Dialysis Catheter Placement and Selection Based on the Right Atrium

How to choose the right catheter tip for optimal performance in different anatomic right atria configurations.

BY JOHN R. ROSS, MD; MICHAEL GALLICHIO, MD; AND INGEMAR DAVIDSON, MD, PHD

Multiple catheter tips have been developed over time, including the stagger, split, and symmetrical tips, as well as a dual-catheter system (Figure 1). Minor variations and new themes have occurred during the past 10 years, with possibly the most important change being the movement of the tip from the superior vena cava to the right atrium. Initially, the idea was to have a very high-flow catheter that could continually deliver 400 mL/min without clotting and, hopefully, without fibrin sheath development. The catheters gradually increased in size, such that achieving adequate flow was not limited by catheter size, but was due to appropriate positioning of the arterial limb in the largest pool of blood—the right atrium.

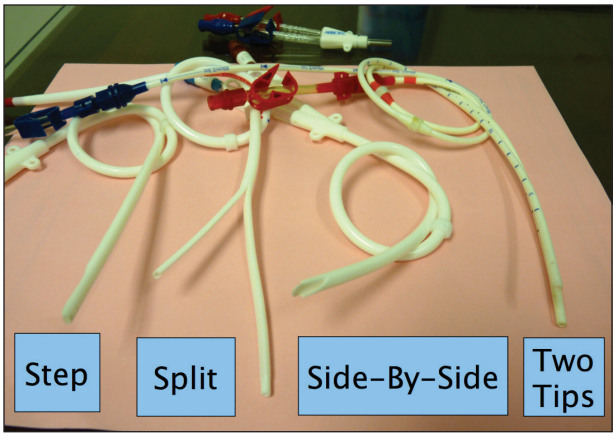

Figure 1. Various catheter tip designs.

TYPES OF RIGHT ATRIA

We studied catheter positioning in the right atrium and found that there are several different types of right atria. In the following sections, the different types of right atria will be discussed, as well as how choosing one of the catheter tips may influence catheter function in certain right atria configurations (Figure 2).

Normal Right Atrium

The normal right atrium consists of a large right atrium that will accommodate many different types of catheter tips. These can be placed from either the left or right side, using a stagger, split, or symmetrical tip, as long as the tip is located in a large pool of blood for good arterial flow.

Mega Atrium

The mega atrium, by definition, is a huge right atrium in which the split tip has plenty of room to split below the level of the superior vena cava entering the right atrium. The stagger tip and the symmetrical tip will also function well in this particular situation. This type of right atrium usually permits the best flow. Again, any type of catheter tip will work. Occasionally, what would be considered a normal atrium will not be conducive to a split tip as there is not ample room for the split tip to split.

Long Tubular Atrium

This is a very unusual atrial anatomy, particularly if the catheter comes from the left side and the catheter tip lies against the lateral wall of the right atrium with somewhat difficult flow. Even with a stagger tip, this does not work very well. Furthermore, a split tip is unable to split in this particular situation, and a symmetrical tip can be somewhat compromised. Frequently, from the left side, the catheter must be placed slightly in the inferior vena cava to achieve adequate flow, and then a symmetrical tip can be used. From the right side, the long tubular atrium seems to function well using a stagger tip, with the arterial limb medially, or a symmetrical tip. However, a split tip will not function properly.

