

ORIGINAL ARTICLE

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Venous patency after open central-venous cannulation

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Abstract To investigate the value of Doppler ultrasound scan (USS) assessment of internal jugular vein (IJV) patency after previous open central-venous cannulation (CVC), a prospective study of 66 consecutive children (median age 4.5 years; range 4 months–17 years) who had previously undergone open insertion of at least one indwelling IJV line and required further CVC for completion of therapy was undertaken. All underwent Doppler USS examination prior to surgery. Where patency of the previously cannulated vein was suggested ultrasonographically, the accuracy of this finding was confined at open surgical exploration. Initial CVCs were in situ for a median of 9 months (1 month–4 years) prior to removal. The median interval to repeated CVC was 11 months (3 weeks–45 months). In 79 Doppler USS, 70 (88.6%) veins appeared patent, 3 (4.2%) stenosed, and 6 (7.6%) obliterated. Of the 70 “USS patent” veins, 66 were explored. Patency was confirmed surgically in 59 (89.4%) and a new CVC successfully inserted. Seven (10.6%) apparently patent veins on USS were found to be obliterated at open exploration. Review of USS images in these cases suggested that enlarged collateral veins were usually responsible. Overall, successful recannulation was possible in 74.6% of all previously accessed veins. In children requiring repeated CVC, Doppler USS of neck veins is a valuable but not entirely reliable guide to the presence of underlying vessel patency and should be interpreted with caution. At least three-fourths of previously cannulated IJVs remain patent after catheter removal and can be reused for CVC.

Key words Central venous catheters · Children · Ultrasound assessment of venous patency

Introduction

Some children require repeated long-term central-venous access for therapy. It has been reported in neonates that following open cannulation the internal jugular vein (IJV) is frequently thrombosed, suggesting that if repeated cannulation is necessary a fresh site should be selected [1]. However, on occasion it may be valuable to be able to recannulate a previously accessed vein, and in this circumstance Doppler ultrasonography (USS) of the great veins of the neck has been suggested as a highly sensitive indicator of venous patency [1–4]. This study further investigates the value of Doppler USS assessment of IJV patency after previous open cannulation in older children.

Materials and methods

Sixty-six consecutive children (median age 4.5 years, range 4 months–17 years) presenting to our unit between 1993 and 1997 were studied prospectively. All had previously undergone open insertion of at least one indwelling IJV line and required further central venous catheterisation (CVC) for completion of therapy. Repeated CVC was performed for chemotherapy ($n = 55$), regular blood transfusions ($n = 5$), total parental nutritional support ($n = 3$), and haemodialysis ($n = 3$). Children in whom the initial CVC had been removed less than 2 weeks previously or who had a recent line tunnel infection were excluded.

For initial cannulation silicone catheters were used and inserted during general anaesthesia by the following standard technique: open cut-down was performed onto the IJV, which was isolated between silastic vascular slings and the catheter inserted through an appropriate-sized venotomy, avoiding the use of a purse-string suture. Catheter size varied between 6.9 and 10 Fr, and the tip was confirmed to lie in the right atrium-superior vena cava junction radiologically. When a further CVC was required Doppler USS assessment of venous patency was carried out. All sonograms were performed by one of three investigators who knew the purpose of the examination but were unaware of the results of any previous

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USS using a 5 MHz sector scanner. Assessment of the vessel margins, normal changes in diameter with respiration or sniffing, flow assessment, and the presence or absence of intraluminal filling defects was made. USS measurements from the vessels were obtained and assessment of blood-flow velocity achieved.

Based on these USS findings, a decision was made as to whether the previously cannulated vein should be re-explored. A new venous site was selected if the vein appeared occluded or stenosed. If the vein was ultrasonographically patent the accuracy of this finding was assessed at open surgical exploration.

Results

Seventy-nine Doppler USS were performed in the 66 children, since in 9 cases more than one recannulation was required and in 4 children both sides of the neck were examined (see later). Initial CVCs were in situ for a median of 9 months (1 month–4 years). The median interval to repeated CVC was 11 months (3 weeks–45 months). Of the 79 IJVs scanned, 70 (88.6%) appeared patent (Fig. 1), 3 (4.2%) stenosed, and 6 (7.6%) obliterated. Of the 70 ultrasonographically patent veins, 66 were explored. Four USS patent veins were not explored; these patients had previously undergone insertion of bilateral IJV lines, both veins were patent on USS, and only one side was explored surgically. Radiological patency was confirmed surgically in 59 (89.4%) of the veins that were re-explored and a new CVC successfully inserted. Seven (10.6%) apparently patent veins on USS were found to be obliterated at open exploration. Overall patency was therefore proven in 59 of the 79 previously cannulated IJVs (74.6%).

