Central venous catheter use in UKCCSG oncology centres

D A Tweddle, K P Windebank, A M Barrett, D C Leese, R Gowing, on behalf of the United Kingdom Children's Cancer Study Group* and the Paediatric Oncology Nursing Forum†

Abstract

A cross sectional audit of central venous catheter (CVC) use was performed in United Kingdom Children's Cancer Study Group oncology centres. There were wide variations in choice of line, insertion technique, aftercare practice, and diagnosis of CVC related sepsis. These variations highlight the difficulty in interpretation of published data on CVC efficacy.

(Arch Dis Child 1997;77:58-59)

Keywords: paediatric oncology; central venous catheter

The use of central venous catheters (CVCs) is associated with significant morbidity and sometimes mortality.¹⁻⁶ This makes it imperative to identify factors that may predispose to complications. The aims of this study were: (1) to characterise CVC use, insertion techniques, and reinsertion rates, (2) to identify variations in aftercare practice, and (3) to survey opinion of diagnosis of CVC related sepsis among multiple centres belonging to a single cooperative cancer study group.

The study involved collaboration of physicians and surgeons of the United Kingdom Children's Cancer Study Group (UKCCSG) and nurses from the Paediatric Oncology Nursing Forum.

Methods

Any child with cancer requiring CVC insertion, treated at a UKCCSG centre, was eligible for the study. Over a six month period, data forms relating to patient and line insertion details, aftercare policy, and diagnosis of CVC related sepsis were collected.

Results

Of 22 UKCCSG centres, 13 participated, returning 347 insertion data forms. Participation of centres depended largely on whether there were oncology nurses to supervise the data collection. The age distribution and diagnoses were representative of the prevalence of individual cancers in the UK population and whether intensive chemotherapy requiring CVC insertion was indicated. External cath-

eters were inserted in 84% of cases and subcutaneous ports in 16%. Of the external catheters, 36%, 62%, and 2% were single, double, and triple lumen, respectively. Whereas 60% of centres did not use subcutaneous ports, in three centres 40% of CVCs were of this type. Only one centre used triple lumen external catheters. The ratio of external catheters to subcutaneous ports was approximately 5:1 for all diagnoses except acute myeloid leukaemia and bone tumours, where the proportion of external catheters was even higher, and in brain tumours, where the proportion of subcutaneous ports was increased. In 74% of cases this was a first insertion; in 21%, 4%, and 1% it was the second, third, and fourth respectively. Thus 26% of CVCs were reinsertions. This was not found to be associated with age or diagnosis.

There was wide variation in surgical insertion technique (table 1). Most surgeons used the right internal jugular vein, which they repaired. Most lines were fixed with at least a cuff suture and the tip positioned in the right atrium. Concurrent operative procedures, for example lumbar puncture, were performed in 20% of cases and prophylactic antibiotics given in 22%.

There was considerable variation among the 21 centres with respect to aftercare techniques. Subcutaneous ports were flushed monthly in 88% of centres, Broviac external catheters twice weekly in 60% (range daily to weekly), and Hickman external catheters weekly in 45% (range daily to every two weeks). External catheters were flushed with 5 ml of 10 U/ml heparinised saline in 76% of centres (range 2.5

Table 1 Aspects of surgical technique

Procedure	% CVCs inserted by this technique (n)
Bevel cut on line	43 (326)
Entry vein	(247)
Right internal jugular	54
Left internal jugular	19
Other	27
Entry vein	(312)
Repaired	72
Ligated	28
Fixation	(330)
Cuff suture	76
Exit site suture	44
Both	32
Tip position	(224)
SVC	21
RA/SVC junction	11
RA	62
IVC	2
Other	4

RA/SVC junction = right atrium/superior vena cava junction; RA = right atrium; IVC = inferior vena cava; SVC = superior vena cava.

United Kingdom Children's Cancer Study Group

D A Tweddle
K P Windebank
A M Barrett
R Gowing

Paediatric Oncology Nursing Forum

D C Leese

Correspondence to:
Dr K Windebank,
Department of Child Health,
Royal Victoria Infirmary,
Queen Victoria Road,
Newcastle upon Tyne
NE1 4LP.

Accepted 12 March 1997

* UKCCSG membership of joint supportive care group: C Bailey, A M Barrett, R Gowing, J Imeson, D Lloyd, D Tweddle, D Walker, J Walker, R Wheeler, K Windebank.

† PONF membership of joint supportive care group: J Auty, S Cook, O Cresswell, D Hodson, D Leese, H Lucas, C Philpott, A Thompson, E Yeomans.

Table 2 Results of questionnaire for criteria for diagnosing CVC colonisation (10, strongly agree; 0, strongly disagree)

Criterion	Median score (range)
Blood culture positive and flush associated rigor	10 (7-10)
Blood culture positive and flush associated fever	10 (5-10)
Infection does not resolve until line is removed	10 (2-10)
Blood culture negative and flush associated rigor	9 (3-10)
Repeated blood culture of candida	9 (3-10)
Repeated blood culture of coagulase negative staphylococcus in an afebrile patient	8 (6-10)
Sequential infection with the same organism	8 (3-10)
Quantitative difference in bacteria from line and peripheral blood samples	7 (1-10)
Blood culture negative and flush associated fever	6 (3-9)
Single blood culture of coagulase negative staphylococcus in a febrile patient	5 (1-10)

to 10 ml), and ports with 5 ml of either 10 U/ml heparinised saline (range 5 to 10 ml) or 100 U/ml heparinised saline (range 2.5 to 10 ml) in 62%. Nurses were taught line care in 80% of centres, compared with 33% for doctors. Parents were taught in 95%, with 67% providing written information as well.

