Superficialization of deep arteriovenous access procedures in obese patients using suction-assisted lipectomy: A novel approach

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DJ Krochmal, AM Rebecca, KA Kalkbrenner, et al. Superficialization of deep arteriovenous access procedures in obese patients using suction-assisted lipectomy: A novel approach. *Can J Plast Surg* 2010;18(1):25-27.

Successful dialysis access necessitates superficial arteriovenous fistula (AVF) placement to facilitate identification of anatomical landmarks for safe cannulation. Suction-assisted lipectomy (SAL) may be an alternative to traditional surgical AVF revision procedures for placing fistulas more superficially. Three patients with an average body mass index of 45.2 kg/m², with inaccessible AVFs due to obesity, underwent ultrasound-guided SAL of their upper extremities. Successful cannulation was achieved within two weeks. A clinically insignificant hematoma and arm swelling occurred in one patient. SAL provides a safe and effective alternative for salvaging deep AVFs for dialysis access in the upper extremities of obese patients.

Key Words: Arteriovenous shunt; Renal dialysis; Suction-assisted lipectomy

Since its introduction in 1966 by Brescia et al (1), the Sautologous arteriovenous fistula (AVF) has been the preferred method for achieving vascular access in those requiring chronic hemodialysis (2,3). Prosthetic materials may be used in patients who are deemed to be poor candidates for AVF formation (4).

Fistulas must be located superficially enough to identify landmarks that will allow for safe cannulation. In a study (3) of fistula immaturity, 46% of arm and 15% of forearm fistulas (28% overall) were more than 5 mm from the skin based on ultrasound, and were therefore deemed to be immature. Fistulas that are located too deeply from the skin surface may require a surgical superficialization procedure, with a reported success rate of 71% (3).

'Superficialization' or 'fistula elevation' involves an incision from the wrist to the proximal forearm in radiocephalic fistulas, and from the antecubital fossa to the proximal upper arm in brachiocephalic or brachio basilic fistulas. Venous branch ligation and occasional transposition of superficial fat to a deep position relative to the fistula allows for superficialization (5,6). Early complications, including prolonged arm swelling, wound infection, hematoma formation and skin necrosis, occur in approximately 10% of patients (7). Cannulation may commence in three to four weeks when the incision has healed and some fibrosis around the fistula is present to aid hemostasis with needle access (5,7).

Suction-assisted lipectomy (SAL) is the most common aesthetic procedure performed in the United States (8). The procedure sculpts the body by removing excess fat in targeted areas using small incisions and a thin suction cannula.

La superficialisation d'abords artérioveineux profonds chez des patients obèses au moyen d'une lipectomie d'aspiration : Une approche novatrice

Afin de réussir un abord vasculaire pour hémodialyse, il faut installer une fistule artérioveineuse (FAV) superficielle pour mieux déterminer les repères anatomiques et procéder à la mise en place sécuritaire des canules. La lipectomie d'aspiration (LA) peut constituer une solution aux interventions classiques de reprise chirurgicale afin d'élever les FAV. Trois patients à l'indice de masse corporelle moyen de 45,2 kg/m², dont les FAV n'étaient pas accessibles en raison de leur obésité, ont subi une LA orientée par échographie des membres supérieurs. On a pu mettre en place des canules moins de deux semaines plus tard. Un patient a présenté un hématome et un œdème du bras non significatif d'un point de vue clinique. La LA constitue une solution sécuritaire et efficace pour récupérer des FAV profondes en vue d'un abord vasculaire pour hémodialyse des membres supérieurs de patients obèses.

A wetting solution (eg, Klein's solution) may be used to infiltrate the tissue with local anesthetic and adrenaline to decrease blood loss and postoperative pain. Ultrasound guidance may reduce the risk of injury to vital structures. We present our experience using SAL to salvage deep AVFs to forego traditional surgical superficialization procedures and their associated morbidities.

CASE PRESENTATIONS

Case 1

A 44-year-old woman with end-stage renal disease (ESRD) secondary to diabetic nephropathy, and a body mass index (BMI) of 51.8 kg/m², underwent a left brachiocephalic AVF in July 2004. Following 12 weeks of maturation, the fistula was accessed; however, needle access proved difficult and a large hematoma ensued. A surgical superficialization procedure was considered, but due to her obesity, the morbidity from the necessary incision length and the need for additional recovery time before fistula use, it was not performed. Subsequently, the patient lost weight and was referred to a plastic surgeon for consideration of SAL. In March 2005, the patient's BMI was 45.1 kg/m², and she underwent ultrasound-assisted delineation of the fistula followed by SAL. Six hundred millilitres of Klein's solution was infiltrated. Using decremental 4 mm then 3 mm liposuction cannulas, approximately 300 mL of fat was removed superficial to the fistula. Ultrasound confirmed a more superficial location with a clinically improved AVF thrill. Postoperatively, a clinically insignificant hematoma and arm swelling developed and quickly resolved without further treatment. Four weeks postoperatively, a number of moderate-sized competing outflow veins inhibited

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Figure 1) Intraoperative ultrasonography demonstrating the shunt depth. **A** Before suction-assisted lipectomy, the fistula depth was 1.74 mm. **B** Following suction-assisted lipectomy, with a significant decrease in subcutaneous fat, the shunt depth was 6 mm. Infiltrating solution is likely still present superficially to the shunt; with absorption, the final depth should be even more decreased

fistula access. Accessibility improved with nonoperative management. At 48 months and 40 months following the AVF creation and SAL, respectively, the fistula was functioning well. The patient continues to undergo 4 h dialysis sessions three times weekly using the AVF without difficulty.

