Assessment (screening or diagnosis)

Doppler echocardiography was not accurate for diagnosing asymptomatic thrombosis associated with an umbilical venous catheter in infants


QUESTION: What is the accuracy of Doppler echocardiography for diagnosing asymptomatic thrombosis associated with an indwelling umbilical venous catheter (UVC) in infants?

Source of funding: Regional Medical Associates of Hamilton, Ontario, Canada.

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Design
Blinded comparison of Doppler echocardiography with contrast venography.

Setting
A neonatal intensive care unit (NICU) at a university based hospital in Hamilton, Ontario, Canada.

Test characteristics of Doppler echocardiography for diagnosis of asymptomatic thrombosis associated with an umbilical venous catheter in infants

<table>
<thead>
<tr>
<th>Observer</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (CI)</th>
<th>+LR</th>
<th>−LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiologist A</td>
<td>21% (5 to 51)</td>
<td>91% (76 to 98)</td>
<td>2.36</td>
<td>0.86</td>
</tr>
<tr>
<td>Cardiologist B</td>
<td>43% (22 to 67)</td>
<td>76% (58 to 89)</td>
<td>1.77</td>
<td>0.75</td>
</tr>
<tr>
<td>Cardiologist C</td>
<td>21% (5 to 51)</td>
<td>94% (80 to 99)</td>
<td>3.54</td>
<td>0.84</td>
</tr>
</tbody>
</table>

*LR = likelihood ratio for a positive test result and −LR = likelihood ratio for a negative test result; CI, +LR, and −LR calculated from data in article.

Commentary
15% of all neonates admitted to the NICU require UVCs, which are commonly associated with thrombus formation in this population. The study by Roy et al found that Doppler echocardiography was not accurate for diagnosis of thrombus in newborn infants. As indicated in the abstract table, echocardiography was poor at identifying thrombi when they actually existed (sensitivity = 21–43%), but more accurately identified when thrombi were not present (specificity = 76–94%). The negative likelihood ratios of 0.75–0.86 indicate that an infant with a negative result on echocardiography still had a 75–90% chance of having a thrombus.

A methodological strength of this study was the blinding of the cardiologists and radiologists who evaluated the results of echocardiography and venography. Interobserver agreement for the presence or absence of thrombus on echocardiography was high for 2 of the cardiologists, but low for a third cardiologist (κ= 0.27 and 0.31). Such a difference among observers further compromises the utility of echocardiography for detection of thrombus in newborns.

The study by Roy et al also provides evidence that the rate of venographically confirmed thrombus (50%) is higher than reported in previously published research where diagnoses were based on echocardiography (1.8–13%). The findings do not support the use of echocardiography over venography, the current gold standard, especially when decisions about long term, potentially hazardous, anticoagulant treatment are to be made on the basis of these test results. For nurse practitioners and other members of the medical team who insert UVCs, and for the bedside nurses who maintain them, the findings of Roy et al also highlight the importance of careful deliberation before UVC insertion to ensure that the benefits of venous access in ill newborns outweigh the associated risks, namely thrombus formation.

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Patients
47 infants (mean gestational age 32.2 wks, mean birth weight 1962 g, 51% boys) who had in situ UVCs for ≥48 hours and the catheter was scheduled for elective removal. All catheters had single lumens and were made of polyvinyl chloride; heparin was not added to intravenous solutions and no blood products were given through the UVC. Exclusion criteria were symptoms and signs of catheter associated thrombosis or catheter malfunction; known anatomic defects of the heart and great vessels; failure to position the tip of the catheter just above the diaphragm, in either the inferior vena cava or the right atrium; and unstable conditions requiring >80% of supplemental oxygen.

Description of test and diagnostic standard
A 2 dimensional echocardiogram supplemented with pulsed wave Doppler and colour Doppler imaging was done by 1 of 3 experienced technologists. The unedited tapes of each echocardiogram were independently reviewed by 3 paediatric cardiologists who were blinded to the venogram results and made a definitive diagnosis about the presence or absence of a thrombus in the right atrium, inferior vena cava, or ductus venosus. The diagnostic standard, contrast venography, was done by a radiologist using a portable image intensifier. A second radiologist, who was blinded to the echocardiographic findings, reviewed the videotaped image and noted the presence or absence of a thrombus and its diameter and location.

Main outcome measures
Sensitivity, specificity, and likelihood ratios of Doppler echocardiography.

Main results
14 patients (30%) had thrombosis on venography (4 in the right atrium, 7 in the inferior vena cava, and 3 in the ductus venosus). The test characteristics of Doppler echocardiography were poor (Table). Interobserver agreement among 2 cardiologists was good (κ=0.90), but was poor between the third cardiologist and the other 2 observers (κ=0.27 and 0.31).

Conclusion
Doppler echocardiography was not accurate for diagnosis of asymptomatic thrombosis associated with an indwelling umbilical venous catheter in infants.