JBR–BTR, 2013, 96: 55-64.

A SPONTANEOUS PRE-ANASTOMOTIC OCCLUSION DOES NOT NECESSARILY IMPAIR FOREARM NATIVE DIALYSIS FISTULAS: ECHO-DOPPLER, 3D MR ANGIOGRAPHIC AND DIGITAL SUBTRACTION ANGIOGRAPHIC IMAGING

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Renal transplantation is the choice treatment of end-stage renal disease. When it is not indicated or not immediately feasible, hemodialysis must be performed, preferably via a native arteriovenous fistula in the forearm.
A pre-anastomotic occlusion of this type of fistula is often accompanied by a thrombosis of its draining vein. In some instances, the venous segment may remain permeable thanks to the development of arterial collateral pathways and may even allow efficient dialysis without any clinical syndrome of distal steal.
We present the echo-Doppler, magnetic and angiographic characteristics of three of these collateralized shunts that have remained functional, in one of the cases following a percutaneous dilation.

Key-word: Fistula, arteriovenous.

Best practice for patients suffering from end-stage renal disease waiting for kidney transplantation or not is hemodialysis via a native arteriovenous fistula created surgically in their non-dominant wrist. Most dysfunctions of this type of fistula are linked to venous steno-occlusive lesions but, sometimes, the problem is due to a deficiency in the arterial blood supply as is the case, in particular, with pre-anastomotic occlusions.

A pre-anastomotic arterial tight stenosis or occlusion will generally entail a thrombosis of the draining vein of the fistula. If this thrombosis is not treated rapidly, it will prove extremely pernicious for the venous endothelium and will alter the permeability of the shunt in the long term.

In some circumstances, in spite of a major or complete pre-anastomotic obstacle, the venous segment of the fistula may remain permeable thanks to the implication of arterial collaterals and, in particular, the palmar arches. The blood flow supplied to the draining vein by these collaterals may even allow efficient dialysis without any concomitant development of a clinical steal phenomenon. The echo-Doppler (USD), 3D magnetic angiographic (3D MRA) and digital subtraction angiographic (DSA) characteristics of these types of shunt are detailed in this paper, as well as a clinical sign we have encountered in two of the three patients mentioned.

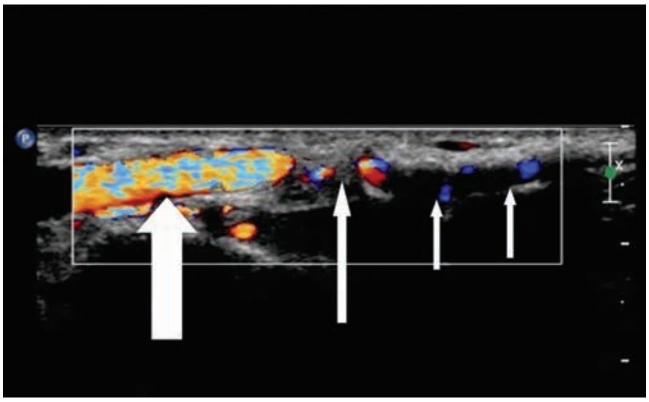

Fig. 1. — Color Doppler of the pre-anastomotic radial artery with partial signal void due to parietal calcifications (short thin arrows), of the arterial occlusion (long thin arrow) and of the free venous side of the shunt (thick arrow); colored spots in front of the long thin arrow are due to small caliber muscular collaterals of the proximal radial artery.

Case reports

Our first patient is a 48-year-old man with end-stage renal disease caused by focal and segmental hyalinosis who has been hemodialysed since 1986 via a radiocephalic fistula in his left wrist. The dialysis sessions have always been unremarkable. Since 2003, when we established an annual systematic monitoring program of dialysis fistulas by USD in our Institution, we have been aware of the particulars of his shunt. It displays indeed an uncommon feature: a juxta pre-anastomotic occlusion of the radial artery (Fig. 1) and a retrograde feeding of its outflow vein via radial, ulnopalmar and interosseous arterial collaterals. The diameter of the pre-anastomotic radial artery is reduced, considering it is a shunt feeding artery, to 3 mm and the Doppler spectrum of the vessel shows a drop of the mean circulatory velocity to 20 cm/s. Subsequently, the artery blood flow is extremely diminished at 90 mL/min (Fig. 2). The pre-anastomotic radial arterial collaterals, which will be shown on the magnetic documents, explain the persistence of a positive diastolic flow and the absence of a “to-and-fro” type phenomenon as it can be observed at the level of the acutely occluded arteries. The relatively

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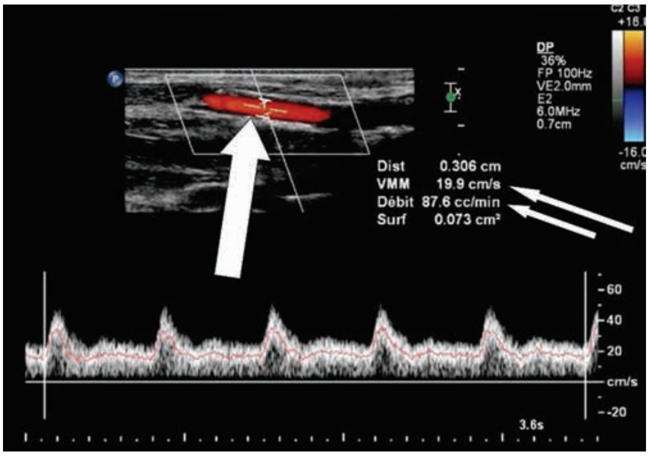

Fig. 2. — Pre-anastomotic radial artery triplex: the thin diameter (3 mm) of the vessel (thick arrow), its reduced mean velocity at 20 cm/s (long thin arrow) and its low flow at 90 mL/min (short thin arrow).

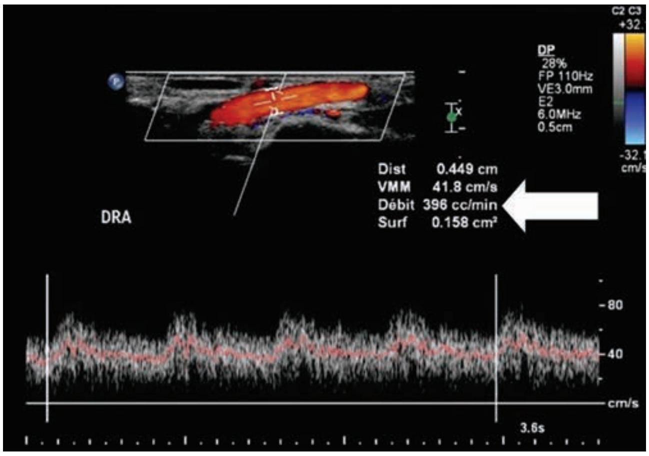

Fig. 4. — Triplex of the anatomic snuffbox, the hand being at left: the inverted flow (positive, in the direction of the probe) in the post-anastomotic radial artery, at 400 mL/min (arrow).

