[17]</sup> and further discussed in a review by Santoro *et al.*<sup>[18]</sup>

There was a high rate of tunneled CVCs use among our patients with ESRD, mainly because it is relatively more cosmetically convenient and associated reduced risk of dislodgement. More importantly, its insertion can be carried out by the nephrologists, unlike the creation of AV fistula which requires experienced vascular surgeons, who are grossly inadequate in most hospitals in Nigeria.<sup>[19]</sup> Second, patients often present late in the hospital with advanced kidney disease,<sup>[20-23]</sup> necessitating salvage HD.

This pattern of vascular access used for HD in our study is similar to the situation in other LMICs where vascular surgeons skilled in AV fistula creation are in small number.<sup>[8,24]</sup> This study also showed a few of our patients had nontunneled CVC because of its relatively temporary nature compared to the tunneled CVC. It is noteworthy that the overall prevalence of procedural complications was relatively low (10%) when compared with those reported from other centers in Nigeria.<sup>[23,25]</sup> The probable explanation might be because all CVC are carried out within the theater suite under close monitoring, aseptic technique for catheter insertion (barrier maximum precautions) and only the experienced nephrologist carries out the procedure.

Ultrasound guidance was required in only 10% of our procedures. Despite the availability of a dedicated radiology unit in our center, there was rarely any use for ultrasound guidance due to the proficiency of the staff placing the NTDC/TDC. Although ultrasound guidance in CVC insertion has been shown to reduce the rate of failed first attempts



**Figure 1: Duration of procedure (in percentages)**

**Table 3: Complications from procedure**

	<i>n</i> (%)
Complications	
Yes	10 (10)
Intraprocedural (chest pain and dense fibrosis intracannulation)	1
Postprocedural	
Reactionary hemorrhage	5
Catheter site infection	2
Catheter dislodgement	1
Hemothorax	1
No	90 (90)
Access	
Functionality	
Functional till indication no longer required (kidney transplant)	45 (45)
Functional till date	50 (50)
Functional till death	5 (5)

**Table 4: Relationship between ultrasound guidance and duration of procedure**

USS guidance	≤30 min	30-60 min	>60 min	$\chi^2$ (P)
Yes	0	5	5	23.59
No	55	35	0	(>0001)

at catheter placement and other immediate complications commonly associated with blind insertion, its propensity to prolong the time required for the procedure discourages its use.<sup>[24,26]</sup> Those patients with difficult vascular routes, however, ultrasonography guidance was employed.

The increasing choice of CVC for the delivery of HD in resource-limited settings as against the use of AV fistula or graft is of great concern and could be a contributing factor to the poor quality of life and suboptimal patients' outcomes. In one report on HD vascular access use from Uyo, South-South Nigeria by Ekpe and Ekirikpo<sup>[25]</sup> only 5% of their patients with ESRD dialyzed with permanent vascular access. Although some of our patients had reactionary hemorrhage around the catheter insertion and tunneling sites, it was not significant enough to require blood transfusion solely because of this bleeding.

The second leading complication among our patients was catheter-related infections (2.0%) and this was slightly higher compared with 0.55% reported by Katneni and Hedayati<sup>[27]</sup> The higher rate of infection among our patients could be explained by the differences in the frequency of catheter care since most of our patients dialyze 2–3 times a week, whereas ESRD patients in the Katneni and Hedayati study were dialyzing thrice a week during which catheter care was carried out as well, hence reducing the chances of developing a catheter site infection.<sup>[27]</sup>

The observed rate of catheter-related infection was higher despite applying mupirocin cream/betadine cream around the exit sites after each session of HD. Applying the topical antibiotics around the arterial and venous catheter ports has been shown to reduce

the incidence of catheter-related infection, particularly sepsis<sup>[28]</sup> suggesting that the incidence of catheter-related infections would have been higher in our patients, if not for the use of the antibiotics.<sup>[29]</sup> The high rate of catheter-related infection in our patients was similar to those reported in other forms of in-dwelling catheter use in our setting.<sup>[27]</sup>

Forty-five percent of our ESRD patients who were on NTDC/TDC for HD had their catheter removed because they had kidney transplantation. This is because only a few of our patients could afford kidney transplantation as a modality of treatment, as patients pay out of pockets for their renal care in Nigeria.<sup>[30]</sup> The inclusion of renal care services in the current National Health Insurance Scheme will go a long way in ensuring more patients transit from NTDC/TDC-based HD to kidney transplantation.

It was also observed that ESRD patients with diabetes mellitus were more likely to develop catheter-related complications and this agreed with previous reports on NTDC/TDC use. Uncontrolled diabetes mellitus increases the risk of infection, thrombosis and catheter failure.<sup>[31,32]</sup> This is because hyperglycemia provides a good medium for bacteria growth, in addition to immunosuppression and vascular disease commonly encountered in patients with uncontrolled diabetes mellitus. The catheter-related mortality of 16.3% observed in this cohort was high; however, the high mortality might have also been contributed to by other factors.

Other factors contributing to the poor patient outcomes were inadequate HD, suboptimal anemia treatment, cardiovascular mortality, malnutrition, and high incidence of infection. Despite the low rate of complications in the use of NTDC/TDC, its use should be restricted to when the ideal is not available, particularly in the setting where the technical know-how for AV fistula creation is not readily available. However, the use of NTDC/TDC in resource-challenged settings should be embarked on with adequate precautions geared toward reducing the high rate of complications. These steps should include appropriately selecting suitable patients for the procedure, use of ultrasonography and fluoroscopy, cardiac monitoring during and immediately after the procedure, while adequate catheter care during, and in-between dialysis must be ensured. While NTDC/TDC is being used for temporary vascular access, efforts should be made to train vascular surgeons in the creation of AV fistula in resource-challenged country like Nigeria.

This study is not without limitations, some patients with NTDC/TDC had to drop out of the study once they had their kidney transplant. Furthermore, the contributions of other factors such as inadequate anemia treatment and HD could not be excluded in the patients with catheter-related mortalities.

## CONCLUSION

With the increasing availability of kidney transplant services in Nigeria, the placement of internal jugular nontunneled and tunneled dialysis catheter is becoming more popular

and expertise is increasing. Despite its drawbacks, with proper cardiovascular evaluation, aseptic techniques, sound anatomical knowledge, cardiac monitoring during insertion with or without ultrasonographic guidance and fluoroscopy, TDC/NTDC are safe with good outcomes among patients on maintenance HD.

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### Conflicts of interest

There are no conflicts of interest.

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