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Preliminary Experience with use of Qureshi-5 Catheters for Diagnostic Cerebral Angiography

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Abstract

BACKGROUND—A catheter technique was developed to overcome current challenges in the stabilization and manipulation of catheter in tortuous arteries such as right subclavian artery and left common carotid artery.

METHODS—The new catheter has the following two lumens: first lumen can accommodate a 0.035-inch guide wire (lumen A) and a curved shape at the distal end; the second lumen can accommodate a 0.018-inch guide wire and terminates at the beginning of the distal curve of the first lumen (lumen B). The catheter is withdrawn or advanced over the 0.018-inch guide wire and the curved free end of catheter manipulated until the end engages the origin of the target artery. Subsequently, either contrast can be injected or a 0.035-inch guide wire advanced into the target artery.

RESULTS—The catheters were used in two patients to perform diagnostic cerebral angiography through a 6F introducer sheath placed in the right common femoral artery. The left and right common carotid arteries and left and right vertebral arteries were catheterized in first patient (contrast used 50 ml; fluoroscopy time 20:09 min). The left and right internal carotid arteries, left and right subclavian arteries, and left external carotid artery were catheterized in second patient (contrast used 40 ml; fluoroscopy time 13:56 min). No complications were observed in either of the two patients.

CONCLUSIONS—The performance of the new catheter for catheterization of multiple arteries in two patients was considered adequate with high-quality angiographic image acquisitions.

Keywords

Supra-aortic artery; cerebral angiography; catheter; Qureshi catheter; double lumen

Current challenges include difficulty in stabilization and manipulation of catheter in tortuous arteries such as right subclavian artery and left common carotid artery[1–4]. Prolonged procedures, the use of multiple catheters, and difficult selective catheterizations increase the risk of cerebral embolization and ischemic events during the procedure [1–4]. The challenge is quite imminent when stability of the distal end of catheter in a particular configuration is desired to engage the tortuous origin of the vertebral artery. Using larger 6F guide catheters that allow placement of two coaxial wires (usually a 0.014 inch and 0.018 inch) may be used in such circumstances. The 0.018-inch wire is placed in the distal subclavian or proximal axillary artery and catheter is withdrawn over the 0.018-inch wire and 0.014-inch wire manipulated to engage the origin of the vertebral artery. However, such technique is limited because the distal end of the catheter is straightened by the coaxially placed 0.018-inch wire and cannot be rotated to engage the origin of vertebral artery or oriented to provide desired trajectory for contrast injection. A method was described that uses a double-lumen catheter and two guide wires to catheterize tortuous arteries and side branches that are difficult to catheterize using standard catheters. Subsequently, specialized catheters were developed based on the method, and herein, we describe the results of clinical use of such catheters for diagnostic cerebral angiography.

DESIGN OF THE CATHETER

The catheter was designed by Qureshi (Electronic Copyright Office [ECO] System claim filed 1-26-2015), developed in conjunction with Biomerics Advanced