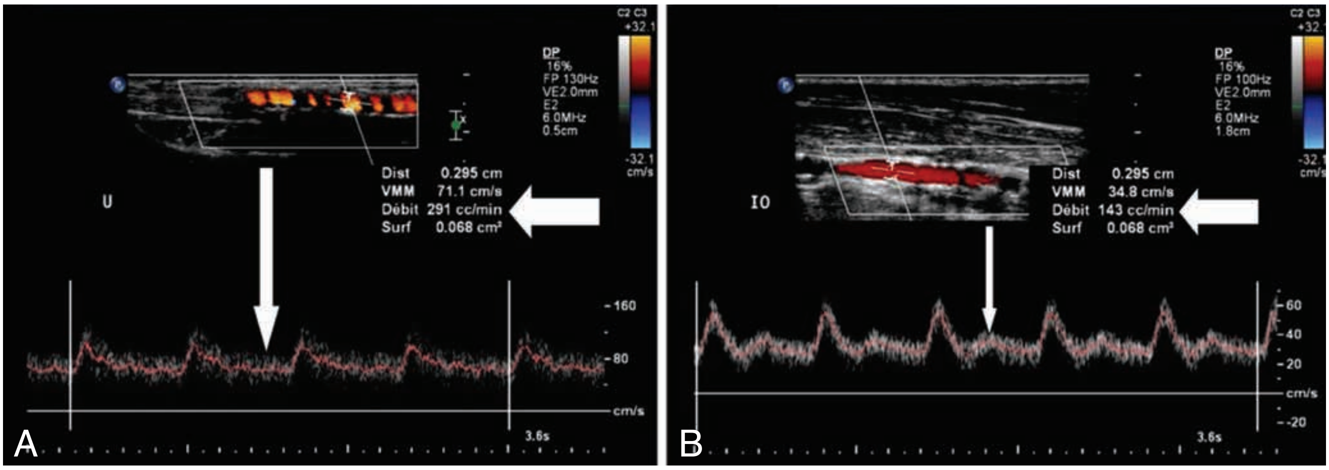

Fig. 3. — Ulnar (A) and interosseous (B) triplex: the enhanced flows (thick arrows) and the low resistive Doppler waves (thin arrows).

hypertrophic ulnar and interosseous arteries feeding the post-anastomotic radial artery in a retrograde fashion display logically increased, low resistive flows (Fig. 3A and B). The post-anastomotic radial artery flux is reversed as expected, positive at diastole and emphasized with a 400 mL/min flow measured at the level of the anatomic snuffbox (Fig. 4). At the anastomosis between the post-anastomotic radial artery and the draining vein, we observe a 3 mm diameter substenosis with a local acceleration at 160 cm/s (Fig. 5). The venous outflow at mid forearm proves quite correct at 630 mL/min (Fig. 6). The aforementioned substenosis will be monitored by USD half-yearly and will undergo treatment only if it becomes significant and alters the quality of the dialysis sessions, which is not the case presently. We also have access to a sequential "TRICKS" (cf. Discussion) 3D MRA for the same patient. An early phase confirms the abnormally thin appearance of the pre-anastomotic radial artery and its distal occlusion. It also pinpoints the relative hypertrophy of the ulnar and interosseous arteries that feed the fistula retrogradely via the muscular collaterals, the palmar arches, and the post-anastomotic radial artery (Fig. 7). An immediately subsequent sequence displays the pre-anastomotic radial muscular collaterals very precisely as well as the substenosed "caudal" anastomosis, which is clearly overestimated. Moreover, it confirms the perfect patency of the caudal portion of the draining vein (Fig. 8). Clinically, and rather strangely (cf. infra), an auscultation of the fistula proves uneventful: the loudest bruit is heard at the level of the anastomosis and a decreased bruit is perceived at mid forearm level. No bruit is identified at the level of the palm of the hand.

Our second patient is a 31-year-old man who benefited from a radiocephalic fistula in his left wrist in 1988. A juvenile nephronophtisis had caused his end-stage renal disease. The characteristics of his shunt have been known since 2003 (cf. supra). He too displays, at USD, a juxta pre-anastomotic occlusion of the radial artery in addition to a high bifurcation of the brachial artery, an anatomic variant which is nowadays considered as a relative contraindication to the creation of a distal fistula. The

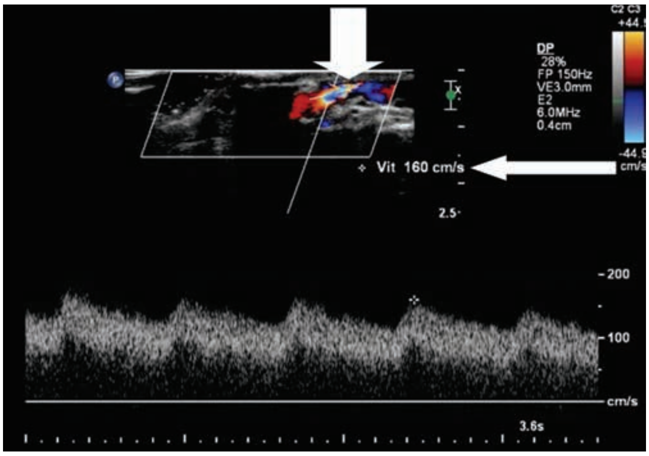

Fig. 5. — Triplex view of the substenosed anastomosis between the post-anastomotic radial artery and the draining vein of the shunt: 3 mm residual lumen (thick arrow) with a local acceleration at 160 cm/s (long thin arrow).

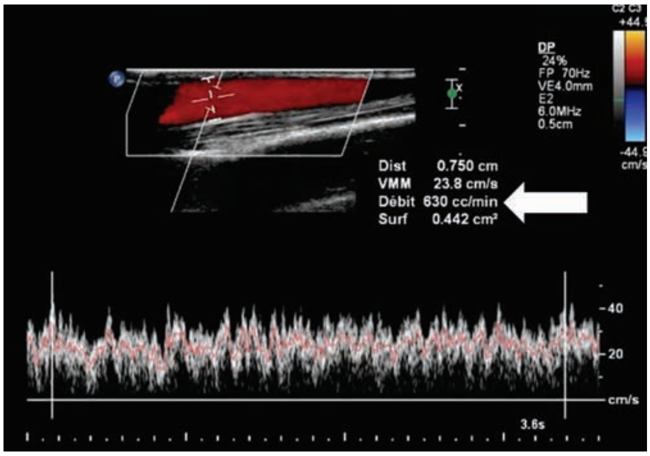

Fig. 6. — Triplex of the excellent, cardiopetal, radial vein flow, at 630 mL/min (arrow).

