

Editorial

Closing the patent arterial duct—plugs, umbrellas and coils

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FOR MANY YEARS, THE PATENT ARTERIAL DUCT WAS closed surgically with insignificant risk of death although, occasionally, complications such as bleeding, damage to the recurrent laryngeal nerve, and persistent residual shunting were known to occur.¹ Over the last 10 years, nonetheless, closure by means of interventional catheterization has become a routine treatment around the world.

The interventional approach, first described by Porstman² as long ago as 1971, employed a plug of polyvinyl alcohol foam (Ivalon). It has now been used in about 1000 patients, but has not been widely accepted because it requires placement of a very large sheath in the femoral artery with the potential to produce complications, such as hemorrhage, arterial occlusion and stenosis.

The Rashkind double umbrella, the most extensively investigated device used for occlusion,^{3,4} had become the method of choice in several countries. It also, nevertheless, has several disadvantages. Firstly, it requires an 8 or 11 French long sheath, precluding its use in small babies. Even with the front loading technique, a 6 or 9 French sheath is required.⁵ Secondly, it is not suitable for closure of very small ducts, unless additional procedure such as balloon dilation is performed.⁶ Third, its use is associated with a high incidence of residual shunts (20 to 34% after one year).^{7,8} These figures do fall below 10% in the longer term follow-up, and if a second device is inserted.⁸ Fourth, embolization of the umbrella to the systemic or pulmonary arteries is another potentially serious complication. In case of systemic arterial embolization, retrieval can lead to damage of the femoral artery, with consequent bleeding or occlusion. In case of pulmonary migration, retrieval is usually feasible, but urgent surgery may be required, because the size of the umbrella means that it can obstruct major pulmonary arterial branches.⁹ Fifth, hemolysis, although rare, is another complication, and may require surgery or the implantation of a second

device, for its cure.¹⁰ Sixth, in infants, a 17 mm umbrella can also partially obstruct the left pulmonary artery or the aorta.¹¹ The final disadvantage is, arguably, the most significant—namely the cost. Use of the umbrella is reported to be more expensive than surgery,¹² limiting its use in many third world countries. Other devices comparable to the umbrella, such as the Bottalo occluder,¹³ the clamshell¹⁴ and the buttoned device,¹⁵ have not been subjected to extensive clinical trials, but do not appear to offer significant advantages over the Rashkind device.

There is now, however, another option for interventional closure. Gianturco coils, employed for vascular embolization for 20 years, have been used in ductal closure since 1992.¹⁶ They were used, initially, in small ducts^{17,18} with their employment being extended for arterial ducts measuring up to 5 mms, or even larger.¹⁹ Use of coils has several advantages over the umbrella. The technique of insertion is very simple, and easy to learn and teach. The coils can be introduced via a 4 French catheter and can, therefore, be employed even in small infants. Most importantly, they are very cheap when compared to other devices. Occlusion using coils costs less than 10% of the expense of the Rashkind umbrella. Coils can be used to close at least 90% of all patent ducts, since their diameters will be 5 mm or less.²⁰ Even larger ducts can be occluded when two or more coils are implanted simultaneously or in series.

When determining the most appropriate device for ductal closure, then morphology is also of importance. Zeevi and his colleagues²⁰ refer specifically to the study of ductal morphology conducted by Krichenko and associates from the Toronto Hospital for Sick Children.²¹ This alphanumeric classification distinguished five patterns for the duct (A-E), and then sub-divided the first two patterns according to their relationship to the trachea. Any alphanumeric system places undue strain on the memory, and this one is no exception. We find that the simple, descriptive, classification of Mullins²² accounts for all the patterns seen by Krichenko et al,²¹ and has the advantage of being easier to use in a clinical setting (Figure). The coil can be used to close all types of ducts distinguished by both groups,^{21,22} al-

