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Wrist Circumference Predicts the Risk of Radial-arterial Occlusion after Cannulation

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Thrombotic occlusion of the radial-artery frequently occurs following percutaneous cannulation for monitoring purposes. Although usually temporary and asymptomatic,¹ these thrombi occasionally result in serious vascular complications such as distal ischemia and gangrene of the hand,² or necrosis of the skin overlying a segment of occluded artery.³ Recently, we observed that measurement of wrist circumference prior to cannulation can be used as a noninvasive method for predicting the likelihood of development of subsequent radial-artery occlusion.

METHODS

The subjects of this study were 100 consecutive patients (60 male, 40 female, mean age 59 years \pm 5 SD) requiring direct arterial monitoring for major elective operations. During the preanesthetic interview, informed consent for the study was obtained and the patency of both radial and ulnar arteries was verified using Allen's test⁴ and a Doppler ultrasonic flow probe. Wrist circumference was measured to the nearest centimeter on the side to be cannulated, using a snugly applied tape measure at the bony prominence of the radial and ulnar styloids.

Just prior to operation radial-artery cannulation was performed with 18-gauge Teflon[®]† Catheters‡ as previously described.¹ Heparinized 0.9 per cent saline solution (2 units/ml) was infused continuously via an

Intraflow§ system at a rate of 3 ml/hour, and all catheters were removed after 26 hours \pm 4 SD. Just before decannulation, arteriography was performed by injecting 3 ml contrast solution¶ while a roentgenogram of the wrist and hand was performed. Two radiologists who did not know the clinical histories measured vessel lumen diameter to the nearest .25 mm and recorded the presence or absence of occlusive vascular lesions.

After decannulation, radial-artery function was evaluated daily using both Allen's test and Doppler examination as previously described¹ until the patients were discharged from the hospital. Statistical comparisons were performed using Yates' correction for chi-square test, Student's t test for nonpaired data, and linear correlation of two variables.

RESULTS

Occlusive radial-artery thrombi developed in 35 patients following percutaneous cannulation. Fifty-two patients had wrist circumferences measuring less than 18 cm, and these sustained a 47 per cent incidence of arterial occlusion. This was significantly different ($P < .05$) from the 21 per cent incidence of occlusion that occurred in the 48 patients with wrist circumferences of 18 cm or more. A negative linear relationship ($r = -.98$) was found between the incidence of post-cannulation radial-artery occlusion and the patients' wrist circumferences (fig. 1).

Confirming previous observations that cannulation causes more occlusive lesions in smaller radial arteries than in larger ones,⁵ we also found a negative linear relationship between the sizes of the cannulated vessels and the incidence of thrombosis (fig. 2).

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†Trademark, Dupont Co.

‡Cathlon IV Jelco Laboratories, Raritan, N. J.

§Sorensen Research, Salt Lake City, Utah.

¶25 per cent sodium diatrizoate, USP, Winthrop Laboratories, New York, N. Y.

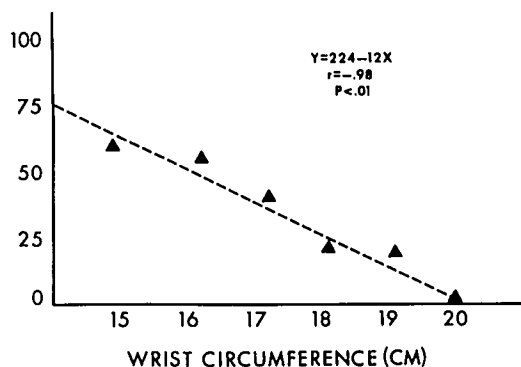
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FIG. 1. Relation between incidence of post-cannulation radial-artery occlusion and wrist circumference. Patients with small wrists sustained a high incidence of occlusion, whereas those with large wrists had relatively few occlusive lesions.

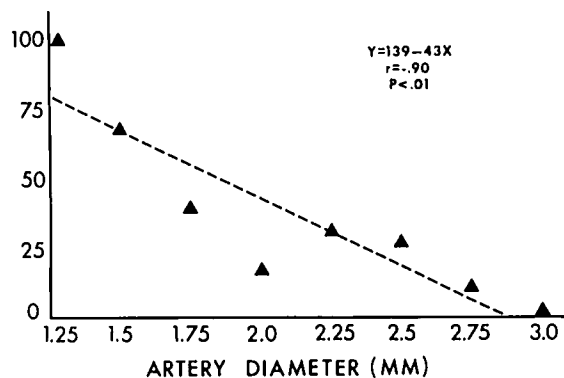
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FIG. 2. Risk of radial-artery thrombosis as a function of vessel size measured by arteriography. Small vessels develop more occlusive thrombi following cannulation than do large vessels.

Comparing the men and women in this study, women were found to have a significantly smaller mean wrist circumference ($16.26 \text{ cm} \pm .21 \text{ SE}$ versus $17.70 \text{ cm} \pm .34$, $P < .01$) and vessel diameter ($2.01 \text{ mm} \pm .09 \text{ SE}$ versus $2.43 \text{ mm} \pm .06 \text{ SE}$, $P < .01$). As might be expected from these findings, women sustained a higher incidence of arterial occlusion following cannulation than did men (48 per cent versus 25 per cent, $P < .05$). There was no difference in the incidences of occlusion between groups of men and women whose wrist circumferences were the same.

One instance of skin slough occurred, over the thrombosed radial artery (2.0 mm diameter) of a woman whose wrist circumference was 16 cm. There was no instance of distal vascular insufficiency, and 13 of the radial-artery occlusions had recanalized before the patients were discharged from the hospital.

DISCUSSION

Since percutaneous radial-artery cannulation is associated with a considerable incidence of temporary vessel thrombosis, the safety of the procedure is predicated on documenting collateral circulation to the entire hand via the ulnar artery. Vascular occlusion tends to occur less frequently in large radial arteries ($>2 \text{ mm}$ diameter), presumably because these vessels sustain less intimal damage and less impairment to blood flow while catheters are in place than do smaller vessels.⁵ Patients who have small wrists tend to have small radial arteries and are at greater risk for developing occlusive lesions than are patients with larger wrists. A similar finding has been reported in pediatric patients undergoing cardiac catheterization, where younger patients with smaller vessels sustained a higher incidence of brachial-artery occlusion than did older children.⁶

Our results indicate that wrist circumference, when measured prior to a controlled period of percutaneous radial-artery cannulation, provides a noninvasive, reliable prediction of the risk for developing subsequent vascular occlusion. Other factors known to reduce the likelihood of radial-artery thrombosis include the use of small (20-gauge) Teflon catheters,⁵ short duration of cannulation,¹ and aspiration of clot from the vessel during decannulation.⁷ These should be considered for all patients, but most particularly for those whose wrists are less than 18 cm in circumference.

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