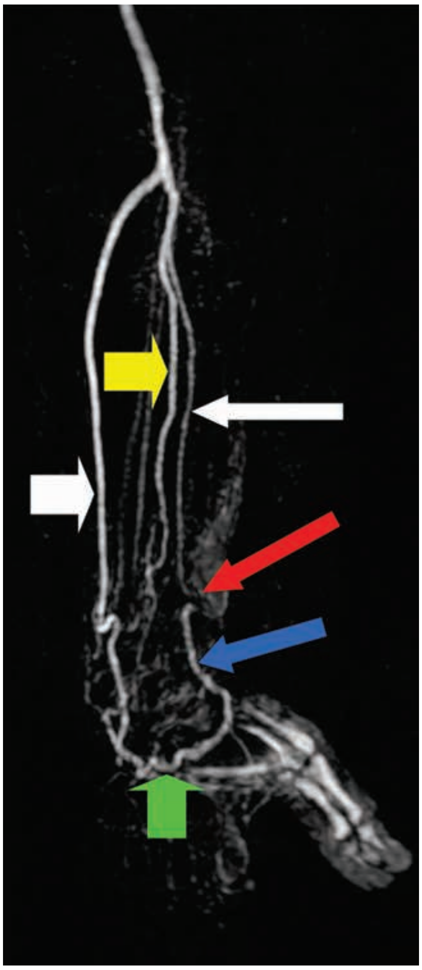

Fig. 7. — Early "TRICKS" magnetic sequence: the thin pre-anastomotic radial artery (long white arrow) and its distal occlusion (red arrow), the enlarged ulnar (thick white arrow) and interosseous (yellow arrow) arteries with the palmar arches (green arrow) retrogradely feeding the post-anastomotic radial artery (blue arrow).

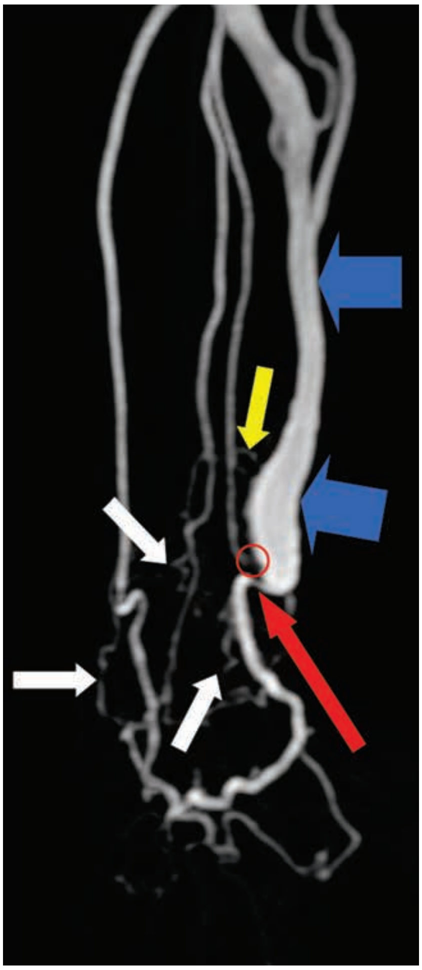

Fig. 8. — A few seconds later, another "TRICKS" sequence clearly depicts the pre-anastomotic radial artery occlusion (red circle), the muscular arterial collaterals (white arrows), some of which being of pre-anastomotic radial origin (yellow arrow), the post-anastomotic substenosis, which is over-estimated (red arrow), and the patent venous outflow tract (blue arrows).

flows of his ulnar and interosseous arteries are markedly emphasized with a pronounced diastolic component. The muscular collaterals are clearly identified (Fig. 9A) and their flows display identical features (Fig. 9B). An inverted post-anastomotic radial arterial flow, measured at 1.2 L/min, confirms the blood diversion (Fig. 10). The venous outflow in the forearm is excellent at 940 mL/min (Fig. 11). The correlation with the "TRICKS" 3D MRA images is very good. Please note that this was our first test, performed in 2008, with tuning parameters that had not yet been fully optimized. Whatever it be, we can visualize quite perfectly the thin radial artery with its occluded end (Fig. 12), the ulnar and interosseous collaterals, and the post-anastomotic radial artery that feeds the venous outflow segment in a retrograde fashion (Fig. 13). On a clinical level, the auscultation of the shunt reveals a maximum bruit at the level of the anastomosis, as it happens classically. Nevertheless, and contrary to the "normal" fistulas that reveal a softened bruit at mid forearm and an absence of bruit at palmar level, an unequivocal palmar murmur is detected here. It is less strong than at the anastomosis but its intensity is superior to that of the bruit perceived at the level of the mid radial vein.

Our last patient is a 50-year-old man who has developed an end-stage renal disease caused by extra membranous glomerulonephritis. He was 30, when a radiocephalic fistula was created surgically in his left wrist. Since his fistula had matured rapidly, he was dialyzed uneventfully until recently when problems of flow

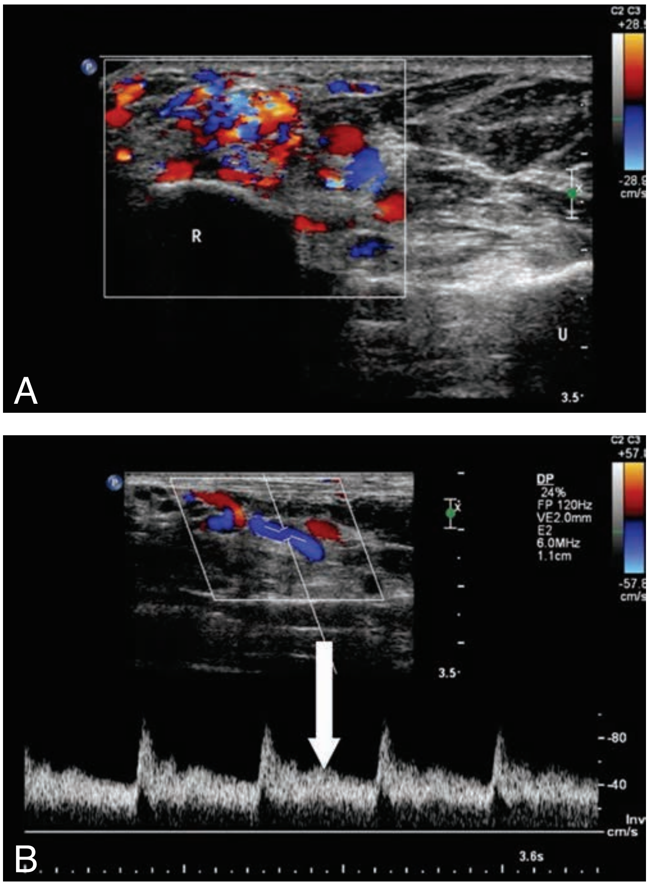

Fig. 9. — Color Doppler at the level of the anastomosis zone (A): the muscular collaterals which are difficult to distinguish from the stardust artifact in this single plane view.
Triplex of a muscular arterial collateral (B): identical systolo-diastolic flow (arrow) to the one of the ulnar artery.

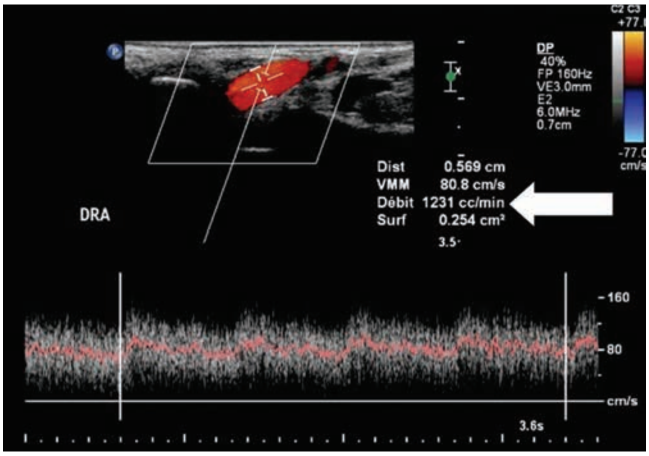

Fig. 10. — Triplex of the radial artery at the level of the snuff-box (the wrist being at left): retrograde, cardiopetal flux at 1.2 L/min (arrow).

