

# Use of the HemaClear® Exsanguination Tourniquet in Dialysis Access Surgery

Eric Ladenheim, MD, Juergen Krauthammer, MD, Siddartha Agrawal, MD, Craig Lum, MD, Nathan Chadwick, PA-C  
Ladenheim Dialysis Access Centers, Fresno, California



## Introduction

We present the first use of the HemaClear® non-pneumatic exsanguination tourniquet for forearm dialysis access surgery in 27 patients (HemaClear®, ohk Medical Devices, Haifa, Israel).

This surgical exsanguination tourniquet (SET) is a sterile elastic device which rolls over the limb starting from the fingers by pulling two handles (Figure 1 a). The elastic silicone ring provide sufficient pressure ( $220 \pm 30$  mm Hg) to block arterial flow into the limb (Figure 1 b). The stockinet can be cut to provide access to the incision area while providing an additional sterile cover over the rest 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 14 to 90 cm. We describes 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 ring up.



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



Figure 1c shows the excellent visibility of the anatomical structures thanks to the near-perfect exsanguination with no residual 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 to elastic silicon ring to avoid inadvertent nicking of the skin.

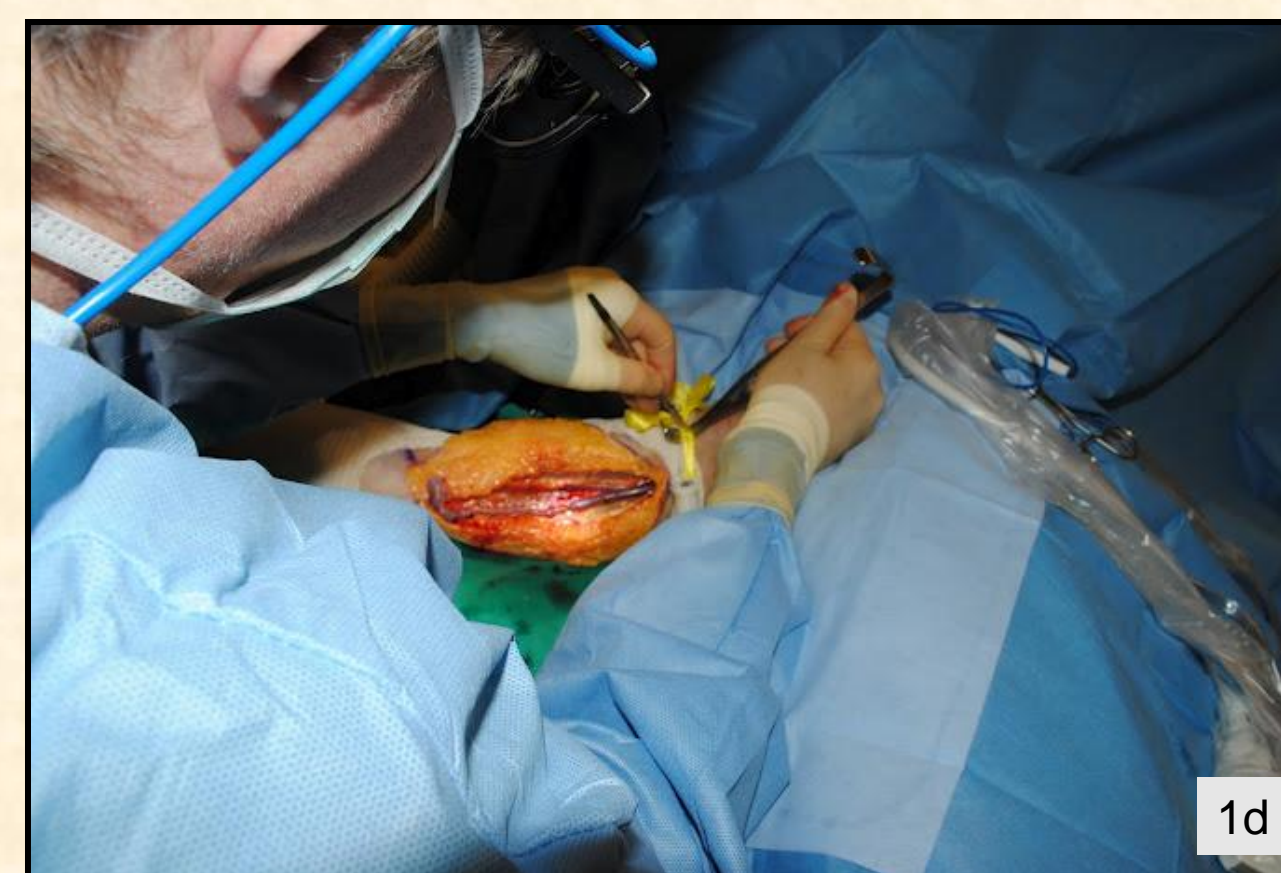
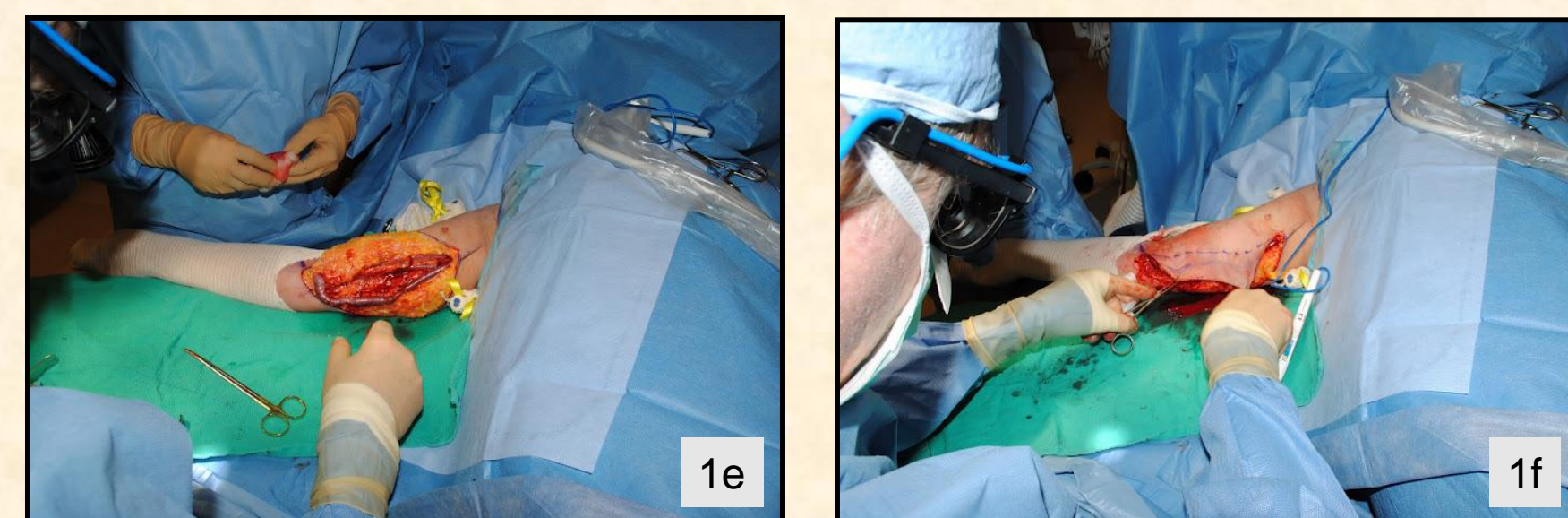


Figure 1e shows the blood-filled vessel after the resumption of blood flow into the arm and Figure 1f shows the preparation for skin closure.



