

NEW TECHNOLOGY

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# Control of Troublesome Bleeding During Repair of Acute Type A Dissection with Use of Modified Rapid Deployment Hemostat (MRDH)

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**ABSTRACT** Troublesome bleeding occurred in the posterior portion of the proximal anastomosis in an ascending aorta graft, being performed on a patient with acute type A dissection. The suture line was close to the left coronary ostium, and attempts at suturing and other maneuvers failed to control hemorrhage. Modified rapid deployment hemostat (MRDH) was successful in achieving hemostasis. MRDH is a novel hemostatic agent with invaluable use in troublesome bleeding occurring during heart surgery. doi: 10.1111/j.1540-8191.2009.00915.x (*J Card Surg* 2009;24:722-724)

Troublesome bleeding can occur during complex aortic surgery, which may be difficult to control with conventional measures. The Cabrol shunt,<sup>1</sup> and its modifications,<sup>2-5</sup> have been very useful in this situation. However, when performing surgery for acute type A dissection, the surgeon usually removes the whole aneurysm shell, making construction of a Cabrol shunt difficult, although not impossible.<sup>3</sup> Troublesome bleeding occurred during surgery for acute type A dissection, which could not be controlled with usual measures of extra suturing and pressure control. Modified rapid deployment hemostat (MRDH; Marine Polymer Inc., Boston, MA, USA), a new hemostatic agent designed for use in trauma and surgical situations, was applied, controlling hemorrhage. We herein report details of the operation and review of MRDH in bleeding conditions that are unresponsive to conventional measures.

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The patient gave consent for reporting this case. A 42-year-old woman presented to our clinic having had one-month history of chest pains, diagnosed at another hospital as acute type A dissection. Due to local circumstances, the patient was treated with medical therapy (beta-blockers and pressure control) and was

referred to us for subsequent management. The patient was stable on admission, had normal blood pressure, and had all pulses present. A computed tomography (CT) angiogram with contrast had been performed that showed acute type A dissection, with an intimal flap in the ascending aorta. The false aneurysm measured 7 cm, and the dissection extended to the innominate artery. At the time of surgery, with cannulation of the right subclavian artery and right atrium, cardiopulmonary bypass was initiated at systemic temperature of 32 °C. The aorta was clamped distally and, under cold hypothermic cardioplegic arrest, retrograde/antegrade, the aorta was opened. The intimal tear was identified starting 1-cm distal to the left coronary ostium. The whole aneurysm shell was removed. The remainder of the operation was performed with systemic perfusion. Since there was minimal aortic insufficiency and the valve leaflets were normal, a number 28 Hemashield graft was used for the proximal anastomosis, with resuspension of the aortic valve. The posterior suture line came very close to the left ostium. Two layers of felt were applied inside and outside the aorta. Bioglue was applied at completion of the anastomosis. The distal anastomosis was performed using a Teflon sandwich to approximate the true and false lumens, with bioglue applied at completion of the anastomosis. Upon aortic declamping, troublesome bleeding occurred in the posterior suture line, near the left coronary ostium. Suturing was difficult and, together with other conventional techniques, failed to control hemorrhage.

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This was despite prolonged hand pressure and infusion of clotting factors, including factor VII. The option would have been to redo the proximal anastomoses, with the consequences of another long pump run, further coagulopathy, and bleeding. An MRDH sponge was applied to the area and covered with local tissue and hand pressure was applied. The patient's chest was left open, and 48 hours later, the sponge was removed with total control of bleeding. The patient's chest was then closed and he recovered uneventfully. He was discharged home on the seventh day post-surgery. Follow-up computed axial tomography (CAT) scan did not show any abnormalities, specifically, no false aneurysm formation.

## DISCUSSION

The Food and Drug Administration recently released MRDH as a class I medical device. MRDH consists of a highly purified fully acetylated poly-N-acetyl glucosamine nanofiber material.<sup>6-8</sup> The mechanism of action of MRDH has been elucidated. It has been shown to have specific platelet and red blood cell interactions.<sup>9-13</sup> These are receptor mediated with high-affinity and high-specificity interactions.<sup>9-11,13</sup> MRDH has been shown to be efficacious in fully anticoagulated animals,<sup>14</sup> suggesting a multifactorial mechanism that involves direct receptor-mediated platelet<sup>9,11</sup> and red blood cell interactions.<sup>10,13</sup> It has been shown, in addition, that its multifactorial mechanism of action includes interactions with exposed endothelial tissue resulting in localized endothelin-1 release.<sup>12</sup>

MRDH was developed as an effective method of hemostasis in trauma, including combat situations, and as such, it has been shown to be very effective in emergency treatment of abdominal injuries, such as liver and renal lacerations and arterial and venous injuries.<sup>15-17</sup>

MRDH is supplied as a sponge with a radiopaque marker, containing a lyophilized sponge material, which consists of purified acetylated poly-N-acetyl glucosamine nanofibers. It is applied to the bleeding site, which is then hand compressed for 10 minutes. Additional MRDH can be applied on top of the first MRDH sponge for continuing bleeding. The 4 × 4 sponge must be removed sometime during or after surgery, as it is a foreign body.

In our patient, there is no doubt that MRDH was effective in controlling bleeding, which had not responded to conventional measures. Hours had been spent trying to control bleeding, with the patient having no systemic heparin. One may say that hand pressure is what controlled bleeding. However, this had been tried for a prolonged period of time without success. The chest was left open with the sponge (4 × 4 with MRDH) applied to the bleeding area. The sponge was successfully removed 48 hours later when the bleeding had subsided.

The limitations of this case report is that it represents a single case, and one wonders whether further pressure or clotting factors would have yielded the same outcome. From the experience of these authors, this

would not have been the case, as we had exhausted all options short of placing the patient back on pump and redoing the proximal anastomoses. Also, we have used MRDH in cases of bleeding, such as during heart transplantation, with success. MRDH has been shown to be effective in traumatic injuries, vascular injuries, and other solid organ injuries, indicating that it is an effective hemostatic agent that should work in conditions such as we have described. Although under these conditions MRDH has been shown to be effective, further studies are needed in major aortic surgery to confirm its efficacy, in the face of heparinization and coagulopathic conditions. One of the concerns is the development of false aneurysm in the area in which MRDH was applied. In this particular case, it did not occur. However, one has to be cautious of this potential complication and follow-up of such patients is needed.

In summary, we herein present a patient with acute type A dissection who developed troublesome bleeding at the proximal anastomoses posteriorly. MRDH successfully controlled hemorrhage, which had not responded to conventional measures. MRDH is important and useful in emergency situations, such as major wounds, solid organ lacerations, and arterial/venous injuries, in which bleeding must be controlled, at least temporarily. MRDH may play an even greater role in cardiac surgery, the main reason being that it can be applied to a bleeding area, such as suture line or laceration, where other hemostatic agents are likely to fail.

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