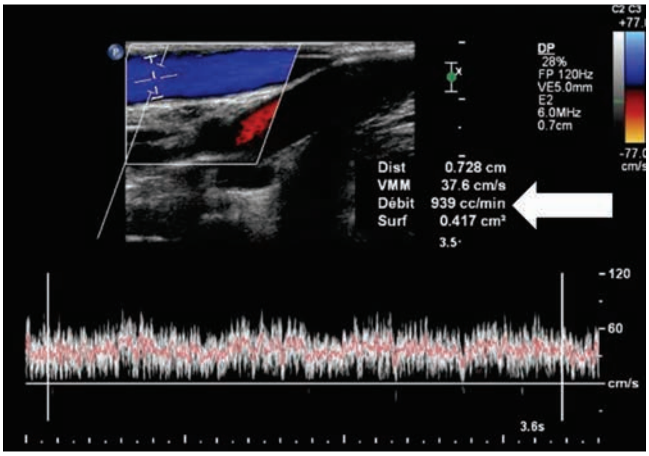

Fig. 11. — Triplex of the radial draining vein of the fistula: excellent flow at 940 mL/min (arrow).

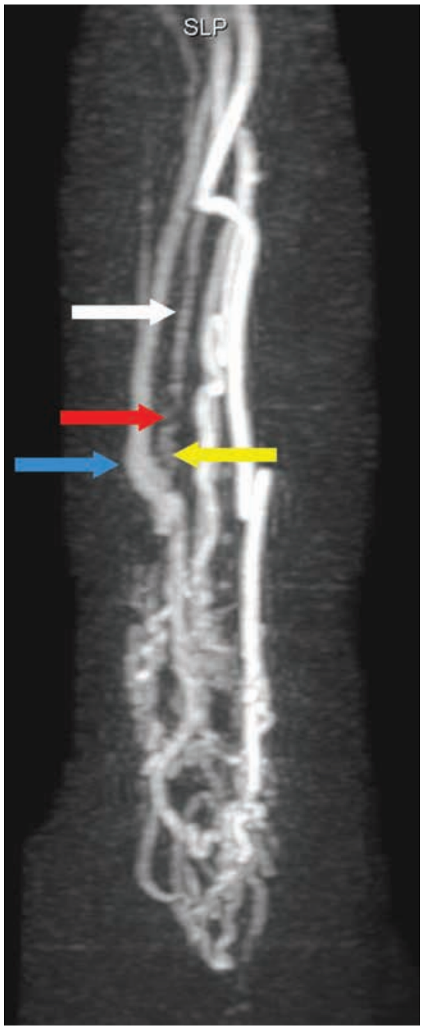

Fig. 12. — Early "TRICKS" magnetic sequence: the thin proximal radial artery (white arrow), its pre-anastomotic occlusion (red arrow) and the early filling of the draining radial vein (blue arrow). The spiral signal between the arterial occlusion and the draining vein is due to tiny muscular arterial collaterals (yellow arrow).

were noticed during hemodialysis sessions. Since 2003 (cf. supra), we have been aware of the peculiars of his fistula, i.e. and once again a pre-anastomotic occlusion of the radial artery with blood diversion along the ulnar and interosseous arteries. A USD reveals, besides the well-known pre-anastomotic radial occlusion and blood diversions, a signifi-

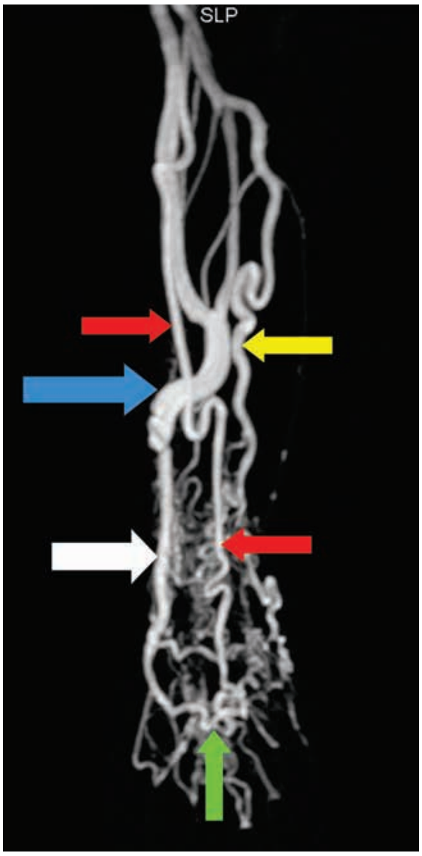

Fig. 13. — Another "TRICKS" view, in an oblique plane, a few seconds later: the enlarged ulnar (red arrows) and interosseous (yellow arrow) arteries, the palmar arches (green arrow), the post-anastomotic radial artery (white arrow) and the draining vein (blue arrow).

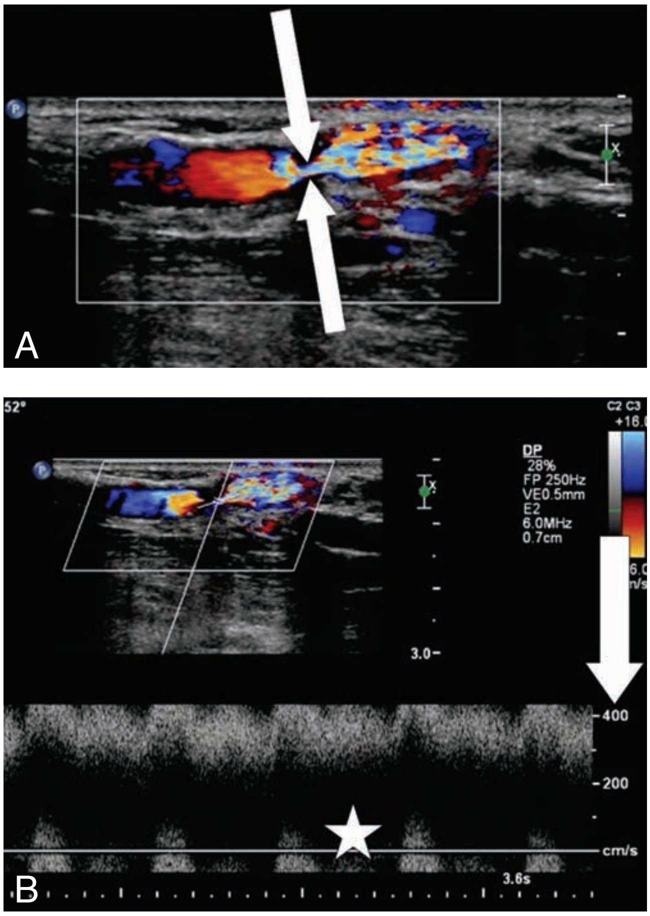

Fig. 14. — Color Doppler at the level of the anastomosis between the post-anastomotic radial artery and the radial vein (A) reveals a tight stenosis (arrows).

