Technique of Arterial Puncture
A New Needle-Cannula for Arteriography

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The most commonly used needle for routine injection of the carotid system in the neck in North America is a standard lumbar-puncture type of needle of 18-gauge or a modification of such a needle, such as a thin-wall, short-bevel needle.

Unfortunately, in bevelled needles, the requirements of minimal length of bevel and maximal sharpness are opposed mutually. The novice in the technique of percutaneous arteriography tends to select needles with bevels of greater than optimum length, since the artery is penetrated more readily by the sharper point provided by the longer bevel.

There then is a real risk that the orifice of the needle may be partly within the lumen and partly within the posterior arterial wall. There frequently is no warning of this state of affairs to be obtained from the pulsatile backflow from the needle and a forceful injection made under these circumstances can result in very extensive intramural extravasation of contrast material, more or less extensively dissecting the coats of the artery (Figs. 1 and 2). Extravasal injection causes transient pain and may cause severe spasm of the internal carotid artery.\(^3,6\) Such dissection produces a risk of severe complications or death.\(^1,4,5,7\) Fortunately, in the large majority of cases, this dissection causes no detectable clinical complications other than transient pain.\(^2\) In more experienced hands, the short-bevel needle has proved to be satisfactory and relatively safe and can be threaded for a distance of a few mm. up the carotid lumen.

Despite this, there is no doubt that a standard 18-gauge needle with a suitably

![Diagram](image)

**Fig. 1.** (A) A long-bevel needle may be inserted in such a manner that the bevel opening is partly within the arterial lumen and partly within the layers of the wall. Pulsatile backflow of blood may be sufficiently good that the state of affairs is unrecognized.

(B) With forceful injection, contrast medium is very likely to cause dissection of the arterial wall to a greater or lesser extent. Perivascular extravasation may also occur.

(C) The short-bevel needle is much less prone to cause this complication, since it is unlikely that the opening will lie in the arterial lumen and the arterial wall at the same time. However, the short bevel is blunter and tends to approximate the anterior and posterior arterial wall on insertion, predisposing to initial penetration of both walls. When the tip of the needle is retracted into the lumen, a forceful injection may dissect under the intimal laceration in the posterior wall so caused.

short bevel has a less than optimal sharpness and this factor causes some difficulty.

In order to obtain satisfactory threading of the artery, with minimal risk of damage to
the posterior wall of the vessel in so doing, the Cournand needle-cannula has been employed for carotid puncture⁸ (Fig. 3a). This instrument provides an added advantage in that the inner needle, being of smaller gauge than the 18-gauge cannula, through which the injection is made, permits of a greater degree of sharpness relative to length of bevel than can be obtained with a standard or thin-wall 18-gauge needle. Nonetheless, a vertical or almost vertical puncture, with penetration of the posterior wall of the artery, tends to be the rule. Once the orifice of the needle is within the arterial lumen, as indicated by withdrawal of the needle and demonstration of good pulsatile backflow through the cannula, a blunt obturator is inserted into the cannula so that the end of the obturator projects a very short distance beyond the rather sharp end of the cannula, which in the case of the Cournand cannula is itself slightly bevelled. The two sections of the instrument, held firmly together, with the haft depressed, then are advanced for a variable and often considerable distance up the lumen of the artery. There is little risk of damage to the posterior arterial wall if the instrument is held so as to lift the distal end as this is advanced in the lumen. The shield allows the needle and cannula to be held with better
control than is possible with conventional needles during arterial puncture and makes much easier the "lifting" of the tip of the needle and artery for threading. The obturator then is withdrawn and the connector and syringe are affixed to the cannula. By this means, a secure position of a relatively blunt cannula of 18-gauge is obtained within the arterial lumen and the patient's head can be manipulated quite freely without risk of dislodgement of the cannula from the artery or of impaction of the tip of the needle in the posterior wall and subsequent intramural extravasation upon forceful injection of saline or contrast medium. Even basal projections (full axial), required for optimum demonstration of the anatomy of certain aneurysms, arteriovenous malformations and vascular developmental anomalies, may be obtained without risk of dislodgement of the needle from the artery. The advantages of the Cournand type of needle (through which a guide may be inserted and a catheter passed over the guide into the carotid system as a primary procedure or after initial injection through the cannula), together with the need to improve the sharpness of the tip of the puncturing instrument used for arteriography and at the same time to avoid a long bevel to achieve this end, led one of us (PFJN) to design a needle-cannula instrument which, it is believed, offers important advantages over those available previously. The theoretical advantages have been proven in practice, and are believed to justify this report.