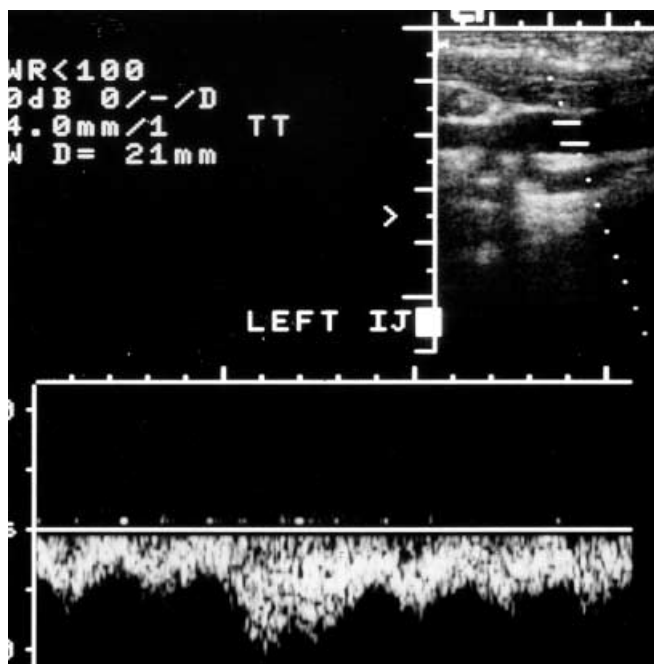


Fig. 1 Doppler ultrasound scan demonstrating patent interval jugular vein

Discussion

Increased sophistication and intensification of treatment has led to improvements in overall survival in many areas of paediatric surgery, and long-term CVCs are integral to many treatment protocols. Many CVCs give trouble-free access, but technical, infective, and occlusive complications prompt premature removal in up to 14% of patients [5]. Additionally, the improvement in relapse disease therapy protocols for many childhood malignancies means that some children who have had previous uncomplicated CVCs will require recannulation. Factors involved in catheter-related venous thrombosis include prematurity, thrombogenicity of the implant and infusate, catheter sepsis, and duration of implant [1,6]. Indeed, one study has demonstrated USS evidence of thrombi of varying extent in the IJV in up to 63% of patients after CVC removal [2].

It is our policy to reuse the previously accessed IJV for repeated CVC where possible. This had the advantage of preserving other central veins, and in general means that CVCs are placed in the right IJV, which in our opinion gives the least complications. Doppler USS is reported to be a valuable and accurate investigative tool in the assessment of venous patency prior to and after CVC in adults [3, 7] and as a guide to the successful placement of subsequent CVCs [8, 9]. However, there are few data available in the literature correlating the accuracy of Doppler USS appearance with the actual findings of venous patency at open operation.

In our patients, patency of the previously-accessed IJV was confirmed as present in 89.4% of all veins suggested to be patent on prior Doppler USS, confirming the usefulness of this investigation in pre-operative assessment. Review of USS in patients where the vein was obliterated at open exploration suggested that the apparent ultrasonographic patency was a result of enlarged collateral vessels. As a result of this study, the Doppler USS assessment has now been extended to try to identify the course of the vein assumed to be the IJV to confirm that it is not a collateral channel. We would also consider evidence of other collaterals in the locality to be a contraindication to re-exploration.

We did not explore veins suggested to be stenosed or obliterated on USS assessment, some of which may well have been reaccessible. Nevertheless, successful recannulation was possible in almost three-fourths (74.6%) of veins previously accessed. Other modalities are available to assess the venous anatomy of the neck, including venography, contrast-enhanced computerised tomography, digital subtraction angiography, and magnetic resonance angiography [10]. However, most require irradiation or contrast injection and are not ideal in children. Doppler USS is convenient, inexpensive, and noninvasive.

We suggest that if the surgeon wishes to insert a second CVC into a previously catheterised vein the child

should undergo Doppler USS assessment prior to reinsertion. This examination, however, is not an entirely reliable guide to the presence of underlying vessel patency and should be interpreted with some caution, particularly in the child where venous access is becoming difficult. Doppler USS should be carried out in a manner designed to distinguish collateral veins from patent IJVs, and we would advise increase caution in the presence of overt collateral channels in the region on either clinical or USS examination.

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