Triplex of the severe stenosis (B): as high as 6 m/s speeds can be depicted (arrow); aliasing (star) is inevitable with this high-frequency probe (Nyquist-Shannon theorem).

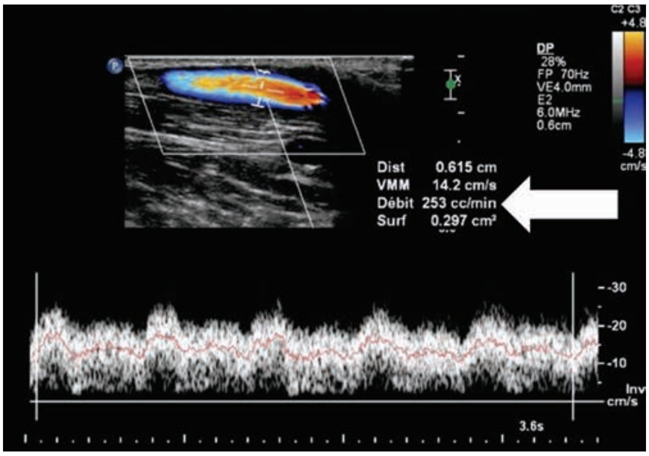

Fig. 15. — Due to the caudal arterio-venous stenosis, the flow of the draining radial vein drops to 250 mL/min (arrow) and this is not enough for correct dialysis (triplex view).

cant stenosis at the junction between the post-anastomotic radial artery and the radial draining vein with a velocity increased to more than 5 m/s (Figs. 14A and B). This severe "caudal" stenosis entails a venous outflow drop to 250 mL/min, which is a clearly insufficient value explaining the difficulties encountered during the dialysis sessions (Fig. 15). Since a percutaneous treatment can possibly be suggested, the patient does not undergo 3D MRA but is directed to the angiography suite. The prograde left brachial artery puncture confirms the pre-anastomotic radial occlusion and identifies the ulnar and interosseous collaterals (Fig. 16). A slightly later phase demonstrates the retrograde opacification of the post-anastomotic radial artery and its "caudal" stenosis; moreover, this phase ensures that the first centimeters of the radial draining vein are patent (Fig. 17). A second brachial arterial injection, focusing the images on the hand, identifies the arterial muscular and palmar collaterals very precisely (Fig. 18); the same happens with the selective ulnar injection, with an even greater precision (Fig. 19). An opacification of the radial artery at mid forearm displays the occlusion quite clearly and objectifies the muscular collaterals of the vessel

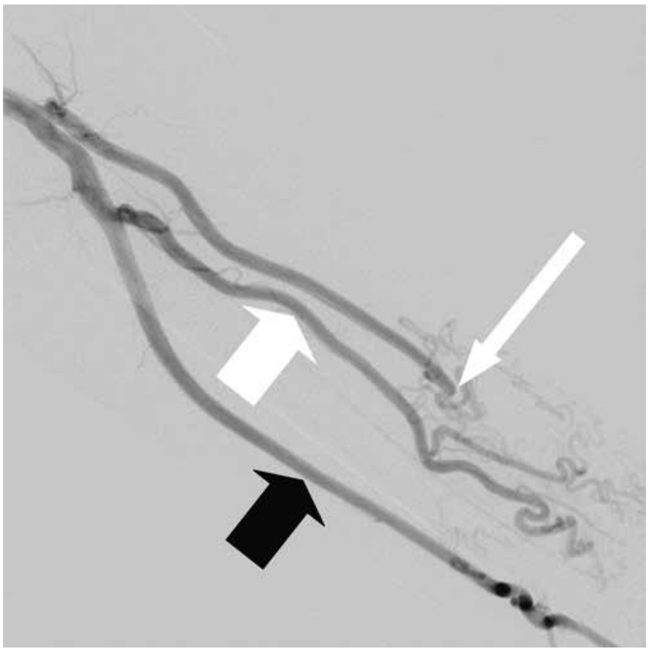

Fig. 16. — DSA (prograde injection in the brachial artery): the pre-anastomotic radial arterial occlusion (long white arrow) with the enlarged ulnar and interosseous arteries (thick black and white arrows, respectively).

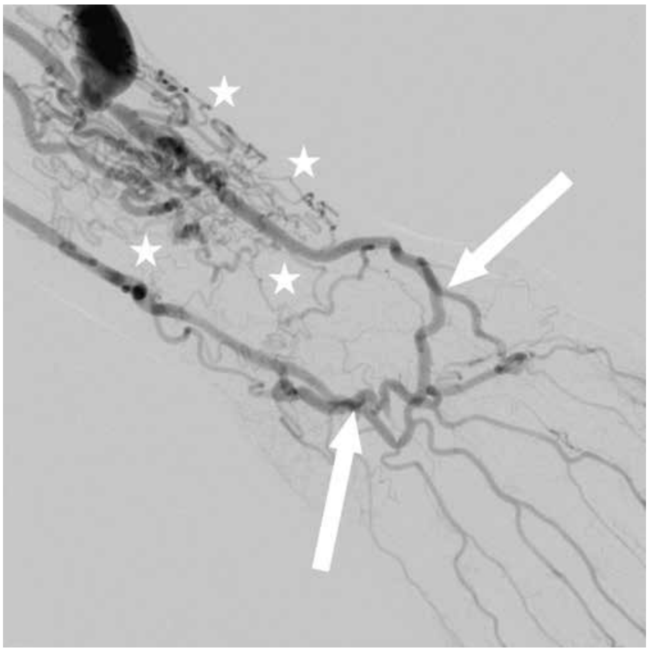

Fig. 18. — A second brachial artery injection clearly shows the palmar arches (arrows) and the ulno-interosseous muscular collateral arteries (stars).

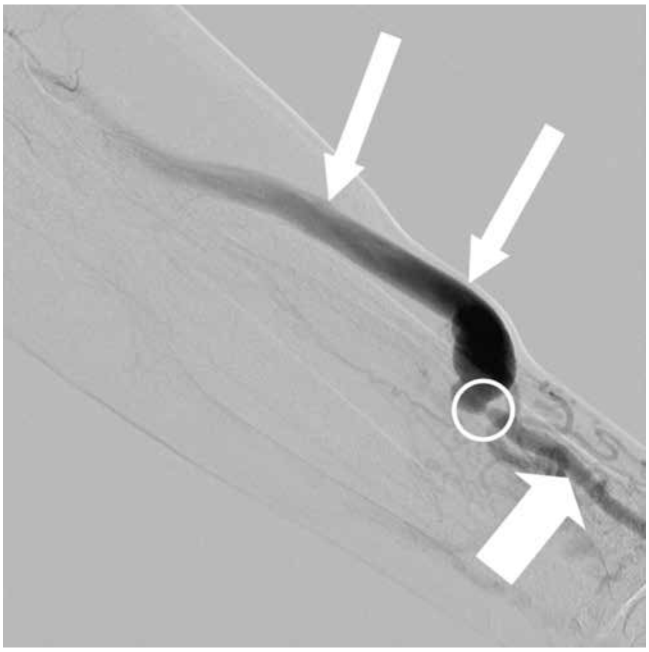

Fig. 17. — *S*ame DSA sequence, two seconds later: retrograde filling of the post-anastomotic radial artery (thick arrow) and of its cranial stenosis (circle); the long arrows indicate the draining radial vein.

