

The use of 8-cm 22G Seldinger catheters for intravenous access in children with cystic fibrosis

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ABSTRACT

Purpose: Long intravenous catheters are an effective and economical choice of vascular access for intravenous antibiotic therapy in children with cystic fibrosis (CF). This prospective audit assesses the use of Vygon Leaderflex 22G × 8 cm catheters in an Australian tertiary centre. Key outcomes included catheter lifespan, ability to complete antibiotic therapy and complication rates.

Methods: All paediatric patients admitted with infective exacerbations of CF lung disease for 18 months between 2012 and 2013 were prospectively included. Data were analysed using *t*-tests and Fisher exact test.

Results: A total of 40 successful catheter insertions for 20 patients during 32 admissions were identified. The mean duration of the catheters was 10.08 days (median 9.5, SD=5.0). Of the 32 admissions, antibiotic therapy was completed with long catheters in 78% of cases (n=25) and with a single catheter in 48% (n=19). Rates of local complications were high, but there were no serious adverse outcomes.

Conclusion: Although limited by a small sample size, the results from this study are promising and suggest that 8 cm long catheters are a safe, effective and economical alternative to peripherally inserted central catheters (PICCs) in treating pulmonary exacerbations in children with CF.

Key words: 8-cm long intravenous catheter, Cystic fibrosis, Intravenous access, Infective exacerbation, Paediatric

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INTRODUCTION

The choice of vascular access for intravenous (IV) anti-biotic therapy for exacerbations of lung disease in children with cystic fibrosis (CF) is vital to the success of treatment. Options for vascular access include standard IV cannulae, peripherally inserted central catheters (PICCs) and long IV catheters. Long IV catheters have variable lengths and are defined as those longer than standard IV cannulae with a tip that does not lie centrally. Descriptions of these long IV catheters can be confusing, including the oxymoron 'short long catheter' and 'midline catheter'.

In a recent Cochrane Systematic Review assessing access in CF, long catheters were found to be the most effective and economical of the three choices (1). Long catheters had a longer duration of use and increased patient satisfaction when compared with standard IV cannulae (1). Although PICCs are generally stable and well

tolerated, they are costly to insert and rare, but serious, complications including central collateral vessel formation, pericardial effusion and cardiac tamponade have been reported (2).

Data regarding IV access in the paediatric CF population have shown that long catheters are easy to insert and comfortable to use (3-5). Millar-Jones highlighted these as important factors in compliance and the reduction of trauma experienced by children (3). Although several studies have been conducted using long catheters of 20-30 cm (3,5), a recent study showed that an 8-cm long catheter was easier to insert, less painful and had the same duration of use as a 30-cm catheter (4).

Long catheters have been proven to be effective in delivering IV antibiotics in exacerbations of CF (1,4). This prospective audit presents our experience of an 8-cm long catheter (Vygon Leaderflex 22G × 8 cm) for vascular access in CF tune-ups at a major Australian paediatric centre.

MATERIALS AND METHODS

All paediatric CF patients admitted to Monash Children's Hospital with an infective pulmonary exacerbation for IV antibiotic treatment were prospectively recruited over an 18-month period between January 2012 and July 2013. The study was approved as a quality improvement activity by the Monash Health Human Research Ethics Committee.

The Vygon Leaderflex 22G $\times$ 8 cm catheter was inserted in all patients according to the Monash Health Long Intravenous Catheter Insertion Protocol (Appendix) using an aseptic Seldinger Technique. Insertions were performed by paediatricians (residents and registrars) and paediatric anaesthetists. All catheters were flushed with weak heparin solution (50 units per 5 ml) following use.

Prospective data were collected assessing catheter success, ease of insertion and complications. Data were analysed using *t*-test and Fisher's exact test.