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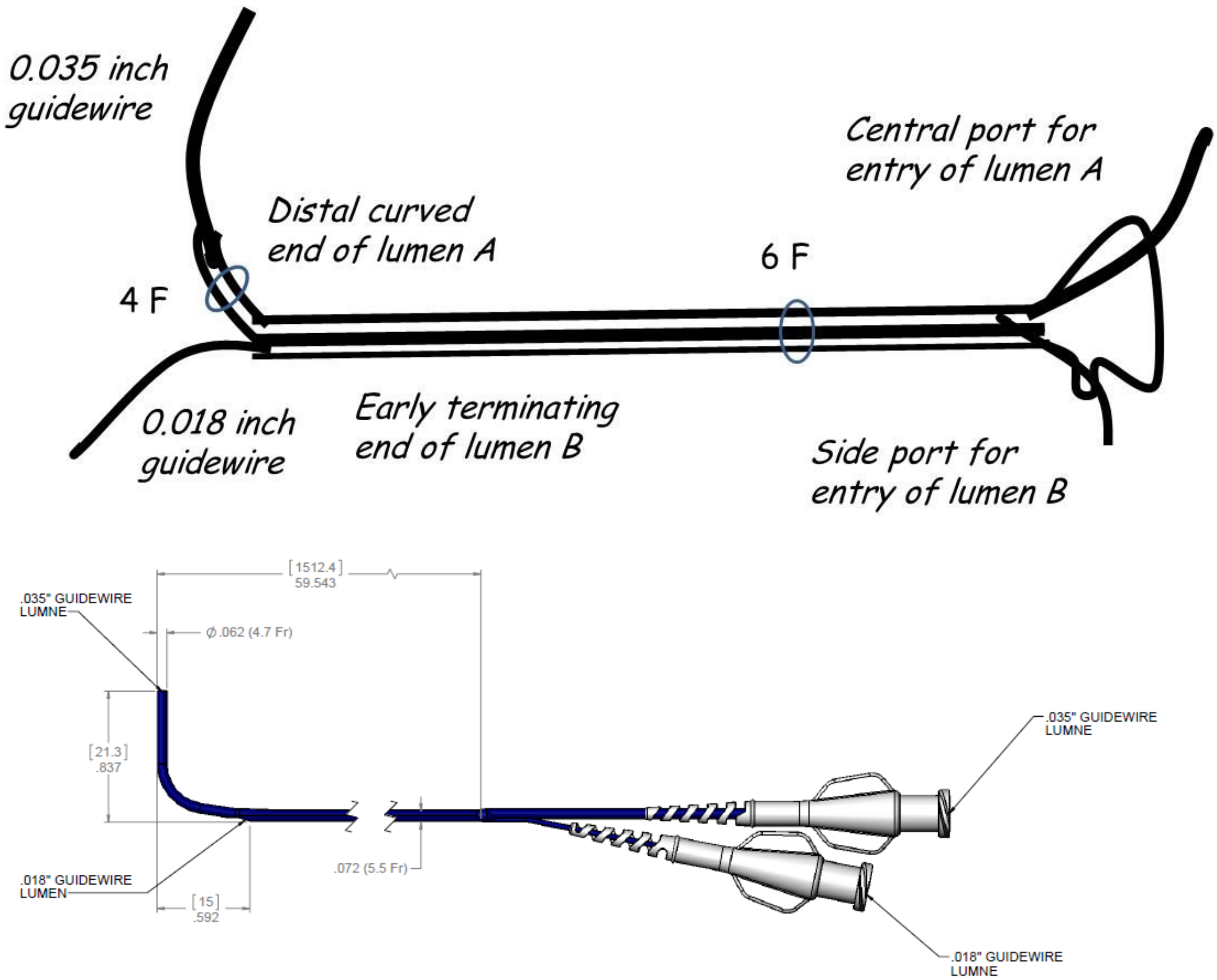
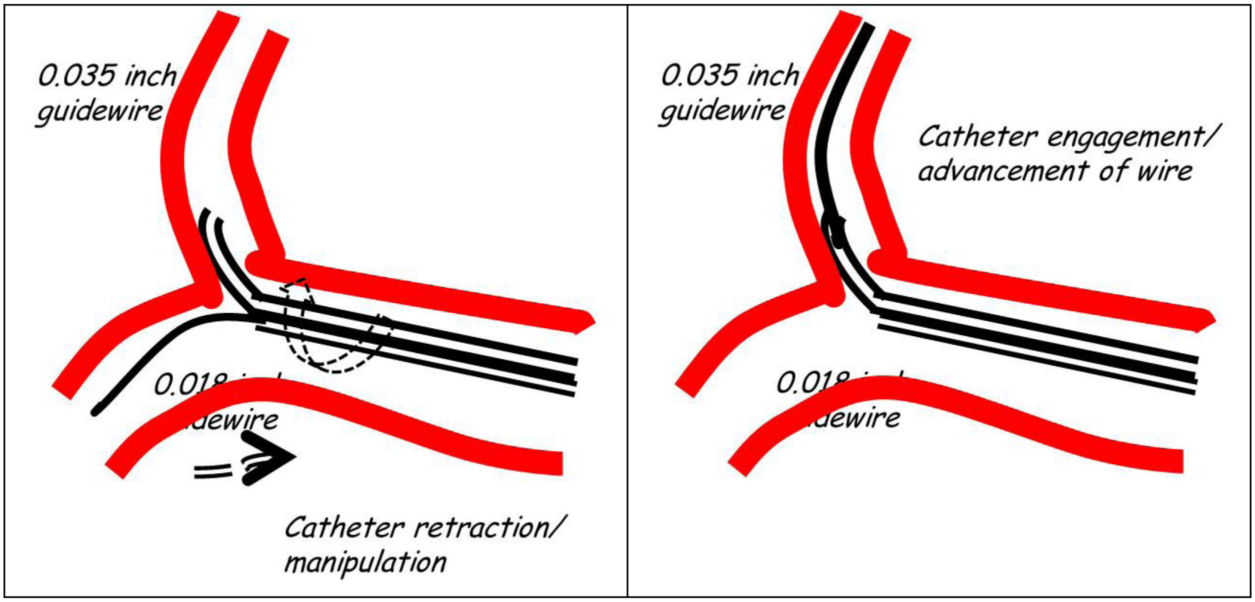