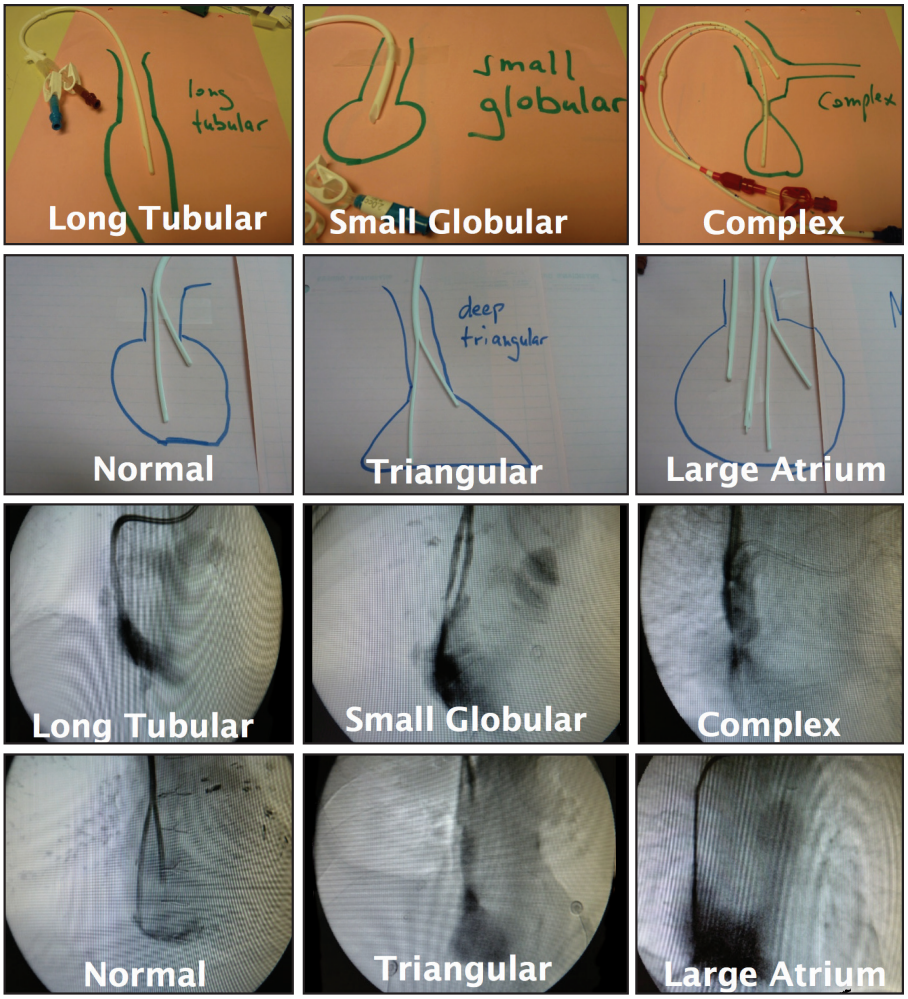

Figure 2. Catheter tip selection based on atrium morphology/geometry. There are tips available to suit every right atrium configuration.

Small Globular Atrium

This is an atrium with very little in the way of vertical dimensions. A split tip will not work in this particular situation, as there is no room to split. A stagger tip also does not work very well because by placing the venous limb appropriately, the arterial limb will frequently be in the superior vena cava, which inhibits achievement of 400-mL/min flow. Frequently, a symmetrical tip will work if placed correctly in the center of the right atrium or just distal to the superior vena cava into the right atrium.

Deep Triangular Atrium

This type of atrial anatomy can be very difficult because the atrium can be very large and triangular in shape, depending on whether you are approaching it from the left or right side to achieve adequate arterial limb positioning. Occasionally, the split tip will work well in this particular anatomy if there is enough vertical distance for the catheter tip to split. If not, a symmetrical tip may be utilized; however, this may again be somewhat problematic based on the triangular shape. Generally speaking, the split tip works well only if the split takes place with the arterial limb located medially within the large pool of blood. Stagger tips do not tend to work well in this particular situation.

Complex Right Atrium

Sometimes, the atrial anatomy can be very complex and difficult, such as when there is a very small right atrium with stenosis associated in the upper part of the atrium or at the superior vena cava/atrial junction. Often, a symmetrical tip can be placed when this situation is encountered and can function well. A dual-catheter system can be used in which one catheter is placed in the central veins and the arterial catheter is placed into the right atrium with successful catheter function. Split tips do not tend to work well in this anatomy, nor

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do stagger tips, as the arterial limb is quite high, unless flow reversal is used. Again, appropriately positioning the arterial limb in the right atrium where there is a large pool of blood dictates whether the prescribed blood flow can be achieved.

IDEAL CATHETER TIP PLACEMENT

These concepts can be different variations on the same theme, but the overall principle is to make sure the arterial limb is in a large pool of blood in the right atrium regardless of the type of right atrium. Choosing the correct catheter tip will allow good positioning and draw of approximately 400 mL/min. Applying the ideal tip based on the anatomy of the right atrium and whether you are approaching from the left side or the right side can make an appreciable difference in outcomes.

Catheters coming from the left side that seem to have contact with the right lateral superior vena cava will, many times, not allow adequate function because the catheter tip is embedded into the right atrial wall. The standard technique for inserting these catheters will include the needle wire introducer and guidewire usually placed into the inferior vena cava.

Angiography is performed to determine the specific anatomical features of the right atrium. It is not necessarily recommended that this be done for the initiation of every catheter, but certainly if pathology is present in which a catheter is not functioning, it may be appropriate to define the right atrium anatomy not by a silhouette of the fluoroscopy, but by actually watching the pool of blood defined by the contrast in the right atria to determine the anatomic features.

Once the anatomy is determined, readjustment of a present catheter that is nonfunctioning or placement of a different type of catheter tip should strongly be considered. ■

John R. Ross, MD, is with the Orangeburg Regional Medical Center in Orangeburg, South Carolina. He has stated that he has no financial interests related to this article. Dr. Ross may be reached at jrrsurgery@aol.com.

Michael Gallichio, MD, is with the Orangeburg Regional Medical Center in Orangeburg, South Carolina.

Ingemar Davidson, MD, PhD, is with Tulane University in New Orleans, Louisiana.

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