## Results

The HemaClear® SET enabled exposure, dissection, and manipulation of upper arm blood vessels under tourniquet control. In all but one case, blood loss was less than 20 ml. No patient required transfusion. We encountered inconsequential adverse effects in 4 of the cases including a twisted vessel, a bleed from a vascular branch, skin tear in an atrophic skin arm and pain. The subsequent follow up of these patients 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 if the sterile tourniquet is used, it is of very limited effectiveness in upper arm arteriovenous fistula surgery. The HemaClear® tourniquet is much narrower than the pneumatic tourniquet and has enabled surgery to be done on upper arm AV fistulas and grafts.

One excellent use of the roll-on non-pneumatic tourniquet is in the creation of the transposed brachio basilic fistula. The basilic vein of the upper arm can be readily harvested through either long incisions or multiple small incisions with long skin bridges. When harvesting the basilic vein through long incisions the HemaClear® tourniquet limits blood loss. When harvesting the basilic vein through small incisions with long skin bridges absolute hemostasis is essential for adequate exposure and visualization. Similarly, the HemaClear® tourniquet has enabled extensive harvest and transposition of the cephalic vein of the upper arm to be done almost bloodlessly.

Additionally, one of the bloodiest procedures in dialysis access surgery is the removal of the infected upper arm arteriovenous graft (Figs. 2a – c). With the surgical exsanguination tourniquet rolled up the junction of the axilla and the upper arm the infected upper arm graft can be removed with very little blood loss.

Fig. 2a. The sterile SET was rolled over the lesion and the fabric of the stockinet cut to expose the surgical site.



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



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

1. After harvesting the basilic or cephalic vein under tourniquet control, it is essential to remove the tourniquet prior to tunneling the vein in order to be able to flush the vein with heparinized saline and verify that it is not twisted. 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.
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 up until after the wound closure process is completed, tiny unligated branches of the fistula may cause very serious bleeding. If no fistula was present, the small venules would ordinarily create no problems for surgical hemostasis but in the renal patient with an arteriovenous fistula the abnormally high blood flow and venous pressure will cause wound hematomas and complications unless extra attention is paid to final hemostasis. As such, we recommend never to close the arteriovenous fistula surgical incision until after the HemaClear® tourniquet has been removed.
3. Caution should be used in patients with very 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 atrophic skin and edema that can heighten their susceptibility to skin tears.<sup>1</sup>
4. Care must be taken to have adequate analgesia or anesthesia. The hemostatic force of the tourniquet is concentrated into a narrower zone than a pneumatic tourniquet. If regional anesthesia is used, keep in mind that the application zone of the HemaClear® tourniquet at the junction of the axilla and upper arm is innervated by the intercostobrachial nerve, which can be missed during some brachial plexus nerve blocks. If local anesthesia is used, additional sedation may be needed.<sup>2</sup>

## Conclusions

We describe the successful use of a sterile elastic exsanguination tourniquet with a narrow footprint in 27 hemodialysis patients. The main advantage is the prevention of blood loss in cases where upper arm procedures would have otherwise been done without a tourniquet and sustained substantial bleeding and need of blood transfusion. No transfusion was required in this group. Additional benefits are the near-perfect exsanguination, excellent exposure and visibility and the avoidance of direct placement of blocking tools on the blood vessels with the ensuing risk of spasm and intima shearing. Operational recommendations aimed to avoid the immediate adverse effects listed above are presented. We conclude that the HemaClear® is effective and safe in facilitating bleeding free upper extremity hemodialysis vascular procedures and in particular in eliminating the need for blood transfusion in these procedures.

## References

1. Jordan SC, Pescovitz MD. Presensitization: the problem and its management. *Clin J Am Soc Nephrol* 2006;1: 421-432.
2. Orthopedics Today European Edition, February 2012. Orthopedists require more education in effective and safe blood management. <http://www.orthosupersite.com/view.aspx?rid=92056> last accessed 16 Feb., 2012

## For more information contact:

Eric D. Ladenheim MD  
Ladenheim Dialysis Access Centers  
6057 N First Street Suite 105  
Fresno CA 93710  
[Eladenheim@ladenheim.net](mailto:Eladenheim@ladenheim.net)  
[www.ladenheim.net](http://www.ladenheim.net)