RESULTS

A total of 40 successful catheter insertions for 20 patients during 32 admissions were identified. The median age of the cohort was 12 years. Operators included anaesthetists ($n=18$, 45%) and paediatric residents/registrar ($n=22$, 55%). Catheters were located in the upper arm ($n=9$, 22%), antecubital fossa ($n=8$, 20%) and forearm ($n=23$, 58%). Insertion was largely successful on the first attempt (85%, $n=34$), with a minority requiring two (10%, $n=4$) or three attempts (5%, $n=2$). No major insertion-related complications were reported. Antibiotic therapy was given for approximately 10-14 days, with variability allowed for clinical progress.

Overall, the mean duration of the 8-cm 22G Vygon catheters was 10.08 days (median 9.5, SD=5.0). Of the 32 admissions, antibiotic therapy was completed with long catheters in 78% of cases ($n=25$) and with a single catheter in 48% ($n=19$). Complications were localized, with no serious adverse events reported. The most common complications were local inflammation/infection ($n=7$, 33%) and pain ($n=7$, 33%).

Factors affecting the rate of successful catheter insertion included the location of insertion and operator. The mean lifespan of catheters inserted in the antecubital fossa (14.5 ± 5.7 days) was significantly greater than those in the arm (9 ± 4.2 , $p=0.04$) and forearm (8.9 ± 4.32 , $p=0.01$). Those inserted by anaesthetists were more likely to complete antibiotic courses with a single catheter than paediatric trainees (67% vs. 32%, $p=0.06$).

As expected, in catheters inserted for children less than or equal to 12 years of age ($n=23$), anaesthetists were required to perform the majority of catheter insertions ($n=15$, 73%) and general anaesthetic was more frequently required

($n=14$, 61%). However age, as an independent factor, was not significant in affecting mean lifespan ($p=0.18$). Interestingly, the severity of disease, as measured by number of admissions in the previous 2 years, did not significantly affect catheter insertion or success.

Importantly, the study outcome measures improved with operator experience. When comparing our data from the last 12 months of the audit to the first 6 months, a greater proportion of antibiotic courses were completed with a single catheter (57.1% vs. 25%, $p=0.09$) and fewer catheters were removed for complications (67% vs. 25%, $p=0.03$). Rates of local complications were high, but there were no serious adverse outcomes.

DISCUSSION

In our experience, 8-cm long catheters inserted in the antecubital fossa by an experienced anaesthetist lasted significantly longer than those inserted elsewhere by resident paediatric staff.

Although there are limited data on the use of 8-cm long catheters in paediatric CF, the study conducted by Carroll et al provides a standard of comparison. The mean survival time of our catheters is less than that published by the study of Carroll et al (4) (10.08 ± 5.00 compared with 12.2 ± 3.1), and may be due to differences in demographics and methods. Although the duration of the study, catheter type and use of Seldinger technique was similar, the present study had a younger cohort (average age 11.8 ± 3.99 compared with 19.3 ± 6.3) and catheters inserted by a range of junior and senior medical staff. The present study also has a larger sample size and may more accurately reflect the practical mean survival time in a wider paediatric population.

These 8-cm long catheters are a valid alternative to PICC in treating CF exacerbations in children. Our data show that the Vygon 8 cm $\times$ 22G catheters are effective and safe. They are also an economical option, both in terms of equipment required and personnel. The Vygon Leaderflex catheters cost approximately \$40 AUD compared with a standard PICC that may cost up to \$150 AUD. In addition, 8-cm long catheters may be inserted on the ward by junior staff and is a relatively quick procedure with a mean insertion time of 24 min.

Limitations of our study included a small sample size and absence of a formal assessment of patient and parent satisfaction. The latter is difficult given the lack of validated tools to provide consistent evaluations across age and developmental stages in children.

Our results have improved with experience and we hope that with continued use, these 8-cm long catheters will provide a safe, effective and economical alternative to PICC for vascular access in treating pulmonary exacerbations in children with CF.

APPENDIX

Barnes, R. Monash Health Long Intravenous Catheter Insertion Protocol, Department of Anaesthetics, Monash Children's Hospital, Current as of January 2014.

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