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Cost-effective central venous line for infants in the developing world

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ABSTRACT

Introduction: The aim of the study was to look into the feasibility, safety, efficacy and cost-effectiveness of utilising the remains of central venous catheters in infants from a developing country.

Methods: Between June 2005 and December 2006, 96 neonates and infants with various illnesses and required the insertion of central venous access, were divided into two groups; those who required it for a short to medium term (44 patients) received a piece of the remains of catheters, and those who required conventional catheter insertion intended for long-term use (52 patients) received a regular catheter. The same principle of insertion was used as for regular central venous access. The external jugular vein was used when possible or the internal jugular vein was used otherwise. After appropriate insertion, the catheter was mounted on an appropriately-sized cannula. A three-way stopcock connection was used to minimise manipulation of the cannula. Postoperative care was the same as for routine central venous lines. Complications encountered in the two groups were recorded and analysed.

Results: Of the short- and medium-term catheters, 32 out of 44 patients (72.7 percent) completed the intended course of treatment successfully, and of the long-term catheters, 42 out of 52 patients (80.8 percent) completed the treatment successfully. Recorded complications were dislodgement, thrombosis and infection. These were, in the short-term group, as follows: five (11.4 percent), three (6.8 percent) and four (9.1 percent), respectively; and for the long-term group, two (3.8 percent), four (7.7 percent) and four (7.7 percent), respectively.

Conclusion: Utilisation of the remains of venous catheters in properly-selected patients for short- and medium-term treatment is feasible, cost-effective and safe, and the rates of complications are comparable to cases with conventional catheter insertion.

Keywords: central venous catheter, modified central venous catheter, venous access

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INTRODUCTION

Venous access and catheter insertion are a common problem in the care of seriously-ill infants and neonates. Recently, there has been a high increase in indications for their insertion. Peripheral venous access quickly becomes limited in neonatal intensive care unit patients and chronically-ill infants. The decision for central venous access stems from inadequate peripheral venous access for necessary therapeutic interventions, such as extended courses of antibiotics, chemotherapy and parenteral nutrition. In the face of limited resources, an alternative source of catheters is of paramount importance. The idea of using the remains of central venous catheters (CVCs) arises in critical situations where the catheter is badly needed or when the proper catheter is not available, a common situation in public hospitals in developing countries with limited resources and limited supply. Each time a CVC is used, a good extra piece is discarded.

METHODS

The remains of the venous catheters are usually discarded. These were saved, packed and re-sterilised by gas (ethylene oxide) sterilisation, to be used in situations when the proper whole catheter is not available. The indications for insertion were intended to be limited to certain selected patients, who needed the catheter for a short- (under one week) or medium-term (under three weeks) period. Beside the exhaustion of peripheral veins, short-term uses included antibiotic administration for infected ventriculoperitoneal shunts, meningitis, osteomyelitis, necrotising enterocolitis, administration of anti-epileptic drugs for intractable seizures, cardiac drugs to treat arrhythmias, immune deficiency, dehydration, nesidioblastosis, vitamin D-dependant rickets, jejunal atresia, oesophageal atresia, exchange transfusion and meconium aspiration.

Between June 2005 and December 2006, 96 neonates and infants with various illnesses at Jordan University Hospital and required the insertion of central venous access, were divided into two groups. The first group (STG), comprising 44 patients requiring central venous

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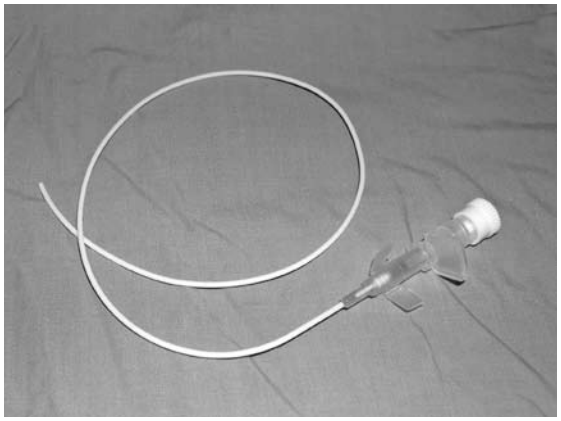

Fig. 1 Photograph shows the remains of the catheter (piece) mounted on an appropriately-sized cannula. Note the matching size of the cannula and the catheter.

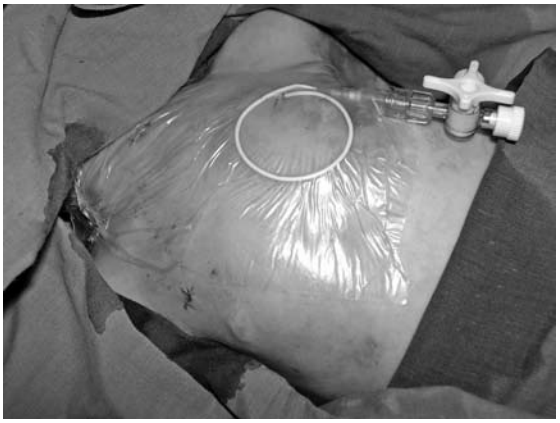

Fig. 2 Photograph shows the final position of the catheter, cannula and dressing applied. A three-way stopcock was used to facilitate the tubing connection. The transparent dressing facilitates exit site inspection.