Figure 1. A schematic depicting the basic structure of Qureshi 5 catheter

Catheter, Rogers, Minnesota. The catheter has two lumens: one of which can accommodate a 0.035-inch guide wire (lumen A) and a curved shape at the distal end; the second lumen can accommodate a 0.018-inch wire and terminates at the beginning of the distal curve of the first lumen (lumen B) (Fig. 1). The lumen A entry is through a central port and the lumen B entry is via a side port (Fig. 1) at the proximal end of the catheter. The principle of the catheter is that a 0.018-inch wire is advanced into the parent artery and used as a stabilizing wire. The catheter is withdrawn or advanced over the 0.018-inch wire and the curved free end of catheter manipulated until the end engages the origin of the target artery or branch. The 0.018-inch wire provides stabilization against catheter retropulsion and inadvertent catheter engagement into tortuosity sidewall or origin of nontarget arteries. The relative straightening of the parent artery by the stiff 0.018-inch wire achieves the stabilization goals as mentioned previously (Fig. 2A). A 0.035-inch guide wire is advanced through the terminal opening of the curved tip into the branch and once enough length of the wire is advanced, the 0.018-inch wire is retracted within the second lumen and catheter advanced over the 0.035-inch guide wire into the target arterial branch (Fig. 2B).

INITIAL ASSESSMENT

The Qureshi 5 catheters were used in two patients to perform diagnostic cerebral angiography. The characteristics of the patients are summarized in Table 1. A 6F introducer sheath was placed in the right common femoral artery using modified Seldinger's technique. The Qureshi 5 catheter was advanced over a 0.035-inch glide



Figures 2A and 2B.Schematics depicting the concept behind Qureshi 5 catheter manipulation and navigation

Table 1. Patients' and procedural characteristics of the diagnostic angiography procedure performed using Qureshi 5 catheter.

	Patient 1	Patient 2
Age (years)/gender	65/M	46/M
Presenting symptoms	Suspected vertebrobasilar ischemia	Suspected vertebrobasilar ischemia
Cardiovascular risk factors	None	Cigarette smoking [20 cigarettes per day for 30 years]
Vessels catheterized	Left and right common carotid arteries and left and right vertebral arteries	Left and right internal carotid arteries, left and right subclavian arteries, and left external carotid artery
Contrast used	50 ml	40 ml
Fluoroscopy time	20:09 min	13:56 min
Radiation dose (mGy)	765	443
Record DAP (mGycm2)	5139	3938

mGy, milligray; DAP, dose area product.

wire (placed in lumen A) through the iliac artery, abdominal aorta, descending aorta, and arch of aorta in a retrograde manner. A 0.018-inch wire (V-18 Control Wire, 0.018 inch, 180 cm, Boston Scientific, Malborough, MA) was concurrently placed in the lumen B throughout the above-mentioned advancement of the catheter, but the distal end of the 0.018-inch wire was contained inside the distal end of the lumen B.

