We present the first use of the HemaClear® non-pneumatic exsanguination tourniquet for forearm dialysis access surgery in 27 patients (HemaClear®, ohk). Ten cases were upper arm and 17 were forearm.

This surgical exsanguination tourniquet (SET) is a sterile elastic device which rolls over the limb starting from the fingers by pulling two handles (Figure 1a). The elastic silicone ring provides sufficient pressure (200 - 300 mmHg) radially, via outward flow into the limbs (Figure 2b). The strain can be cut to provide access to the incision area while providing an additional secure zone near the site of the limb. The HemaClear SET is being used extensively in orthopedic surgery for both upper and lower extremities. The 4 available sizes cover limb circumferences from 24 to 85 cm. We describe our experience with the use of the device with special attention to several adverse effects we have encountered and specific recommendations for the safe use of the device in dialysis access surgery.

Ten cases were upper arm and 17 were forearm.

Methods

Figure 1a shows the application of the SET by pulling the strips and rolling the ring up.

Figure 1b shows the final position of the ring just distal to the elbow with wide surgical site exposure. Note the lack of bleeding from the incision.

Figure 1c shows the excellent visibility of the anastomotic structures thanks to the non-perfect exsanguination with no remarkable blood left in the arm.

Figure 1d shows the removal of the HemaClear SET by cutting the ring with a scalpel. Note the insertion of the retractor beneath the elastic silicon ring to avoid inadvertent nicking of the skin.

Figure 1e shows the blood-filled vessel after the resumption of blood flow into the arm and Figure 1f shows the preparation for skin closure.

Figure 1g shows the blood-filled vessel after the resumption of blood flow into the arm and Figure 1h shows the preparation for skin closure.

Discussion and Clinical Points

The traditional pneumatic tourniquet has been shown to be effective in minimizing blood loss for forearm procedures. However, even the safety tourniquet is used, it is very well known that this is an arm exsanguination tourniquet and may cause serious complications if the limb is amputated. The HemaClear® tourniquet is a major reparator of the classic tourniquet and eliminates the need on upper arm AV fistula and grafts.

One excellent use of the roll-on non-pneumatic tourniquet is in the creation of the transposed brachiobasilic fistula. Through the use of the tourniquet the surgeon can make multiple small incisions with long skin bridges. When harvesting the basilic vein through long incisions the HemaClear® tourniquet becomes facial blood loss. When harvesting the basilic vein through small incisions with long skin bridges absolute hemostasis is needed for adequate exposure and visualization. Similarly, the HemaClear tourniquet makes easier access and manipulation of the cephalic vein of the upper arm to be done almost bloodlessly.

Additionally, one of the bloodless procedures in dialysis access surgery is the removal of the infected upper arm venous graft (Figure 2a, b). With the surgical exsanguination tourniquet rolled up the incision sites and the upper arm and the infected upper arm graft can be removed with very little blood loss.

Figure 2a. The lesion was dissected widely with essentially no blood loss.

Figure 2b. The lesion was dissected widely with essentially no blood loss.

Results

The HemaClear® SET enabled exposure, dissection, and manipulation of upper arm blood vessels under tourniquet control. In all cases, blood loss was less than 20 ml. No patient required transfusion. We encountered incremental adverse effects in 4 of the cases including a twisted vessel, a bleed from a vascular branch, retraction in an anastomotic site and graft. The subsequent operations on these patients were uneventful with any adverse effects that could be attributed to the use of the HemaClear® surgical exsanguination tourniquet.

Figure 2c. The lesion was dissected widely with essentially no blood loss.

Discussion and Clinical Points

Pitfalls to Avoid with the HemaClear® Tourniquet in Dialysis Access Surgery

1. Avoid harvesting the basilic in open-skin, sterile tourniquet control. It is essential to remove the tourniquet prior to attempting the vein to ensure that the vessel with particular venous injection and verify patency. Thus, we recommend to always remove the tourniquet prior to tunneling in order to be able to flush the vessel with heparinized saline and verify patency. Once the vessel is successfully flushed, the tourniquet can be reapplied. Any uncertainty about whether the vessel is patent can be solved. A second incision can be made in order to solve this problem.

2. Another useful site that must be avoided is the level of the high blood flow in the arm when an anastomotic fistula is present. The tourniquet must be removed and hemostasis verified prior to vessel closure. If the tourniquet is left up until the second closure process is completed, it may result in the later failing of the fistula may cause serious bleeding. If the fistula is failed, the small vessels would suddenly release their contractile forces leading to serious hemorrhagic fistula and in the recurrent patient with an amputated anastomosis the residual arm blood flow would be the same as the native arm blood flow. The HemaClear® tourniquet can also be used in the vascular access surgery as it does not need to be removed during the formation of a new fistula.

3. Caution should be used in patients with poor skin integrity. The process of rolling the tourniquet up the arm applies some shear stress to the skin. Some patients with chronic kidney disease have a fragile skin and patients that have thin skin are not the candidates to avoid skin loss. Thus, we recommend to always remove the tourniquet and double check for twists before tunneling. If the tourniquet is left in place during the tunneling process, there will be some uncertainty about whether the vein is twisted. A twisted vein will cause technical failure of the procedure. Thus, we recommend to always remove the tourniquet and double check for twists before tunneling.

4. Care must be taken to avoid some anatomic or aesthetic problems. The hemostatic force of the tourniquet is concentrated in a narrow zone where it can cause necrosis. If surgical incisions are kept tight in the hemostatic force of the HemaClear® tourniquet can cause ischemia. If the incision site is irrigated by the surgical instruments, which can be achieved doing some bursal irrigation with saline. If focal necrosis is seen, additional sedation may be needed.

Conclusions

We describe the successful use of a sterile elastic exsanguination tourniquet with a narrow zone in 27 hemodialysis patients. The main advantage in the present of this tourniquet is the easy upper arm procedures would have otherwise been done without a tourniquet and without increased bleeding and need of blood transfusion. For patients who are exposed to this tourniquet we recommend never to close the arteriovenous fistula surgical incision until after the HemaClear® tourniquet has been removed.

References


For more information contact: Eric D. Ladenheim MD Ladenheim Dialysis Access Centers 2207 N. Port Street Suite 180 Fresno, CA 93710 eladenheim@ladenheim.net