Layered wrapping technique combined with oxidized cellulose and vascular prosthesis for effective haemostasis in aortic surgery

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Abstract

Bleeding from anastomotic sites is one of the major complications of aortic surgery. We describe a novel double-layer wrapping technique using a combination of oxidized cellulose and a vascular prosthesis to effectively achieve haemostasis. The anastomotic site is surrounded by a prosthetic graft inlaid with a strip of Nu-Knit. These are fixed by horizontal mattress and over-and-over sutures. Nu-Knit acts as an ideal cushion to achieve haemostasis, because it has a haemostatic effect and fills the space between the anastomotic site and wrapping graft. This technique is simple, and facilitates adequate haemostasis without complications.

Keywords: Aortic operation • Bleeding control • Surgical techniques

INTRODUCTION

Bleeding from anastomotic sites, especially sites of aorta-to-artificial graft and graft-to-graft anastomoses, is one of the major factors leading to increases in the operative time, rate of blood transfusion and surgical mortality in aortic surgery [1]. This type of bleeding is difficult to control because of severe coagulopathy, mainly induced by deep hypothermia, and a long cardiopulmonary bypass time [1–3]. We describe a simple technique using a vascular prosthesis inlaid with a strip of oxidized regenerated cellulose (Nu-Knit; Ethicon, Johnson & Johnson, Somerville, NJ, USA) to achieve adequate haemostasis of an anastomotic site in aortic surgery [4, 5].

TECHNIQUE

After completion of the aortic anastomosis and administration of protamine sulphate in a routine fashion, the bleeding point is carefully checked. Significant arterial bleeding at the anastomotic site is controlled by additional sutures. When oozing remains but a precise bleeding point cannot be detected, this technique is applied. A strip of Nu-Knit is prepared based on the width of the vascular prosthesis used for the wrapping technique. Any surplus prosthetic graft remaining after the main procedure of anastomosis is used as an outer layer. The remaining graft is usually long enough to use for the wrapping technique once or twice. The graft width usually ranges from 2 to 3 cm. A strip of Nu-Knit as an inner layer is placed on the prosthetic graft, and both materials are of sufficient length to surround the anastomotic site (Fig. 1A). Then, the anastomotic site is simply enwrapped by the layered Nu-Knit and vascular prosthesis. We usually do not fix the layered Nu-Knit and vascular wrapping in advance of wrapping the anastomotic site. Both ends of the prosthesis are tightened on the top of the anastomotic site by forceps, and fixed with horizontal mattress and over-and-over sutures (Fig. 1B). The tightness is adjusted by additional simple mattress sutures at the bottom of the fixation suture lines under pulsatile arterial pressure when there is a redundant space beneath the approximation line. Reduced bleeding is usually achieved soon after application of this method. No further haemostatic procedure is required for the wrapping site in most cases. This technique is applicable for both aorta-to-graft and graft-to-graft anastomoses (Fig. 2).

DISCUSSION

Bleeding from an anastomotic site is sometimes difficult to control in aortic surgery mainly due to a long cardiopulmonary bypass time and hypothermia associated with heparin activity, haemodilution, increased fibrinolytic activity and the consumption of platelets and coagulation proteins [1, 6, 7]. Despite the appropriate transfusion and administration of blood-derived products for haemostasis, coagulopathy remains perioperatively in these situations. Additional sutures sometimes cause new bleeding from the needle puncture sites, especially in patients with fragile tissue. Bleeding from anatomically difficult sites makes suturing problematic. Sutureless procedures such as compression with or without fibrin products [8], oxidized cellulose [5] or the wrapping technique are effective in these cases [2, 3, 8]. Although fibrin and collagen sealant are effective agents for haemostasis, they are expensive and sometimes related to the occurrence of pseudoaneurysms in the presence of high-pressure bleeding when used alone [9, 10]. Recently, wrapping techniques were applied to not only achieve adequate haemostasis, but also to prevent further dilatation of an already dilated aorta, as well as to reinforce a dissected ascending aorta [2, 3, 9]. Sakakibara et al. [2] reported a
technique similar to ours using fat tissue and a Teflon felt strip. In the present study, we used Nu-Knit as an inner layer and a vascular prosthesis as an outer layer. Since a felt strip is a nonwoven fabric that can easily lose its initial tension, we avoid using it for outer-layer wrapping. Nu-Knit is composed of oxidized regenerated cellulose and has some unique properties, such as haemostatic and antimicrobial effects, and it is biologically absorbed within a few weeks [4, 5]. If only the vascular prosthesis is used for wrapping, the gap between the anastomotic site and wrapping material will result in inadequate compression for haemostasis. The novelty of this technique is the usage of Nu-Knit as an inner layer to surround the anastomotic site. (A) A strip of oxidized cellulose (‘Nu-Knit’) is trimmed and placed on the vascular prosthesis as an ‘inner layer’ to surround the anastomotic site. (B) A cross-sectional schema of the layered wrapping technique. A strip of ‘Nu-Knit’ (dotted line) with a vascular prosthesis (dashed line) is simply placed around the anastomotic site. The ends of the vascular prosthesis are secured by horizontal mattress and over-and-over sutures.

Figure 1: (A) Photograph showing preparation for the layered wrapping technique. A strip of oxidized cellulose (‘Nu-Knit’) is trimmed and placed on the vascular prosthesis as an ‘inner layer’ to surround the anastomotic site. (B) A cross-sectional schema of the layered wrapping technique. A strip of ‘Nu-Knit’ (dotted line) with a vascular prosthesis (dashed line) is simply placed around the anastomotic site. The ends of the vascular prosthesis are secured by horizontal mattress and over-and-over sutures.

Figure 2: Intraoperative photograph of thoraco-abdominal aneurysm resection with the layered wrapping technique. Two anastomotic sites (arrows) are wrapped by ‘Nu-Knit’ with a vascular prosthesis.

Figure 3: A strip of oxidized cellulose (‘Nu-Knit’) with a vascular prosthesis.

The novelty of this technique is the usage of Nu-Knit as an inner layer. The presence of fragile tissue, especially after a case of clearly identified projectile bleeding, this technique could occasionally cause new bleeding. The preferable timing of using this procedure is after the administration of protamine sulfate. We unwrap the vascular prosthesis under a certain arterial pressure (systolic pressure >70–80 mmHg) after the resumption of spontaneous circulation in order to avoid excessive banding, which causes stenosis at the anastomotic site. The cost of oxidized cellulose is less than one-tenth that of other haemostatic agents such as fibrin products, collagen sheets or absorbable haemostatic powders. We employed this technique for 5 patients (chronic dissection: 2, degenerative true aneurysm: 3) from April 2012 to March 2014. We did not apply it for acute aortic dissection or connective tissue disorders such as Marfan, Ehlers-Danlos or Loeys-Dietz syndrome. There were no infections or complications related to anastomosis during the follow-up period in any patient. However, the number of patients was limited, and so further study is necessary to evaluate the efficacy and safety of this technique.

In conclusion, the combination of using Nu-Knit and a vascular prosthesis is a safe, simple and useful technique to control oozing from anastomotic sites in aortic surgery. This technique is not technically demanding, and applicable in other similar situations to achieve adequate haemostasis.

Conflict of interest: none declared.

REFERENCES