All the target supra-aortic arteries were successfully catheterized using the Qureshi 5 catheter. Once the catheter was advanced past the origin of the right innominate artery in the aortic arch, the 0.035-inch wire was retracted within the distal end of the lumen A. The distal end of the catheter was manipulated to orient in cephalad direction and retracted to engage the origin of the supra-aortic arteries. The catheter was advanced over the 0.035-inch wire into the supra-aortic arteries (Figs. 3 and 4). For subclavian arteries, the catheter was advanced into the distal segment past the origin of the vertebral artery. The 0.018-inch wire was advanced into the distal subclavian artery, and the 0.035-inch wire was retracted within the distal end of the lumen A. The catheter was withdrawn and manipulated over a stable 0.018-inch wire until the desire location and orientation for the distal end was achieved as identified on fluoroscopic imaging. The 0.035-inch wire was advanced into the vertebral artery or the right common carotid artery. The 0.018-inch wire was retracted within lumen B and catheter advanced into the vertebral or right common carotid artery. For left common carotid artery, the 0.018-inch wire was advanced into the right distal common carotid artery and the 0.035-inch wire was retracted within the distal end of the lumen A. The catheter was withdrawn and manipulated over a stable 0.018-inch wire until the origin of the left common carotid artery was engaged as identified on fluoroscopic imaging. The catheter was advanced into the left common carotid