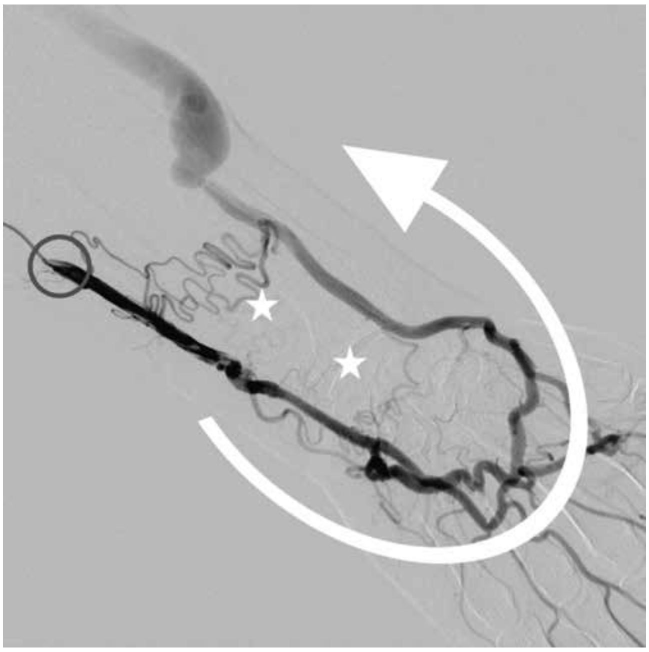

Fig. 19. — Selective ulnar artery prograde injection (gray circle): the direction of the flow (curved arrow) through the palmar arches and the millimetric muscular arterial branches (stars).

that feeds retrogradely its distal counterpart which has remained permeable (Fig. 20). We then decide to treat the "caudal" anastomotic stenosis in order to restore a correct venous outflow; for that purpose we puncture the post-anastomotic draining vein in the retrograde direction and get through the obstacle with a guide wire. A 5 mm diameter dilation balloon is then inflated (Fig. 21) with a good post-procedural angiographic result (Fig. 22). A USD check performed three months after the intervention displays the patency of the dilated zone measuring 4 mm in diameter (Fig. 23A) and an excellent downstream venous outflow at

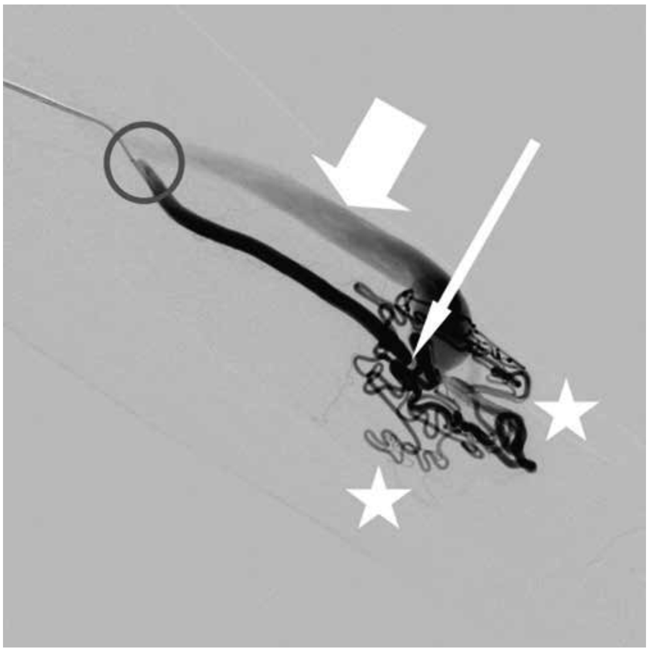

Fig. 20. — Selective radial artery injection at mid-forearm (gray circle): the artery pre-anastomotic occlusion (long arrow) and its muscular arterial collaterals (stars) feeding the vessel's caudal counterpart, which is difficult to see. The thick arrow indicates the venous outflow.

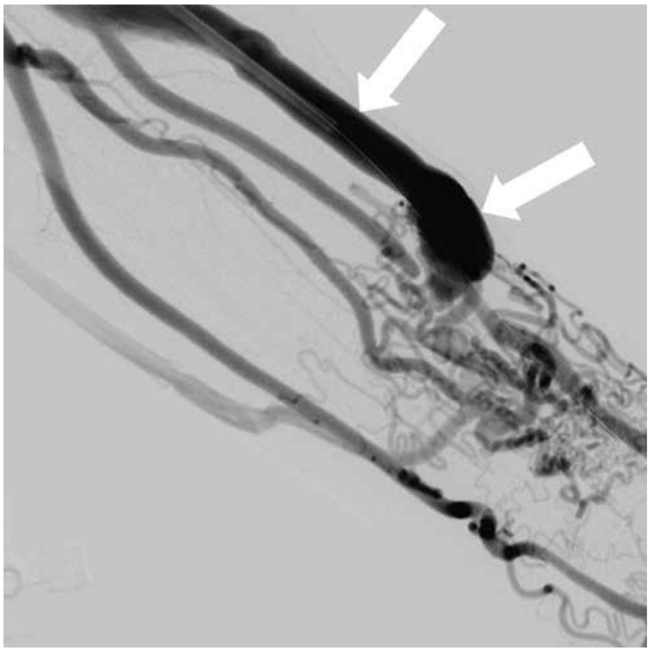

Fig. 22. — Prograde brachial artery injection, showing a better filling of the radial draining vein (arrows), after dilation.

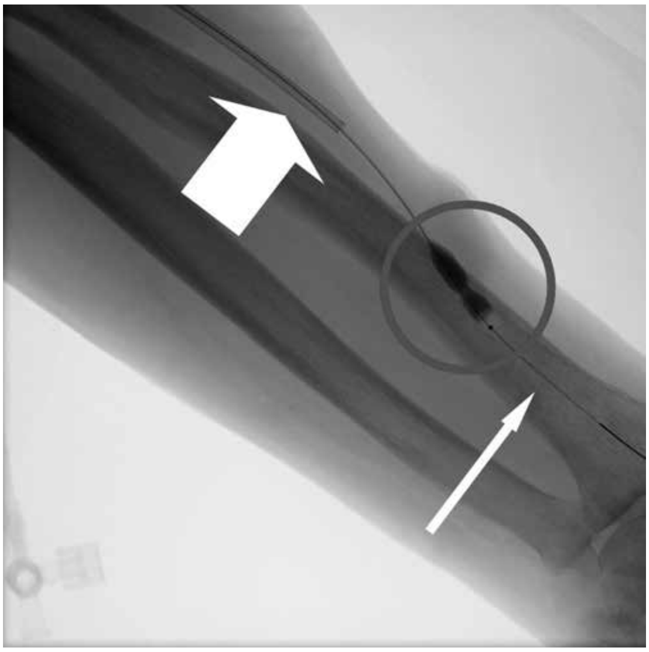

Fig. 21. — Venous retrograde approach with a 7F sheath (thick arrow): a 0.018 guide wire is passed through the stenosis. The gray circle indicates the 5 mm-thick balloon biting the stenosis, during the first phase of inflation.

