Surgical Glue and Necrosis of Arterial Wall

To the Editor:

I read with interest the report by Kirsch and colleagues on aortic wall alterations after application of glue [1].

Necrosis of arterial wall after application of glue is not new. Thirty-nine years ago, while working in the vascular laboratory of Dr Robert H. Goetz, I used the adhesive methyl 2-cyanoacrylate (Eastman 910 monomer) for nonsuture vascular anastomoses in dogs. Because all the anastomoses disrupted, we conducted the following experiments: 39 arteries in 13 dogs were dissected, with no arterial incisions or anastomoses performed. In 34 arteries, the adhesive was applied to the surface of a short arterial segment. Five arteries served as controls. They were dissected free, but no adhesive was applied. On arteriography within the first week, 31 of the 34 arteries developed fusiform dilatations of the segment to which the adhesive had been applied. No dilatations were noted in the control group. The arteriographic findings were confirmed by gross examination. Histologic studies of dilated segments showed necrosis of the entire arterial wall with complete absence of all cellular structures, strictly limited to the area to which the monomer had been applied. The development of necrosis was followed by an infiltration of polymorphonuclear leukocytes from the intima to the media, which in some cases took on the proportions of an abscess in the arterial wall [2, 3]. In our later, long-term study, 43 canine arteries, similarly treated, were observed for 7 months. The necrosis and abscesses in the arterial wall were finally replaced by dense fibrous tissue [4].

Tissue adhesives are not innocuous when applied to the arterial wall. This is apparently true not only with regard to the methyl 2-cyanoacrylate, but also to gelatin-resorcinol-formalin glue, and mitigates against its indiscriminate use.

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References

1. Kirsch M, Ginat M, Lacerf L, Houël R, Loisance D. Aortic wall alterations after use of gelatin-resorcinol-formalin glue. Ann Thorac Surg 2002;73:642–4.
2. Weissberg D, Goetz RH. Tissue reactions to methyl 2-cyanoacrylate (Eastman 910 Monomer). Surgical Forum 1964;15: 226–7.
3. Weissberg D, Goetz RH. Necrosis of arterial wall following application of methyl 2-cyanoacrylate. Surg Gynecol Obstet 1964;119:1248–52.
4. Goetz RH, Weissberg D, Hoppenstein R. Vascular necrosis caused by application of methyl 2-cyanoacrylate (Eastman 910 Monomer): 7-months follow up in dogs. Ann Surg 1966;163: 242–8.

What Are the Risks of Using Biologic Glues?

To the Editor:

The article by Kazui and colleagues [1] on the role of biologic glue and the risk to aortic root redissection caught my attention. In the last 1½ years, I have reoperated (for pseudoaneurysm) on 3 of approximately the last 15 patients where Bio-glue was used to assist in the repair of a dissection of the ascending or aortic arch. I cannot recall a pseudoaneurysm in my non-glue patients. This may be purely chance, but it does raise my suspicion that the glue may be having unexpected consequences. In the literature, several authors have suggested that the use of aortic glue is associated with local tissue damage, a local inflammatory response, or an increased risk of pseudo-aneurysm formation [1–4].

Pseudoaneurysms in patients treated with a glue may arise for many reasons including:

1. Local cell death from toxic products in the glue that lead to tissue breakdown over time.
2. The aortic glue may have stopped bleeding in an area that would have been better served over the long term with a suture than by glue closure (analogous to duct taping an area that should have been bolted together).
3. Patients who would not have survived surgery due to bleeding from coagulopathy and local tissue compromise are now surviving. They may be at more risk for late complications than patients who did not need the glue to get out of the operating room.

If there is a trend toward more pseudoaneurysms in glue-treated patients, hopefully, it will be due to reason number three and not numbers one and two. Biologic glues may be very useful, but there is not free lunch in this world. We should be alert for any patterns of late complications that would suggest that the use of biologic glue has some downsides.

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References

1. Kazui T, Washiyama N, Bashar AH, et al. Role of biologic glue repair of proximal aortic dissection in the development of early and midterm redissection of the aortic root. Ann Thorac Surg 2001;72:509–14.
2. Bingley JA, Gardner MA, Stafford EG, et al. Late complications of tissue glues in aortic surgery. Ann Thorac Surg 2000;69:1764–8.
3. Martinelli L, Graffigna A, Guarnerio M, Bonmassari R, Disertori M. Coronary artery narrowing after aortic root reconstruction with resorcin-formalin glue. Ann Thorac Surg 2000; 70:1701–2.
4. Katsumata T, Moorjani N, Vaccari G, Westaby S. Mediastinal false aneurysm after thoracic aortic surgery. Ann Thorac Surg 2000;70:547–52.

Reply

To the Editor:

I thank Dr Downing for his concern about the potential harmful effects of biological glues used in the surgical treatment of acute type A aortic dissection. The complication of pseudoaneurysm formation at the site of Bio-glue application certainly deserves attention. Bio-glue was introduced with the expectation that it is less toxic than GRF glue and causes minimum tissue necrosis. GRF glue was not approved by the FDA (Food and Drug Administration) because of concerns regarding tissue toxicity. Bio-glue, which obtained FDA approval, was welcomed by many aortic surgeons in the US.

We have extensive clinical experience with GRF glue, and

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have found it a useful adjunct facilitating aortic repair in dissection patients. Recently, we had a chance to use Bio-glue as part of a clinical trial. Though the experience is limited, we have seen pseudoaneurysm formation in 2 out of our 5 patients receiving this glue. Last year, Bavaria and colleagues presented the results of a prospective randomized study with Bio-glue at the 81st Annual Meeting of the American Association for Thoracic Surgery [1]. In this study, there were 4 patients out of 17 in the Bio-glue group who required late reoperation, and two of these reoperations were due to pseudoaneurysm formation.