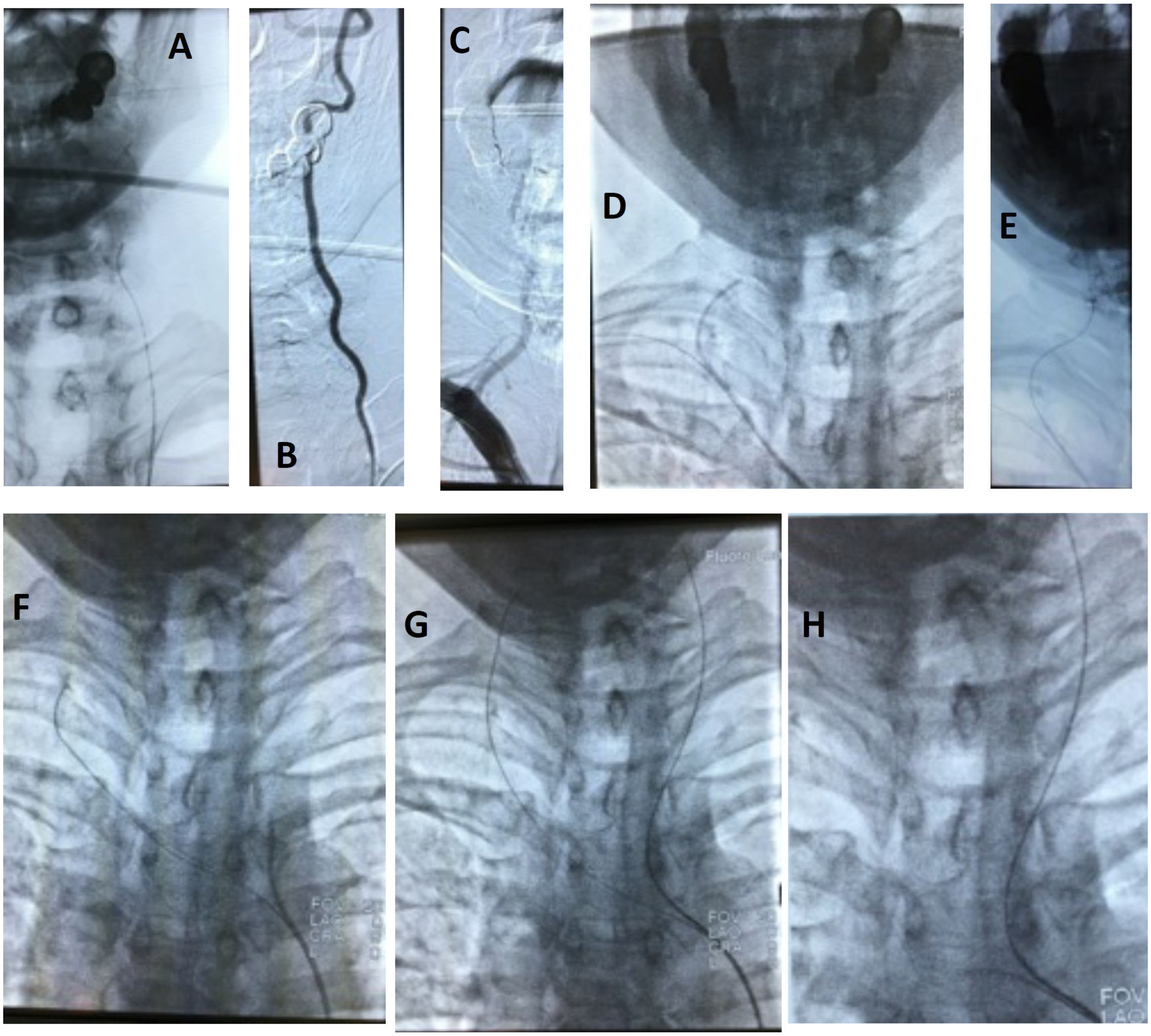


Figure 3. Images of diagnostic cerebral angiography performed in first patient using Qureshi 5 catheter.
A. A 0.018 inch wire protruding from lumen B is stationery in distal left subclavian artery while a 0.035 inch guide wire is passed through lumen A into left vertebral artery; B. Contrast injection from lumen A of catheter placed in left vertebral artery; C. Contrast injection from lumen A of catheter placed in right subclavian artery; D. The 0.018 inch wire protruding from lumen B is stationery in distal right subclavian artery while the 0.035 inch guide wire is passed through lumen A into right vertebral artery; E. The 0.018 inch wire is withdrawn into the lumen B allowing the catheter to advance into the right vertebral artery; F. The distal end of the catheter is withdrawn and manipulated to engage the left common carotid artery origin over the 0.018 inch wire that is stationery in right common carotid artery; G. The 0.035 inch guide wire is passed through lumen A into left common carotid artery after distal end of the catheter engages the origin of the artery; H. The 0.018 inch wire is withdrawn into the lumen B allowing the catheter to advance into the left common carotid artery over the 0.035 inch guide wire.

artery after retraction of the 0.018-inch wire as described previously. For selective catheterization of the internal carotid arteries, the catheter was advanced over the 0.035-inch guide wire with 0.018-inch wire retained in the lumen B. The intravascular contrast agent Xenetix 300, Lobitridol injection was used in both procedures. The quality of the contrast injection and subsequent opacification and visualization of cervical and intracranial arteries was considered adequate in each image acquired. The femoral sheaths were removed followed