Opinions were sought from surgeons, oncologists, and microbiologists about criteria for diagnosing infection due to CVC colonisation. Forty replies were received from 11 centres, ranging from strong agreement (score 10) to strong disagreement (score 0) regarding whether a particular clinical or microbiological finding was indicative of CVC colonisation. Table 2 shows that the range of answers for the first two questions was small, but for the remainder it was large, indicating wide variation in the criteria for diagnosing CVC colonisation.

Discussion

This study showed that 26% of CVCs were reinsertions. This compares with previous reports of 23% reinsertions¹ and of irreversible line failure rates of 20–53%.^{1,2} Non-randomised prospective studies have shown that removal of catheters for any complication is significantly more likely with external catheters than with subcutaneous ports,^{2,3} although one randomised study showed no difference.⁴ The reasons for reinsertion were not identified in our study, but a prospective study of UK centres is clearly needed to ascertain which variations in CVC practice are associated with complications leading to untimely removal.

Surgical insertion technique is likely to be important for subsequent mechanical problems. The right internal jugular vein, used in 53% cases in our study, is chosen as the entry vein because of its accessibility and as a reliable route to the right atrium. The line tip was positioned in the right atrium in 62% of our

patients, which may facilitate sampling and minimise the risk of thrombus formation.⁵ Other operative techniques, for example a cuff suture, are recommended to prevent early line dislodgement,⁶ although it is unclear yet whether an exit site suture is also beneficial. The value of perioperative antibiotic use is still unproven. The relevance of performing other procedures under the same anaesthetic with respect to future line complications has not previously been reported.

Flushing solution and frequency may be important for line infection and occlusion. Published studies range from minimal flushing without heparin⁷ to twice daily with 10 ml of 10 U/ml heparinised saline.³ If these methods could be shown to be equally effective, minimal flushing procedures could have considerable cost saving implications. The importance of teaching line flushing to medical staff to reduce line infection is highlighted in one study.⁸

The difficulty in diagnosing CVC infection arises in establishing whether the line is colonised with the infecting organism and is therefore the primary focus of infection. Our results show wide variations in how CVC colonisation is diagnosed. The pragmatic solution is a prospective study relating the overall pattern of clinical presentation and laboratory findings to outcome, without attempting a formal diagnosis of CVC colonisation. It should then be possible to estimate relative predictive values of clinical and microbiological features.

Centres participating in the study: Aberdeen, Belfast, Birmingham, Cambridge, Cardiff, Christie Hospital (Manchester), Dublin, Edinburgh, Glasgow, Great Ormond Street Hospital (London), Leeds, Leicester, Manchester Children's Hospital, The Middlesex Hospital (London), Newcastle, Nottingham, Oxford, Sheffield, Southampton, and St Bartholomew's Hospital (London).

We are grateful to the UKCCSG/PONF centres for recruiting patients and to Michael Cole for statistical support.

Merck Sharpe and Dohme Ltd provided financial support and D A Tweddle was supported by the Leukaemia Research Fund.

The UKCCSG is supported by the Cancer Research Campaign.

- Sellden H, Lannering B, Marky I, Nilsson K. Long-term use of central venous catheters in paediatric oncology treatment. *Acta Anaesthesiol Scand* 1991;35:315–9.
- Ingram J, Weitzman S, Greenberg ML, Parkin P, Filler R. Complications of indwelling venous access lines in the pediatric hematology patient. *Am J Pediatr Hematol Oncol* 1991;13:130–6.
- Mirro J, Rao BN, Stokes DC, *et al.* A prospective study of Hickman/Broviac catheters and implantable ports in paediatric oncology patients. *J Clin Oncol* 1989;7:214–22.
- Mueller B, Skelton J, Calendar DPE, *et al.* A prospective randomised trial comparing the infectious and non-infectious complications of an externalised catheter versus a subcutaneously implanted device in cancer patients. *J Clin Oncol* 1992;10:1943–8.
- Lucas H, Attard-Montalto SP, Saha V, Bristow A, Kingston JE, Eden OB. Central venous catheter tip position and malfunction in a pediatric oncology unit. *Pediatr Surg Int* 1996;11:159–63.
- Wiener ES, McGuire P, Stolar CJH, *et al.* The CCSG prospective study of venous access devices: an analysis of insertions and causes for removal. *J Pediatr Surg* 1992;27:155–64.
- Smith S, Dawson S, Hennessey R, Andrew M. Maintenance of the patency of indwelling central venous catheters: is heparin necessary? *Am J Pediatr Hematol Oncol* 1991;13:141–3.
- Puntis JWL, Holden CE, Smallman S, Finkel Y, George RH, Booth IW. Staff training: a key factor in reducing intravascular catheter sepsis. *Arch Dis Child* 1990;65:335–7.