The reason behind pseudoaneurysm formation is not clear but a degree of tissue necrosis and perhaps technical flaws in application of glue may be involved. In our article, we emphasized the importance of proper use of glue to obtain the desired effect [2]. Ensuring that the area where glue is to be applied is dry and bloodless is an important precaution. Similarly, care should be taken to prevent spilling the glue. Bio-glue being more liquid in consistency than the GRF glue has a greater chance to exude out of the false lumen when a clamp is applied to ensure firm apposition between the intima and adventitial walls. However, it appears that despite all these precautions, pseudoaneurysms develop. This implies that we still do not have a perfect glue. While the search for better glues should continue, we should not lose sight of the fact that biological glues have greatly facilitated aortic repair in dissection patients. Dr Bavaria showed that use of Bio-glue significantly reduced pump time, aortic repair time, and total operation time.

Dr Bachet, while discussing Dr Bavaria's article, mentioned that with the use of glues, mortality in acute type A dissection patients has steadily fallen over the years and stabilized at around 18%. Therefore, I agree with Dr Downing when he says that there is no free lunch in this world. For the greater benefit of improving survival in critically ill acute type A aortic dissection patients, we may have to pay this small price of occasional pseudoaneurysm formation, at least for the time being. Given the limited experience with Bio-glue, it is probably too early to make any definitive conclusions regarding potential detrimental effects.

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References

1. Bavaria JE, Pochettino A, Brinster DR, et al. Prospective randomized study of bioglue tissue adhesive during repair of acute type A aortic dissection. Presented at the 81st Annual Meeting of the American Association for Thoracic Surgery, San Diego, CA, May 7, 2001.
2. Kazui T, Washiyama N, Bashar AH, et al. Role of biologic glue repair of proximal aortic dissection in the development of early and midterm redissection of the aortic root. Ann Thorac Surg 2001;72:509–14.

MISCELLANEOUS

Alternate Technique of Routing the In Situ Right Internal Mammary Artery to Graft the Left Anterior Descending Artery and Its Branches

To the Editor:

I have read with interest the article by Al-Ruzzeh and colleagues [1]. I would like to congratulate them on their excellent results. I concur with their findings and recommendations for the use of the pedicled (in situ) right internal mammary artery (RIMA) for grafting the left anterior descending artery. However, many cardiac surgeons have not adopted this technique because of the need for the RIMA to course across the midline and over the aorta, as stated in the discussion of Al-Ruzzeh and colleagues. To supplement their findings, I would like to outline an additional maneuver that has not been previously described. The new technique alters the course of the in situ RIMA so as to provide additional length as well as protect it from injury during reentry or cannulation during a future reoperation. The technique consists of the following steps:

1. The RIMA is harvested completely, close to its origin from the subclavian artery.
2. The patient is then heparinized and the RIMA is divided distally.
3. The superior vena cava (SVC) is easily dissected away from its thin surrounding tissue at the level of the proximal RIMA.
4. By passing an angled clamp under the SVC from medial to lateral and grasping the end of the RIMA (with minimal to no pedicle), it is passed posterior to
5. the SVC and redirected from its original lateral position to one medial to the SVC.
6. The innominate vein is easily freed from its surrounded tissue and off the aortic arch in a similar fashion.
7. The RIMA is then passed posterior to the innominate vein (alternatively, the IMA can be passed under both the innominate vein and the aortic arch if additional length is needed) to emerge through the mediastinal fat directly over the main pulmonary artery and right ventricular outflow tract: a very favorable position to graft the left anterior descending artery; diagonal and occasionally ramus intermedius artery (Fig 1).

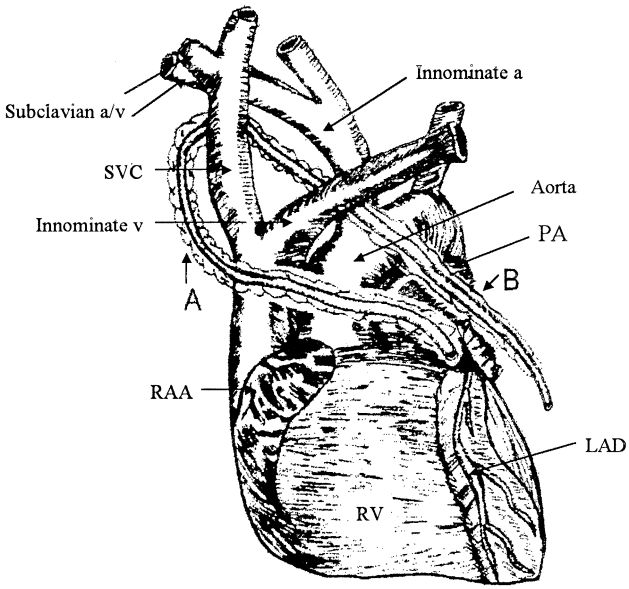

Fig 1. (A) *Conventional route of the in situ RIMA to the LAD courses anterior to the SVC and ascending aorta.* (B) *A more direct and less exposed route to the LAD and its branches courses the RIMA under the SVC, innominate vein and alternatively, the aorta.* (a = *artery;* a/v = *artery/vein;* LAD = *left anterior descending;* PA = *pulmonary artery;* RAA = *right atrial appendage;* RIMA = *right internal mammary artery;* RV = *right ventricle;* SVC = *superior vena cava;* v = *vein.*)

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