Case 2

A 63-year-old woman with ESRD secondary to nephrosclerosis and diabetic nephropathy presented to a vascular surgeon regarding permanent vascular access. Venography demonstrated a reasonable cephalic vein in her left upper extremity. In January 2003, with a BMI of 43.9 kg/m², she underwent brachiocephalic fistula creation in an end-to-side fashion in her upper arm. Following an eight-week maturation period, the fistula was deemed too deep to be accessed safely. In May 2003, with a BMI of 41.4 kg/m², she underwent SAL of her left upper extremity. Five hundred millilitres of fat was removed using a 5 mm suction cannula. Four weeks later, the patient underwent ultrasound mapping to mark the boundaries of the fistula for access. The fistula was accessed successfully using a single needle with blood return via an Ash Split Cath (Medical Components Inc, USA). In December 2003, the patient developed a septic left hip with bacterial seeding of her dialysis catheter, with subsequent removal. She continued dialysis using only her AVF, undergoing 4 h sessions three times per week. In January 2006, she underwent resection of a 4 cm aneurysmal segment of her cephalic vein with primary venovenous anastomosis. The following day, needle stick injury at dialysis resulted in a hematoma. The arm was explored with repair of the needle hole. An Ash Split Cath was again placed. The catheter was removed eight weeks later, and the fistula continued to function well. In May 2008, she again developed aneurysmal changes in her fistula that resulted in inadequate flow rates during dialysis. Before surgical correction, she halted dialysis and transferred to hospice care due to her other comorbidities and self-perceived poor quality of life. She passed away later that month.

Case 3

A 42-year-old woman with ESRD due to diabetic nephropathy was referred for AVF creation. Previous surgeries included

unsuccessful fistula creation in June 2006, and an arteriovenous shunt that became infected and was subsequently excised. In May 2007, with a BMI of 40 kg/m², the patient underwent brachiocephalic arteriovenous shunt formation. The brachial artery, and basilic and cephalic veins, were deemed diminutive. Therefore, a 6 mm CenterFlex polytetrafluoroethylene shunt (Boston Scientific, USA) was placed in an end-to-side fashion to the brachial artery and vein. Four weeks later, the staff at her dialysis centre could not locate the shunt due to her overlying subcutaneous fat. In July 2007, the patient underwent SAL following ultrasound guidance and identification of the graft's location. Klein's solution was infiltrated and approximately 275 mL of fat was removed from the area over the graft. Intraoperative ultrasound images of the shunt location pre- and postliposuction are shown in Figure 1. The shunt was deemed to be ready for use two weeks later. The patient's last clinic appointment was in October 2007, at which time the proximal portion of the graft could be easily accessed.

DISCUSSION

The proper location of AVFs and shunts must allow for the identification of landmarks to ensure successful needle access. Traditionally, AVFs located too deeply are superficialized with a formal surgical procedure. This procedure necessitates a larger incision and requires an extended healing time before the fistula may be accessed. In contrast with the larger incisions with traditional superficialization procedures, SAL removes excess fat through limited incisions (typically simple stab incisions).

The three patients discussed represent our institutional experience with SAL for fistula and graft superficialization. Fat was removed, and the procedure was considered successful when the fistula's landmarks and a palpable thrill were more readily appreciated. In all cases, the procedure allowed for successful dialysis access.

In this setting, SAL is not without risk. Patients were counselled preoperatively about the risks of bleeding, infection, scarring, fat embolus, and fistula thrombosis or injury requiring removal or

revision. Ultrasound guidance was used to reduce the risk of fistula injury. One patient developed a clinically insignificant hematoma and arm swelling that resolved spontaneously. Prolonged arm swelling, wound infection and skin necrosis, which are known complications of superficialization procedures, were not observed in our series. There were no complications that affected fistula or graft performance or timing of access.

SAL may be considered to be a viable alternative to traditional surgical superficialization procedures for AVFs deemed inaccessible due to excessive overlying subcutaneous adipose tissue with acceptable success rates.

NOTE: Portions of the manuscript were presented at the Southwestern Surgical Congress 61st Annual Meeting in San Diego, California (USA), on March 22-25, 2009.

DISCLOSURE: The authors have no sources of financial support to declare.

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