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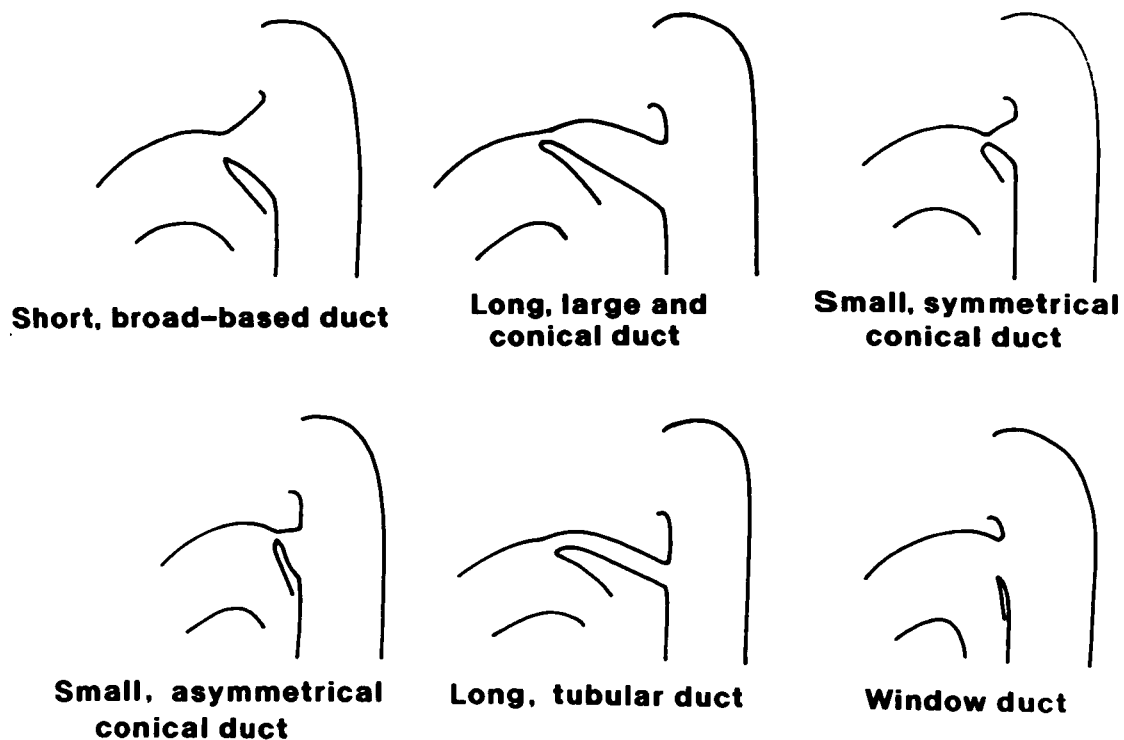


Figure. The system proposed by Mullins²² for classification of the different forms of persistently patent arterial duct.

though for the very short and large “window” duct the umbrella could be more appropriate as, in this variant, there is no ampulla in which to lodge the coil. The long tubular duct, which makes up about one twelfth of ducts, carries the highest risk of embolization since there is no area of constriction to be straddled.

The papers by Zeevi,²⁰ Hazama²³ and their respective colleagues in this issue confirm the efficacy of the use of coils, with rates of closure reported at 87.5% and 100%, respectively. The report from Zeevi et al²⁰ describes the insertion of Gianturco coils incorporating a snare to improve the safety of delivery. This is a clever maneuver, first described by Sommer and colleagues²⁴ to decrease the risk of embolization. This method makes the procedure more complicated but potentially safer. Now that the detachable coils are available, however, this has become unnecessary. The low risk of embolization is certainly the main advantage of this type of coil. The Cook detachable coil, used in the study of Hazama et al,²³ was employed in 19 patients without a single instance of embolization subsequent to release. Detachable coils, such as the Cook PDA coil or Duct Occlud pfm coil, carry such a low risk of embolization because their release is much more controlled than is the case with the classical coil.

The Gianturco coil is deployed simply by pushing it out of the catheter with a guide wire. As soon as it emerges, there is no further control in the deployment,

neither can it be repositioned or withdrawn. If this coil is, therefore, extruded in a suboptimal position, withdrawal into the catheter used for delivery is impossible, and embolization may then occur. The detachable coil, in contrast, is screwed in the delivery wire. After emerging from the catheter, it forms its loops but remains attached to the delivery system. If necessary, it can be repositioned or withdrawn. The device is released by unscrewing, rotating the wire for this purpose. In cases where embolization does occur, and for any reason the retrieval is not possible, then obstruction of a small pulmonary arterial branch is the usual consequence. In this setting, the coil can safely be left in place without risk of major complication. Another advantage of the detachable coil is that it can be positioned more precisely, thus avoiding the need to use additional coils for complete closure.

Both teams have advocated the arterial approach to occlude the duct. Although this may be more appropriate for the standard Gianturco coils, the detachable coils can be delivered transvenously, the arterial catheter being used for the aortogram prior to the release of the device. In that Hazama et al²³ performed all their cases from the arterial approach, a second arterial sheath was needed to perform the aortogram. Insertion of this second arterial sheath could have been avoided had the procedure been performed transvenously. In our experience using detachable coils, we have found it necessary

to occlude the duct from the aorta only in those rare instances where a small duct cannot be traversed from the pulmonary trunk.

In summary, the results of Zeevi and Hazama and their colleagues^{20,23} confirm the conclusions of previous reports,^{16-19,25} along with the anecdotal experience from several centers, that the detachable coil is the ideal device for transcatheter closure in the majority of patients with patency of the arterial duct. With this simple, safe and cheap technique, it is now justifiable to close even small silent ducts, since these lesions can, occasionally, lead to endarteritis.²⁶ Further studies are necessary to assess the efficacy of the multiple coils in ducts greater than 5 mm in diameter.

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