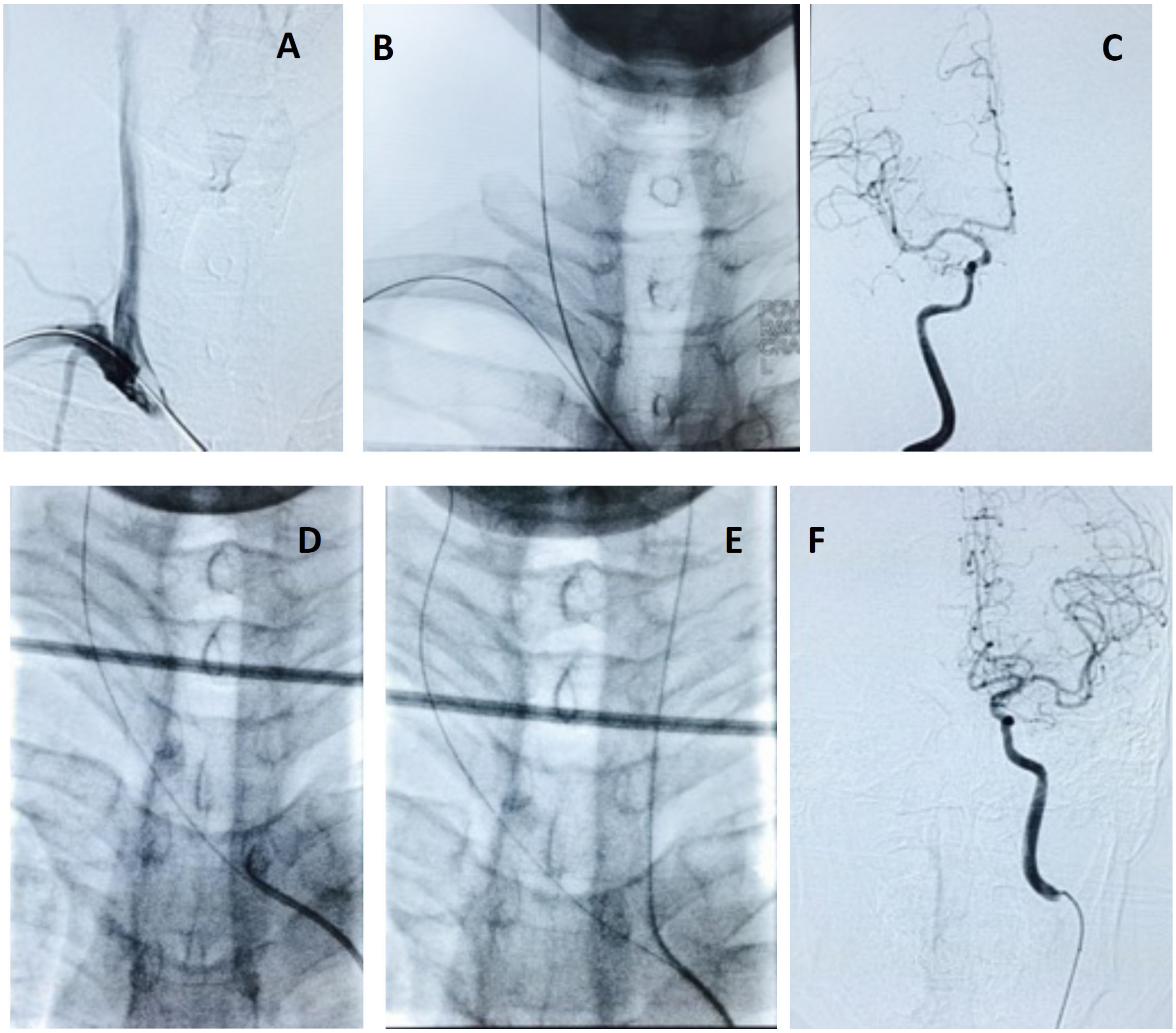


Figure 4. Images of diagnostic cerebral angiography performed in second patient using Qureshi 5 catheter.
A. A 0.018 inch wire protruding from lumen B is stationery in distal right subclavian artery while contrast is injected through lumen A to visualize origin of right common carotid artery; B. The 0.018 inch wire protruding from lumen B is stationery in distal right subclavian artery while the 0.035 inch guide wire is passed through lumen A into right common carotid artery; C. Contrast injection from lumen A of catheter placed in the right internal carotid artery after 0.018 wire is retracted in the lumen B and 0.035 inch guide wire is removed from lumen A; D. The distal end of the catheter is withdrawn and manipulated to engage the left common carotid artery origin over the 0.018 inch wire that is stationery in right common carotid artery; E. The 0.035 inch guide wire is passed through lumen A into left common carotid artery after distal end of the catheter engages the origin of the artery; F. Contrast injection from lumen A of catheter placed in the left internal carotid artery.

by manual compression to achieve hemostasis. A neurological assessment performed at the conclusion of the procedure did not demonstrate any new neurological deficits.

DISCUSSION

The performance of the catheter for catheterization of multiple arteries in two patients was considered adequate with high-quality angiographic image acquisitions. Three areas were identified for improvement in the first-generation Qureshi 5 catheters. Firstly, the radio-opacity of the distal end of the catheter needs to be increased to allow better visualization of the manipulation and rotation of the distal end under fluoroscopy. Secondly, the exit point of the lumen B appeared to have a step off which created an irregularity with potential impediment to smooth advancement in narrow arteries. Thirdly, a rotational device at the proximal end of the catheter needs to be included to facilitate external rotation at the complex double-entry point system. It is anticipated that larger diameter catheters can be used for the delivery of devices including angioplasty balloons and/or stents in highly angulated locations such as vertebral artery origin. The design of the catheter also makes it a useful device for the catheterization of branches of the aorta and coronary arteries with highly angulated origins that require high degree of stability of the distal end of the catheter. The distal end of the catheter can be conformed to lengths and configurations that may be best suited for particular applications. The new catheter is expected to reduce the complexity and associated complications of selective catheterization necessary for cerebral angiography in patients with tortuous arterial anatomy.

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