Do we need a better mouse trap?

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This editorial refers to ‘Primary percutaneous coronary intervention by magnetic navigation compared with conventional wire technique†, by M.S. Patterson et al., on page 1472 and ‘Randomized comparison of the magnetic navigation system vs. standard wires in the treatment of bifurcations‡, by S. Ramcharitar et al., on page 1479.

Interventional cardiology continues to evolve in response to the challenges encountered in treating increasingly complex anatomy and often higher risk patients. There have been many giant steps forward in the field including steerable guide wires, over the wire, and monorail balloons, bare metal stents, and then drug-eluting stents to name but a few. Against this collage of giant steps, the application of magnetic guidance for procedural performance must be placed in perspective. As is true with any new technology, a crucial question to be addressed is what is the magnitude of the problem that the new technology tries to solve, and what is the outcome of applying this new technology.

The articles by Patterson et al.† and Ramcharitar et al.‡ explore the application of a unique magnetic navigation system in two separate populations. This system has been described in other publications. This system has two external magnets with appropriate user interface for varying the magnetic field. A touchscreen control panel is used by the operator to direct the magnetic field vector in three dimensions. Changing this magnetic field vector results in deflection of the magnetically enabled wires and facilitates reproducible steering and navigating through the coronary arteries. As Ramcharitar et al. state ‘it is an expensive technology requiring a learning curve for both the operator and the technical staff’. In addition, they state ‘the rigid 2–3 mm magnetic tip limits flexibility when compared with… standard conventional wires’. Certainly, the novelty of this approach has considerable appeal; the ideal of precision-controlled guidance through tortuous segments to reach the intended goal is very attractive. One has to consider, however, the magnitude and implication of the problems to be overcome, and the success of applying this technology.

Patterson et al.,† evaluate magnetic guidance application in a small series of patients undergoing primary percutaneous coronary intervention (PCI) and compare it with a historical cohort from the randomized PASSION trial.§ The primary goal was to determine if this technology would result in a reduction in contrast media and it did—reducing contrast media from 200 mL (150–250) to 170 mL (100–200). We do not know any details about the renal function in these patients or their haemodynamic state so that the clinical impact of reducing contrast media by 30 mL remains unknown. However, there may be some patients in whom a reduction of that magnitude may have important clinical implications. Although procedural times were not significantly different at 29 min vs. 31 min, there was a reduction of 1.6 min in fluoroscopy time (7.4 vs. 9.0 min). While a goal for all invasive catheterization procedures is to reduce radiation exposures, the magnitude of the reduction documented here appears, at best, modest. In terms of distal embolization, we have only data with the magnetic guidance group and it occurred in 7.7%; whether this is really less than expected is unclear. In many clinical cases, distal embolization more commonly occurs with stent placement and dilatation than with wire passage; that being the case, then guide wire navigation may not make a dramatic difference to the frequency of distal embolization.

It is of interest that in this series, the magnetic guidance appeared to increase procedures on side branches, not just the target lesion. This may simply represent the observation that 40% had side branch involvement in the magnetic series vs. 11.6% in the conventional PCI series, with a subsequent 3-fold higher frequency of side branch protection, compromise, and treatment. This achievement is, however, controversial—clinical practice usually dictates that primary PCI procedures treat only the target lesion, leaving side branches for a later time, if needed.

The case for widespread application of this technology for this specific niche seems somewhat limited. Is there a downside in addition to the considerable expense, learning curve, and potential patient delays in setting the equipment up? From a practical standpoint, one of the most important potential downsides is the amount of equipment in the constrained laboratory space. If haemodynamic instability develops with the need for urgent resuscitation, there may be physical problems in just getting additional equipment to the patient. Although the magnets can be rotated away from the catheterization laboratory table, they remain bulky and the rotation does take some time, albeit short.
In the second article, by Ramcharitar et al., the application of magnetic guidance is much more intuitive and the clinical need appears greater. Bifurcation disease continues to bedevil the field and, although many approaches are used, as yet no obvious solution is at hand. The crucial issue is the ability to access the side branches safely in a hostile environment of difficult geometric angles, plaque shift, intertwined wires, and finally multiple layers of stent struts. This is a field that continues to need innovation at many levels. It is unclear why such a small trial of only 31 patients was randomized and performed. We have no power calculations and we do not know why the trial was stopped; perhaps this was the result of the authors statement that ‘at present, the system offers no clear advantage over conventional wire techniques’. That indeed may be the case, but the promise of this technology for such highly complex anatomic situations is compelling. Certain lesions are known to cause significant problems—very tortuous anatomy, multiple side branches, severe angulation, and chronic total occlusion. In such cases, magnetically guided navigation may make a great difference in optimizing the outcome and decreasing radiation exposure and contrast volume (Figure 1). Such cases can often be identified at the time of a diagnostic angiogram. Then these cases could be scheduled electively in such a complex high tech room with the most experienced operators dealing with the nuances of the equipment.

Is there a need for a better mouse trap? If so, is magnetic guidance that better mouse trap? It has great potential but it is early yet. Better magnetically enabled guide wires are needed, as is the development of remote navigation to reduce radiation exposure for the operators. We need evaluation in larger groups of complex lesions and patients, and we need more trained physicians and centres. Defining the limits of the space that magnetic guided procedures will fill needs the additional data that both Patterson and Ramcharitar and their colleagues call for.

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**References**