Creating a Fistula That Works: Is It an Art or Is It Science?

See Hernandez et al., pp. c39–c44

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In 2005 there will be more than 1.5 million dialysis patients globally and 90% of these will be receiving hemodialysis [1]. Assuming an average life span of a hemodialysis fistula of 2–3 years, it is clear that approximately half a million new fistulae are being surgically created each year. With this amount of experience since the introduction of the Cimino fistula in 1966, one would expect to achieve a high success rate. Surprisingly this is not the case. As an article by Hernandez et al. [2] in this issue of *Nephron Clinical Practice* indicates, between 23 and 53% of these operations fail to yield a functional native fistula. How did nephrology get there?

In the 1970s and 1980s the preparations for a fistula operation used to be strict and straightforward. The patient's forearms were considered privileged territory. They were never to be used for venipuncture – for fear of later stenosis. Immediately before the operation the surgeon would examine the patient's arms visually and manually, testing the arterial pulses and the appearance of the veins. On this basis he would go ahead and operate.

In the 1990s, ultrasound entered the field. It permitted visualization of deep veins that had been missed before and allowed measurement of vascular diameters. In addition it was now possible to determine arterial and venous flow, at baseline and after stimulation. For instance it was suggested that an internal arterial diameter <1.5 mm, a venous diameter <2.5 mm (during the application of a proximal tourniquet) and a resistance in-

dex – a measure of diastolic arterial flow – <0.8 after release of the clenched fist were all predictors of a poor functional outcome of a fistula operation [3].

Several centers published their results using such methodology. In 116 patients undergoing an operation to create a native fistula in the forearm, Malovrh [4] reported a primary patency rate of 80%. In his study an internal diameter of the feeding artery approximating a mean value of 2.4 mm predicted functional success as did a low resistance index of 0.50 during reactive hyperemia. The condition of the vein was equally important. In successful operations he observed that the veins were able to dilate in response to proximal compression by approximately 60%; in contrast, venous dilatation of 15% or less was associated with eventual failure. Comparable results have been reported by Wall et al. [5], Parmley et al. [6], Mendes et al. [7] and others – although in a few publications the authors failed to encounter any significant benefit from Duplex ultrasound [8].

This is where the work of Hernandez et al. [2] in this issue of *Nephron Clinical Practice* sets in. In 119 patients undergoing operations to create native fistulae at the level of the forearm or of the upper arm, their surgical team used standard procedures – physical examination and Duplex ultrasound – in preparing the operation. Nonetheless, there was a 23% early failure rate. The authors then sought to answer the question which risk factor(s) seemed to be involved. They made four observations:

distal location of a fistula, i.e. in the radiocephalic position, posed a major risk for early failure (a), as did female gender (b), the presence of diabetes mellitus (c) and limited surgical expertise (d). The patient's age at the time of operation did not contribute to the risk – the mean age of the patients in this study having been between 56 and 60 years.

The study by Hernandez et al. [2] suggests that surgeons and nephrologists cannot rely solely on Duplex ultrasound in its present form to secure a functional fistula. Rather, we must learn to integrate additional and individual risk factors into the decision-making. With the data of Hernandez et al. there is little doubt that one ought to think twice before attempting to generate a fistula in the radiocephalic position in an elderly female or in a diabetic male patient – even when appropriate measurements had been demonstrable by ultrasound.

But how should we get to the root of these issues? The present retrospective study [2] did not report any early hemodynamic measurements in the fistulae to distinguish between different stages of function. It is likely that failure of the feeding artery to dilate and/or remodel and

of the draining vein to enlarge and mature could have been major factors in the risk observed [2]. It should not be very difficult to test a hypothesis of this kind in a prospective manner [9]. If confirmed, specific corrective measures might become possible. They might be possible by direct intervention [9] or by preceding medical treatments other than those tested by Hernandez et al. [2]. Alternatively, some part(s) of the risk described by Hernandez et al. might turn out to be intractable.

While these and other aspects of successful fistula operations may have to wait until more research is reported, the publication by Hernandez et al. [2] does indicate one area with a potential for rapid progress: *surgical expertise*. As described by the authors [2], a surgeon creating less than five fistulae per year is going to have a several-fold higher failure rate than a surgeon doing more fistulae. I am biased to think that the role of surgical expertise tends to be underestimated – particularly so when training purposes are involved and when the fistula operation is considered a minor procedure. In that sense, creating a native fistula still has something to do with an art, aided by science.

References

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