Use of the HemaClear® Exsanguination Tourniquet In Dialysis Access Surgery

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Introduction

We present the first use of the HemaClear® non-pneumatic exsanguination tourniquet for forearm dialysis access surgery in 27 patients (HemaClear®, Juxta Medical Devices, Ventura, CA). The 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 (25-30 mm Hg) to block arterial flow into the limb (Figure 1b). The elastic can be cut to provide access to the incision area while providing an additional elastic cover over the end of the limb. The HemaClear SET is being used extensively in orthopedic surgery for both upper and lower extremities. The SET is available in sizes covering limb circumferences from 14 to 95 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 straps and rolling the tourniquet up (Figure 1a).

Figure 1b shows the final position of the SET just distal to the deltoid with wide surgical area exposure. Note the lack of bleeding from the incision.

Figure 1c shows the excellent visibility of the anatomical structures thanks to the new-perfect exsanguination with no medical/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 chestnuted vessel while providing an excellent view of the anatomical structures (Figure 1d). With the surgical incision completed, it is very helpful to dissection the cephalic vein in the upper arm with the SET rolled up the junction of the arm (Figure 1e). The SET must be removed and hemostasis verified before wound closure. If no fistula is present, the SET can be left in place for 5 minutes to allow for perfect hemostasis with no residual blood left in the arm.

Results

The HemaClear® SET enabled exposure, dissection, and manipulation of upper arm blood vessels under tourniquet control. In all case, blood loss was less than 1 ml. No patient required transfusion. We encountered incremental adverse effects in 4 of the cases including a limited view, blood from a vascular branch, and loss of anatomic skin island and distal tip. The last patient follow up of 16 cases was not associated with any adverse effects that could be attributed to the use of the HemaClear surgical exsanguination tourniquet.

Discussion and Clinical Points

The traditional pneumatic tourniquet has been shown to be effective in minimizing blood loss for forearm procedures. However, even with the elastic tourniquet used, it is very difficult to achieve arterial bloodless exposure in upper arm arteriovenous fistula surgery. The HemaClear® tourniquet is much narrower than the pneumatic tourniquet and has enabled surgery in the upper arm to be done on non-SET and non-SH.

One excellent use of the SET is non-pneumatic tourniquet in the creation of the transposed brachial/popliteal graft. The elastic is used for the upper arm or the need to visualize the brachial/popliteal vessels. When harvesting the basilic vein through small incisions with long skin bridges, the SET can be used to protect the brachial/popliteal vessels. Excellent exposure and visualization of the brachial/popliteal vessels has been achieved under SET exsanguination.

One additional use of the SET is non-pneumatic tourniquet in the creation of the transposed brachial/basilic graft. The elastic is used for the upper arm or need to visualize the brachial/basilic vessels. When harvesting the basilic vein through small incisions with long skin bridges, excellent exposure and visualization of the basilic vein has been achieved under SET exsanguination.

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References


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

1. Make sure the SET is tight enough under exsanguination control. It is essential to ensure the tourniquet cuff is keeping the vein in order to allow the vein with temporary control and yield a good surgical exposure. Failure to do so may cause some uncertainty about whether the vein is blocked. A well-set SET will cause total hemostatic failure of the procedure, so we recommend to always remove the SETs and check our hands before narrowing.

2. Another pitfall that must be avoided is related to the high blood flow in the arm when an arteriovenous fistula is present. The tourniquet must be removed and hemostasis verified prior to wound closure. If the tourniquet is left in place and left for the actual closure process is completed, deep arterial branches of the SET may cause some minimal bleeding. If this occurs, the SET must be removed and hemostasis verified before wound closure.

3. Care must be taken in patients with very poor skin integrity. The process of rolling the tourniquet up the arm applies some static stress to the skin. Some patients with chronic kidney disease have atrophic skin and edema that can heighten their susceptibility to skin tears. The process of rolling the SET up the arm can cause minor skin tears that will heal quickly.

4. Care must be taken to have adequate analgesia or anesthesia. The hemostatic force of the tourniquet is concentrated on a narrow area that is at risk for segmental avulsion. Proper analgesia is needed, so that in mind the application area of the HemaClear® tourniquet at the junction of the arm and upper arm is removed from the incision area, which can be treated leaving some branch intercostal nerve blood flow. Flaccid anesthesia is used, additional sedation may be needed.

Conclusions

We describe the successful use of a sterile elastic exsanguination tourniquet with a narrow footprint in 27 hemodialysis patients. The mean exchange of the exsanguination tourniquet in each case was 15 mm Hg. The surgical procedures would have otherwise been done without a tourniquet and sustained substantial blood and need of blood transfusion. The incidence of vascular injury was reduced in this group. Additional benefits are the perfect exsanguination, excellent exposure and visibility on the evidence of direct placement of hemostatic agents to the brachial vessel with the advantage of an exsanguination and life-threatening bleeding scenario. Operational recommendations aimed at avoiding the immediate adverse effects listed below are presented. We conclude that the HemaClear® SET is effective and safe in building bleeding time and anatomic exposure in vascular procedures and in particular in avoiding the need for blood loss in these procedures.

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