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Tourniquet use in controlling arteriovenous graft/fistula hemorrhage

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Arteriovenous (AV) graft and fistula hemorrhage is a known complication and regaining control can be a messy ordeal. Although tourniquet use is not a first line treatment, it does allow for an additional avenue to controlling a potentially life-threatening bleed. Tourniquets have fluctuated from being widely accepted to taboo to once again gaining acceptance. The civilian sector has traditionally been lagging behind the military in trauma care. According to the latest Tactical Combat Casualty Care (TCCC) military guidelines, tourniquets are the first-line treatment for life-threatening external hemorrhage when applicable (1). Tourniquets have been well documented to gain control of bleeding in traumatic situations, but not much has been reported for use in fistula/graft control. The following are two cases showing temporary tourniquet use to gain control of bleeding accesses.

Case 1:

At 2300 hours, Emergency Medical Services (EMS) brought in a 26-year-old male with bleeding from pressure bandages applied to the left arm while the paramedic was also applying pressure to the area. The patient states he has a history of the end-stage renal disease (ESRD) and is being prepared to start on hemodialysis. In the past week he underwent the placement of an AV fistula to the left arm which is currently maturing, and this evening he awoke to pain and bleeding from the fistula site. Pressure was applied to slow bleeding until EMS arrived and attempted to grain control with pressure bandages and direct pressure with limited success.

The patient was immediately placed in the trauma bay, and the staff was gowned. Vitals were Pulse 110, Blood Pressure (BP) 145/95, Oxygen Saturation 100% on room air, Respirations 22 and the patient appeared anxious. The left brachial artery and cephalic vein were located as pressure points and attempted to be compressed as the pressure dressings were removed. On removal of the final dressing, hemorrhaging was noted from the superior aspect of the AV fistula before dressings were reapplied.

Vascular surgery was called in, and the Operating Room (OR) needed to be opened which could take up to 30 minutes. To gain better control of the bleed, it was decided to apply a tourniquet. As the Windlass tourniquet was cranked down, hemorrhaging slowed from the bandages which were removed (slowly and with a bit of apprehension as the room cleared) to reveal the bleeding was controlled. Examination of the fistula showed the sutures of the superior aspect to have broken. A purse string suture was applied to the fistula, and the tourniquet was slowly released revealing the bleeding continued. The tourniquet was reapplied, and quick-clot gauze was applied, and direct pressure held as the tourniquet was removed. Dressings were applied, and the patient was taken to the OR for revision of his fistula.

Case 2:

68-year-old female with right forearm AV graft arrived at 1800 hours with poorly controlled bleeding from the graft. The patient had completed dialysis and sent to the Emergency Department for bleeding unable to be controlled by direct pressure. The patient was noted to have a history of ESRD, malignant hypertension, poorly controlled diabetes, congestive heart failure, and chronic obstructive pulmonary disease. The patient's vitals were Pulse 95, BP 168/97, Respirations 18 and Oxygen Saturations of 95%.

The patient was immediately placed in a room and pressure applied proximal to the graft. The dressings were removed to reveal a continuously bleeding AV graft from the needle insertion site. A tourniquet was applied proximal to the site while quick-clot and direct pressure to the site were applied before removal of the tourniquet. Pressure was held for 5 minutes, and no further bleeding was noted. The site was wrapped, and the patient was monitored for rebleeding before being discharged home.

Discussion:

More than 350,000 patients in the United States require hemodialysis for end-stage renal disease yearly, which is expected to double in the next decade (2). Dialysis is achieved by a number of methods, but we are looking at two in this report, fistulas, and grafts. An arteriovenous fistula is created by joining a native artery and vein while a graft uses synthetic tubing to create a connection. In the creation of fistulas, the radial artery flow rate has been measured before and after the creation of an end-to-side fistula showing an increase in flow rate from 21.6 ± 20.8 ml/min to 208 ± 175 ml/min immediately after. Rates ultimately reached 600 to 1200 ml/min (3)(4).

Dialysis flow rates vary among countries. In the US, a minimum of 400 ml/min is required while in Europe the rate is 300 ml/min and Japan require 200 ml/min (5). The minimum flow rates are required for dialysis settings, and the higher the rate, the quicker a patient can get through dialysis. Blood flow should exceed the desired dialysis rate by at least 100 ml/min to avoid vein collapse (5). Minimum fistula flow rates are required in the US to be 350-400 ml/min while graft rates are 800-1000 ml/min. Fistulas were found to thrombose at rates less than 200 ml/min while grafts less than 600 ml/min (5).

With flow rates able to reach 1200 ml/min, an individual would be able to bleed out within minutes if bleeding was not controlled. Dialysis access site hemorrhage is usually due to over-coagulation, rupture, or aneurysms (6). Uremia also inhibits platelet aggregation resulting in prolonged bleeding times even when other coagulation studies and platelet counts are normal (7).

Control can be attempted through many methods. Direct pressure to the site, either digitally or with a clamp, for 5-10 minutes is first-line therapy followed by observation for 1-2 hours for rebleeding or thrombosis. Protamine can be administered at 1mg for every 100 units of heparin when patients are over heparinized which can lead to a reversal in 10 minutes. Gelatin sponges or quick clot can also be applied to assist in clot formation. Finally, if the above does not work, apply pressure to distal and proximal ends of the graft or fistula digitally, or apply blood pressure cuff or tourniquet proximal or distal to

the fistula or graft, depending on if it is a loop graft or not. After gaining control of the bleed, apply 4-0 nonabsorbable suture with a noncutting needle in figure-of-eight or horizontal mattress suture (8).

Although control can usually be achieved before the need for tourniquets and sutures through direct pressure, it is essential to have multiple options available.

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