**Technique**

The needle (Fig. 3B) differs from the Cournand needle in the following respects: the end of the cannula is not bevelled, but square-cut. Very smooth fairing of the cannula provides the minimum irregularity between the tip of the cannula and the inner needle. The inner needle is solid (no lumen) and is provided with a hollow ground, "needle-sharp" tip. The distance between the end of the cannula and the tip of the needle is 2-3 mm. (Fig. 4). The proximally projecting extension of the cannula through the Luer-lok section of the Cournand needle has been omitted for convenience of insertion of the obturator after the cannula has been inserted into the arterial lumen. The obturator is essentially similar to that used in the Cournand needle, except that special attention has been directed towards obtaining a perfectly smooth rounded tip to minimize possible damage to the intima of the posterior wall of the artery, such as could be caused by the rather flat tip of the obturators supplied with some other needles.

The tip of the solid inner needle of this instrument provides the maximum possible sharpness, with a relatively short longitudinal measurement.
The sharpness is sufficiently great that as soon as the tip impinges upon the anterior wall of the artery it is locked in position and the needle and cannula can be advanced together smoothly, without any very forceful thrusting motion, even if the instrument is inserted with a relatively shallow angle of attack. It usually is possible to feel some resistance as the end of the cannula engages in the anterior wall of the artery and a slightly firmer pressure will as a rule permit a smooth entry of the cannula into the lumen. By this means, penetration of the posterior wall of the artery can be avoided in many cases. In those cases in which the tip of the needle does enter the posterior wall, it is evident from the shape of the tip of the needle that a smaller wound would be made in the posterior wall than by the cutting tip of a bevelled standard hollow needle. Following confirmation of entry of the cannula into the lumen, proved by removal of the solid needle and observation of the pulsatile backflow, the obturator is inserted into the cannula, and the haft of the cannula is depressed and threaded for a distance of several mm. up the arterial lumen, the patient's neck remaining somewhat extended (Fig. 5).

When such a cannula and obturator are threaded together up the arterial lumen, it is virtually impossible to place the cannula in such a position that subsequent injection produces intramural extravasation, unless the obturator is not kept fully pressed home in the cannula. It is also important to maintain downward pressure on the haft of the cannula during the procedure, to reduce the possibility that the tip of the cannula may press upon the posterior wall of the artery. In

![Fig. 4. Drawings showing detail of end of the cannula: (A) blunt obturator in position, and (B) solid inner needle in position.](image)

![Fig. 5. (A and B) Extremely sharp tip of needle engages easily and securely in anterior wall on contact, even with relatively small angles of attack, so favoring entry into lumen without penetration of the posterior wall of the artery. (C) Obturator in position. (D) Depression of the haft of the cannula, with simultaneous "lifting" of the tip (facilitated by the shield of the cannula), thus elevating the artery for threading up the lumen with minimal risk of injury to the posterior arterial wall.](image)
allows passage of a small Seldinger type of guide wire over which a P.E. 205 polyethylene or Teflon catheter (internal diameter 1.57 mm., external diameter 2.08 mm.) may be passed after the cannula has been removed. Alternatively, after initial injection or injections, selective injection of internal or external carotid artery may be performed by catheter replacement of the cannula over a guide wire, in the usual manner.

As with the Cournand and Seldinger needles, a small nick in the skin, using a Bard-Parker No. 11 blade, facilitates entry of the needle-cannula and allows more delicate maneuvering of the tip of the needle.

The risk that a standard arteriographic needle, advanced into the arterial lumen without a stylet, may become plugged by a small clot or needle biopsy of muscle or other tissue is a real one. If the needle and connector are well aspirated into a syringe with blood flow from the arterial lumen and the syringe is discarded, the risk of injecting an embolus into the circulation is probably more theoretical than real. However, the needle so plugged may prevent immediate recognition of entry of the tip into the arterial lumen, occasionally resulting in unnecessary arterial trauma or formation of perivascular hematoma before the state of affairs is recognized and corrected. The above risks, real or theoretical, are obviated by the use of the needle-cannula instrument. The round tip of the needle, which parts the fibres of the arterial wall, can be expected to produce a puncture that seals more readily after withdrawal of the needle than one produced by a cutting bevel of conventional type and it is our distinct impression that formation of hematoma has been less in the patients on whom the new needle has been used than with the use of conventional needles.

It is the routine practice at this centre to make a small test injection (2.0 ml 60 per cent Renografin undiluted or diluted with 1.0 ml normal saline) after final positioning of the patient's head has been completed and to record this on a Polaroid print centred to the neck (lateral projection). This adds only a minute or so to the procedure and aids in determination of a satisfactory position of the needle. With the use of standard arteriographic needles, warning is given of extravasation and the needle can be repositioned before more extensive injury is produced by forceful injection of the full amount of contrast medium. After repositioning of the tip of the needle a further test injection is of course advisable.