access for a short to medium term, received a catheter piece, and the second group (LTG), comprising 52 patients requiring catheter insertion for long-term use, received a regular catheter. The ages were comparable in the two groups. There was no gender difference, and all catheters were inserted under the same circumstances, i.e. via a strict aseptic technique in the operating theatre. Anaesthesia was given according to the general condition of the patient. Vigorous patients were given general anaesthesia, while sick patients received local anaesthesia. The external jugular vein was used whenever possible; otherwise, the internal jugular vein was used. Only on two occasions was the saphenous vein used. All catheters were inserted by the open method with a subcutaneous tunnel and under fluoroscopy guidance. After appropriate insertion, the catheter was mounted on an appropriately-sized cannula, and the cannula and the catheter were fixed to the exit site of the catheter by non-absorbable sutures (Fig. 1). A three-way stopcock connection was used to minimise manipulation of the cannula hub, and the dressing was applied in the usual manner (Fig. 2). Postoperative care was as per routine central venous lines, usually done by a designated intravenous catheter nurse. Informed consent was obtained from the parents/guardians of all patients. Any complication encountered was recorded and analysed.

RESULTS

In the STG, 32/44 (72.7%) patients completed the intended course of treatment successfully, whereas in the LTG, 42/52 (80.8%) patients completed the treatment course successfully. The most common complications encountered in the two groups were dislodgement, thrombosis and infection. These were, respectively, five (11.4%), three (6.8%), four (9.1%) cases in the STG, and two (3.8%), four (7.7%), and four (7.7%) cases in the LTG. Central venous line infection was determined according to the Centers for Disease Control and Prevention (CDC) guidelines.

Catheter-related infection was diagnosed if one of the following was present: positive blood culture from the catheter and positive blood culture from the peripheral vein, positive blood culture from the catheter and negative from the peripheral vein, infection of the exit site or tunnel caused by an organism isolated from the catheter blood culture, and excluding other sources of infection. Many of these cultures were negative, either because these patients were on antibiotics or there were other unknown reasons. The most common organisms isolated were: Gram-positive organisms, such as *Staphylococcus aureus* and *Staphylococcus epidermidis*, and Gram-negative organisms, such as *Enterococcus* spp., *Escherichia coli*, *Klebsiella* spp., *Candida* spp. and mixed organisms. There were a total of 22 cultures taken, 11 were positive, four were catheter blood cultures, one was peripheral vein blood culture and six were exit site and tunnel cultures. Only on two occasions were the peripheral blood and catheter cultures identical, one in the STG and one in the LTG. The organism was *Klebsiella* spp. in the STG and *Candida* spp. in the LTG. At no instance was the cultures at the three sites positive or identical.

Other comparison characteristics are shown in Table 1. Considering the insertion duration of the catheters, there was no statistically significant difference between the two groups regarding the common complications affecting CVCs. However, because these patients were high-risk cases, there were six deaths in the whole group. Two deaths occurred in the LTG and four in the STG. None of the deaths was catheter-related, as all catheters were functioning well at the time of their death.

DISCUSSION

Central venous access utilising commercially-available

Table I. Clinical characteristics, complications and outcome of the two groups of patients.

Characteristics	Study group (short-term catheters)	Control group (long-term catheters)	p-value
No. of patients	44	52	
Mean age (months)	6.1	8.4	
Mean duration (weeks)	3.1	9.8	
No. (%) of complications	12 (27.3)	10 (19.2)	0.350*
No. (%) of complications per catheter-day	3/954.8 (0. 31)	4/3,603.6 (0. 11)	0.153*
No. (%) of dislodgement	5 (11.4)	2 (3.8)	0.514*
No. (%) of infection	3 (6.8)	4 (7.7)	0.508*
No. (%) of thrombosis	4 (9.1)	4 (7.7)	0.160*
No. (%) of patient deaths	4 (9.1)	2 (3.8)	
No. (%) of completed therapy	32 (72.7)	42 (80.8)	

*Significant value ($p < 0.05$)

catheters involves a heavy financial investment.[1-3] CVC placement, even in small premature infants, has become accepted as routine.[4-6] Originally, CVC was performed for three main reasons, viz. total perenteral nutrition and adminstration of some chemotherapeutic drugs, venous pressure measurement and exhaustion of peripheral veins. Today, the indications for its use have increased, and includes extended courses of antibiotics, intractable seizures, anti-arrhythmia medications, among many others. In many circumstances, it is used for the comfort of the patient (to avoid repeated venipuncture) or for the convenience of nursing care.[7,8] Continued improvement of these catheters include the use of a Dacron cuff or a silver-impregnated cuff to minimise tunnel infection and inadvertent expulsion, and the use of a totally implanted catheter and port.[9,10] However, these improvements paralleled the increase in the cost of treatment.

With limited resources in the developing countries, a search for an alternative is of paramount importance. In this study, the remains of commercially-available catheters were utilised for selective use in patients requiring central venous access for short- to medium-term periods, without any apparently significant increased risk of complications. Complication rates were comparable to other published series, where line sepsis occurred in 5%–50% of the cases, line thrombosis in 4.6%–13%, and mechanical complications in 7.7%–23% of the cases.[11-13] In the current study, the use of these catheters was limited to selected patients who needed the catheter for short- to medium-term purposes. Its use in these cases was considered acceptable as these catheters served the original purpose they were intended for. The rate and type of complications were comparable to the control group (LTG), most likely attributed to the short duration of use of these catheters in the study group. Considering the limited indications of use of the remains of the CVCs, this study has shown that with proper care, they were not associated with more complications than the application of the conventional catheters.

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