900 mL/min (Fig. 23B). Finally, a careful auscultation of the fistula reveals, just like in the second patient, a definitive palmar murmur which intensity is higher than the one detected at mid forearm.

Discussion

Nowadays, the number of end-stage renal disease patients is increasing steadily. This increase is due to population aging and, as a consequence, to higher rates of metabolic and vascular alterations that prove toxic for the renal function, such as diabetes and arterial hypertension (1).

Renal transplantation is the method of choice for the treatment of end-stage renal disease. When it is not indicated or not immediately feasible, scientific consensus recommends hemodialysis via a native arterial fistula constructed surgically in the non-dominant forearm, a technique initiated in 1966 by Brescia, Cimino and Appell. Please note that if the surgeon questions the reliability of the vascular network before creating the shunt, they can be helped by the radiologist, who will perform a mapping and a functional USD (2). Surgical fistulas in the arm are a second choice. Indeed, if they mature faster, they are shorter-lived and generate more excessive flows, ischemias and aneurysmal transformations. Fistulas created with a polytetrafluoroethylene (PTFE) graft should be a third choice only. They entail real infection risks and their rate of stenosis, in particular at the site of the prosthetic venous anastomosis, is very high. The double lumen catheter should only be used in case of emergency or as a last solution because of its numerous infectious and thrombotic complications (3). Also note that peritoneal dialysis can be an alternative in selected cases and for a rather short period (1).

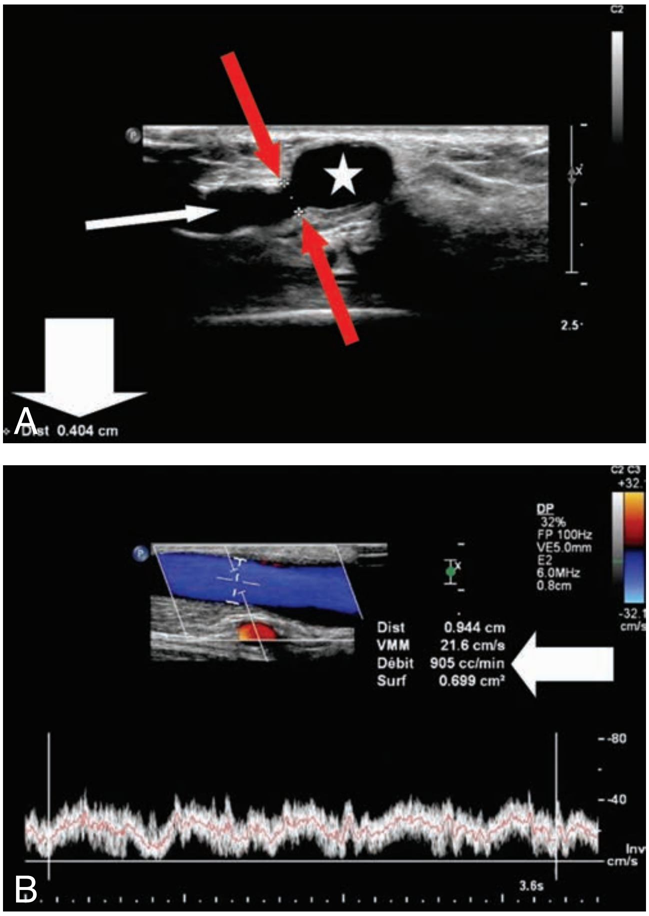

Fig. 23. — B-mode of the dilated "caudal" anastomosis (A) (red arrows), three months after intervention: a correct diameter of 4 mm (thick white arrow) between the post-anastomotic radial artery (thin white arrow) and the first centimeter of the draining vein (star)…
allows an excellent venous outflow (B) (triplex view) at 900 mL/min (arrow) and so, correct dialysis.

So, efficient dialysis must ideally be ensured by wrist fistulas of the radiocephalic side-to-end type, though other arteriovenous combinations are possible. In order to achieve efficient blood purification, the draining vein must have a diameter of at least 6 mm, be located at a maximal depth of 6 mm and the fistula flow must exceed 600 mL/min. The length of the vein to be punctured must be equal to 10 cm or twice 4 cm at least (4). In our western countries we are used to waiting until the shunt has matured completely, after about six weeks, before performing the first punctures (1).

Any clinical anomaly, any difficulty in cannulating, inefficient blood purification or prolonged bleedings after hemodialysis must require a control USD to look for abnormalities within the shunt (1). Should this examination prove inconclusive, 3D MRA or even DSA can be performed.

Detectable lesions are essentially intrinsic venous stenoses generated by turbulences and repeated punctures or resulting from former central catheterizations (1). As a reminder, note that a venous stricture is considered significant in a dialysis fistula if it reduces the lumen of the vessel by more than 50% or if the residual diameter of the vein is less than 2.7 mm (3, 5). USD proves particularly successful in detecting extrinsic compressions, partial thromboses or central disorders linked with the cardiac function. On the other hand, it is a bit less efficient than 3D MRA or DSA to assess lesions of the central veins (6).

In some cases, the dysfunction of the shunt will be of arterial origin. Any type of arterial obstacle can be detected by USD, 3D MRA or DSA: from the central stenoses, whose origin is rather atheromatous to the more distal ones, whose etiology is frequently diabetic. Juxta pre-anastomotic stenoses or occlusions can also be spotted quite easily (6, 7, 8). They are generally considered to result from a technical surgical error when they impair the shunt soon after its construction (6).

A pre-anastomotic arterial occlusion may entail a thrombosis of the fistula venous segment. This thrombosis must be treated without any delay because the inflammatory contact between the thrombus and the wall of the vessel will exert a pernicious effect on the permeability of the vein in the long term (1, 3). The clot must be resected surgically or sucked up percutaneously and a new anastomosis must be constructed some centimeters upstream (9).

In some instances, in spite of a juxta pre-anastomotic tight stenosis or occlusion of the radial artery, the fistula will keep functioning thanks to the development of arterial collateral pathways, essentially the superficial and deep palmar arches, fed by the ulnar artery, which supply the venous outflow tract via a post-anastomotic radial artery inverted flux (10, 11, 12). This reversed feeding of the post-anastomotic radial artery is also ensured by small caliber muscular arterial branches of ulnar, radial or interosseous origin. The venous blood flow ensured by the arterial collaterals sometimes remains sufficient (i.e. 600 mL/min at least) to ensure adequate dialysis without any clinical distal steal. Such uncommon asymptomatic cases are a reason, together with that of more numerous clinically "silent" venous stenoses which flow is also maintained, which motivate, in our Institution, an annual USD assessment of the patients without any biological anomaly during dialysis and without cannulation problems (6). We must notice however that a very careful auscultation of the shunt sometimes enables the detection of its anomaly: if, similarly to the cases of the radiocephalic fistulas without stenosis, the maximum bruit can be heard right above the anastomosis, in the presence of a pre-anastomotic obstacle, an "auscultatory interposition" can be heard, in the sense that a palmar bruit appears whose intensity lies between the one audible at the anastomosis and the one that can be perceived at mid forearm. In one of our cases (case 1) we have not been able to observe this sign and we cannot offer any logical explanation for this situation.