An added advantage of the technique is that the condition of the distal portion of the common carotid artery, bifurcation and proximal portions of the internal and external branches is recorded, whereas otherwise these areas frequently are excluded from the routine lateral angiographic study by the demands of optimal coning and centring.

Fig. 6. Polaroid prints; lateral cervical projections during test injection of a small amount of Renografin 60 per cent.

(A) Modified cannula in good position, with tip threaded 1.7 diameters of common carotid artery to the bifurcation.

(B) Tip of modified cannula shown impinging upon the posterior wall of the common carotid artery, with pressure sufficient to deform the wall. Even so, no dissection of the wall occurred. With the tip of a conventional needle in this situation, dissection would be expected to occur routinely.

(C) Tip of conventional needle impacted in posterior wall. Even with a small test injection, sufficient dissection has occurred to cause appreciable obstruction to the true lumen, with poor flow distally, particularly in the internal carotid artery.
of the beam. The true frequency of intramural extravasation of contrast medium cannot be appreciated unless the site of arterial puncture is demonstrated in all cases. Also, the frequency of unsatisfactory or equivocal angiograms because of slow circulation and arterial spasm can be reduced by early warning of an unsatisfactory position of the needle or tip of the cannula.

Following routine use of the instrument described herein, the technique of preliminary test injection and Polaroid exposure has been continued. This has provided a record of the situation at the site of puncture.

Results

To date a total of 45 unselected patients of wide variety from the neurological and neurosurgical services have been subjected to angiography employing the modified needle, with a total of 54 arterial punctures (44 common carotid, 10 brachial). The ages of the patients ranged from 7 to 93 years.

The artery was entered at the first pass in 19 instances, second pass in 19, third pass in 7 and fourth pass in 1. In 1 patient with a short, thick and muscular neck, 3 passes with the new needle failed and the artery was punctured readily with a conventional needle.

In 3 cases, up to eighteen passes with a conventional needle failed to produce satisfactory arterial puncture and a change to the new needle resulted in satisfactory puncture in one or two passes (same operator). In 7 instances, no record of the number of insertions of the needle required for successful puncture was made.

The series included a few patients of unusual obesity (1 a female of 280 lbs.) or muscularity, with extremely short thick necks and barely palpable common carotid pulses, yet no difficulty was experienced in obtaining satisfactory punctures with the needle-cannula instrument, except in 1 case mentioned above.

No intramural extravasation using the new needle occurred except in the first case in the series, when the cannula was advanced very slightly without the obturator in place and a small subintimal collection (0.5 mm. thick) was noted in the common carotid artery after an injection of 8.0 ml.

No neurological or other complications were encountered in the series.

The distance the cannula was threaded up the arterial lumen was clearly demonstrated in 20 common carotid punctures and was measured in terms of the diameter of the artery at the point of puncture.

The maximum distance threaded was equal to 3 diameters, the minimum 1.25 diameters and the mean distance was 1.9 diameters.

The brachial arterial punctures were performed preparatory to retrograde catheterization for vertebrobasilar, carotid and aortic arteriography. Although the number of cases is still small, the same improvement in ease of arterial puncture over the Courmand needle has been noted as in the carotid studies. It is anticipated that the needle will prove equally advantageous in femoral arteriography and studies of retrograde femoral catheterization. With reduction in size and gauge, the instrument should prove very well suited to arteriographic punctures in very young children and infants.

Summary

A new needle has been described, which in the opinion of the authors has shown a marked superiority over conventional needles and the Courmand needle in common carotid and brachial arteriography. Although the number of cases in which the needle has been employed is still comparatively small,* the advantages of the needle are sufficient to justify a report, in the opinion of the authors, one of whose (PFJN) experience in arteriography is extensive and covers most of the needles used previously for arteriography. The new needle, essentially a modification of the Courmand needle, possesses the advantage that ease of arterial puncture is increased, particularly in the case of very sclerotic, tortuous, or very soft arteries. The security of the position of the needle in the

* Since this report was submitted for publication further 129 carotid angiograms and 16 brachial angiograms have been performed using this instrument, which is now the needle usually employed for carotid and brachial arteriography at this centre.
arterial lumen is improved, with reduction in risk of arterial damage and intramural dissection, particularly when the operator is relatively inexperienced in the techniques of arteriography. The instrument is entirely suitable for arterial catheterization, either as a primary procedure or subsequent to initial injections via the cannula, when selective internal or external carotid angiograms may be obtained without the need for further arterial punctures. The needle should also prove advantageous in arterial punctures at other sites.

References
8. Potts, G. Personal communication.