These cases of fistulas that have kept functioning in spite of spontaneous pre-anastomotic occlusion should be put in parallel with those where the juxta pre-anastomotic obstacle is created surgically in order to reduce the blood flux of the shunts in excess flow (13). Thanks to this technique, the excess flow that is detrimental, in the long term, for the cardiac function will be curbed by ligating the pre-anastomotic radial artery after ensuring first, by USD for instance, that the palmar arches are efficient and that the draining vein does not display any stenosis.

Our three cases of fistulas without any associated clinical steal but with spontaneous juxta pre-anastomotic obstacle and "salvaging" arterial collaterals occurred in relatively young (mean age at shunt creation: 19), non-smoking, non-diabetic patients whose arterial networks were, in principle, in good shape. We can then suppose that both the correct state of the arterial system and the congenital richness of its interconnections are prerequisites to this distinctive type of evolution.

USD is neither expensive nor traumatic. It is easily available and detects pre-anastomotic obstacles accurately, as we have underlined (3). It should be mainly performed with a high frequency (12 MHz) probe. Such an examination being very observer-dependent, extreme care will be required for a correct adjustment of the focal distance and of the gains (in B-mode, in pulsed Doppler and in color Doppler) as well as of the Doppler angle of insonation (ideally between 30 and 60°), of the size of the gate (i.e. 2/3 of the diameter of the vessel) and of the pulse repetition frequency (PRF). This must be done without any inconsiderate pressure on the transducer, especially in the venous segment of the fistula (6). In case of pre-anastomotic arterial stenosis we visualize the narrowing directly and we detect a local increase of velocity to more than 3 m/s accompanied by a widening of the Doppler spectrum and an enhancement of the stardust artifact which is normally spotted around the arteriovenous anastomoses (5, 6). A pre-anastomotic radial arterial occlusion is clearly visible and the Doppler displays a decreased circulatory velocity at the level of the mid artery whose outflow has collapsed. The arterial flow immediately upstream the obstacle does not turn into a "to-and-fro" type as it can be observed at the level of the acutely occluded arteries or at the neck of the false arterial aneurysms (14) because of the presence of the muscular collaterals. These arterial collaterals are easily detected by color Doppler (their steady courses differentiate them from stardust artifacts) and a retrograde flow can be identified at the level of the post-anastomotic radial artery. The condition of the venous drainage must be scrutinized closely, of course, and its outflow can remain normal. Please note that the blood flow is calculated automatically in recent machines by using the classical formula: outflow (in mL/min) = average blood velocity x $(\pi D^2/4) \times 60$ where D represents the vessel diameter in cm (6).

As far as macrocyclic chelates are used at a minimal dose in order to avoid a systemic nephrogenic fibrosis and maintain a possible residual renal function, the gadolinium enhanced 3D MRA will prove almost as non traumatic as USD (15). The former is nevertheless more expensive and less available. On our 3 Tesla MRI machine we use the Time Resolved Imaging Contrast KineticS ("TRICKS", GE Healthcare) technique, with 3D sequential acquisition, combining good spatial (about 2 mm) and temporal (one acquisition every seven seconds) resolutions. The examination is completed in minutes and identifies stenoses and blood diversions well though it has a tendency to overestimate the former (8). This tendency is, in our experience, less marked than when the magnetic technique of the Time of Flight ("TOF") is used without any contrast material. If it proves more delicate to detect venous thrombi in the "TRICKS" sequences than in the USD ones, our opinion is that the former surpasses the latter for the close analysis of the central veins. Finally, in the case of radiocephalic fistulas in the wrist, and as far as it concerns the machine we use currently, the size limit of the magnetic study area (48 cm) often prevents visualizing the entire fistula. This compels us to perform two different examinations: one focusing on the thorax and the other on the upper limb. Should the study of the shunt be performed in two steps, we carry out the distal study in the "Superman" position (the patient lying prone or supine) in order to get the most precise images possible without any wrap-around artifacts as they can be observed in examinations performed in the supine position with the patient's arms alongside their body (8).

We do not have any practical experience of CO2 angiography in the study of dialysis fistulas and the literature does not mention any case of spontaneous juxta pre-anastomotic obstacle described by this method. A multisection angio-scanner study should certainly prove outstanding in these peculiar examples but it should be reserved to centers that do not have an angio suite because of radiation exposure (7).

It is quite clear that DSA keeps its place in our diagnostic arsenal (1, 3). It is rather expensive and also more traumatic, all the more since the usual retrograde venous access remains more limited in our cases. Most often indeed the direct arterial access proves necessary in order to identify blood diversions, among others ulnopalmar ones. Whatever it be and thanks to its excellent spatial resolution, this examination enables a perfect measurement of the intensity of the obstacles. The impressive frame rates of present machines make it quite easy to quantify the balance of flows. Possible thrombi can be diagnosed too with, in this case, but it is also true for 3D MRA, inferior possibilities to those of a USD, at least as far as the venous system is concerned. From time to time and in spite of the fast frame rates of modern machines, precise estimation of the fistula will be hampered by arteriovenous superpositions. Different angiographic incidences will then be most significant. Should the difficulty persist, an echography machine will be brought into the angio suite in order to solve the problem quite easily. Let us not neglect the importance of the dilution of the iodinated contrast product if a residual renal function is to be preserved (16).

The treatment of juxta pre-anastomosis occluded fistulas remains the armed standby as far as there exists no significant clinical phenomenon of steal and as far as the venous outflow enables efficient dialysis. In cases where the opposite is true, as we mentioned above, a new anastomosis will have to be constructed some centimeters upstream the former one after a possible thrombosis has been treated (3, 9).

One of our three patients (case 3) presented with a pre-anastomotic occlusion next to a tight stenosis of the post-anastomotic radial artery with, as a consequence, a weak venous outflow, inadequate for dialysis. Basing ourselves on P. Bourquelot's experience, we opted for a percutaneous dilation of the stenosis, a simple gesture performed through venous retrograde puncture, which enabled us to restore a correct venous outflow without any secondary clinical steal phenomenon. If a steal had occurred, we would have resorted to ligating the distal radial artery and to constructing a new cephalic anastomosis. We will also select this method should a restenosis appear, for it seems more perennial than percutaneous dilation (9).

Conclusion

In some cases the juxta pre-anastomotic arterial occlusion of a radio-cephalic dialysis fistula does not induce a thrombosis of the draining vein thanks to the development of arterial collateral pathways.

More rarely, the blood flow supplied by these collaterals to the venous segment of the shunt remains high enough to enable efficient dialysis, without the occurrence of any clinical phenomenon of distal steal.

Several imaging modalities are available to examine the situation thoroughly and even to treat the problem: USD, which is very observer-dependent but non-invasive, not expensive, and widely available, 3D MRA and DSA.

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