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Future Demands from Artificial Vascular Grafts: A Short Communication on the Basis of a Case Report

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Abstract

Based on the story of an operated patient, in this article, by mentioning current hemorrhagic problems of the vascular grafts, a number of ideas was presented that could guide the researches on artificial vascular grafts. A 59-year-old man was operated for carotid artery stenosis and then was revised 2 days after surgery due to acute hematoma at the incision site. During the surgical exploration, it was observed that the patient had a hemorrhagic diathesis due to the incompatibility between anticoagulant and antiaggregant usage in addition to the active bleeding from a needle hole on the polytetrafluoroethylene patch. Hemostasis was achieved with appropriate applications involving the combination of surgical and medical interventions. By means of this case, it was once again seen that vascular grafts has not been completed their development strictly. "The Mnemotechny Grafts" and/or "The Sandwich Grafts" detailed in this article will lead to the formation of new vascular grafts that can offer the sought solution.

Keywords: Dacron; Hemorrhage; Hemostasis; Graft; Mnemotechny grafts; Polytetrafluoroethylene; Sandwich grafts; Vascular

Introduction

Arterial occlusive diseases like carotid stenosis or peripheral artery occlusions or visceral artery stenosis in addition to any kind of aortic diseases are still significant problems of the mankind despite of evolving current technologies in medicine and surgery. Not always but almost in many cases, the only solution to cure the patient necessitates the usage of an Artificial Vascular Graft (AVG). This vascular graft may be a tube graft or sometimes a patch graft. Although rare, AVGs may be needed for venous system even. Given the prevalence of the diseases we have considered since the beginning of this paragraph, it will be better understood how much humanity needs AVGs.

As being a pioneer of cardiovascular surgery, up to now from the days around the early 1950s in which DeBakey developed the first AVG with a Dacron material by sewing at his wife's sewing machine [1], the AVGs have undoubtedly shown a significant improvement. However, there are still some major and minor problems with them. One of the important problems with the AVGs is the post-procedural bleeding from needle holes.

In this article, the story of a patient undergone revision due to hemorrhage coming out of the artery through needle holes on the patch after his carotid endarterectomy operation was presented and based on his medical story future demands for the AVGs were explained hypothetically.

Case Presentation

A 59-year-old male patient in whom there was the partial loss of function in the unilateral upper and lower extremities due to previous cerebrovascular event in his medical history was admitted to our clinic in order to undergo carotid endarterectomy operation. Colored Doppler ultrasonography and angiographic evaluations revealed significant carotid stenosis bilaterally. The patient who was scheduled for left carotid endarterectomy at the first stage was transferred to the ward from the intensive care unit after his smooth operation. Two days later, an acute hematoma appeared at the incision site (Figure 1). This hematoma developed suddenly within minutes in the patient in whom every parameter related to him were normal just one hour ago. He was underwent an emergent revision. During the surgical exploration, it was observed that hematoma was related to bleeding coming out through needle holes (1) which was possibly the combined result of the incompatibility between antiaggregant and anticoagulant therapy (2) + a severe hypertensive attack (3) and excessive coughing (4) of the patient. Hemostasis was achieved by the combined surgical and medical applications. These 4 different factors are thought to potentiate each other. And, in

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Figure 1: Please note the mass of acute hematoma on the left side of the patient's neck. This hematoma developed suddenly within minutes in the patient in whom every parameter related to him were normal just one hour ago.

particular, the last three factors together are thought to force the needle holes to bleed.

Patient was discharged without any problem after his second operation. Three months later he was admitted for his right carotid endarterectomy.

Discussion

Previous reports have been presenting a risk of peri-operative bleeding varying from 1.2% to 4.3% after carotid endarterectomy operations [2]. Drug therapies and also hypertensive attacks have been shown to be responsible from these events [2]. As well-known, any hematoma at incision site after carotid operation can be highly mortal due to its pressure on trachea.

Previous articles reported different ratios for the prevalence of carotid stenosis varying from 0.5% to 12.7% in different populations [3].

Apart from the prevalence of carotid stenosis, the prevalence of peripheral arterial diseases has an important ratio which increases up to 33.8% in different patient groups according to various articles reported previously [4].

On the other hand, the group of aortic diseases is another group of the diseases which needs AVGs usage. According to literature, even only abdominal aortic aneurysms represent an important public health problem with prevalence between 1.3% and 12.5% [5]. This ratio will increase much more by adding the prevalence of the aneurysms of other parts of the aorta and occlusive aortic diseases.

As a result, AVGs are the sine qua nons of humanity. When we look at the financial dimension of these grafts, we see very striking figures. According to the "Market Research Report" about AVGs on the internet, the global vascular graft market size was valued at USD 1.95 billion in 2014 and is expected to witness healthy growth rate over the forecast period [6].

Consequently, we need AVGs and we have to improve them and must try to eliminate their problems. As humanity, we have to develop the closest AVG to the natural vessels.

As noted in this paper, a major problem with AVGs is the bleeding from the needle holes. This can be a reason for highly morbid or even mortal events. As seen in our patient, a hematoma in the neck after carotid endarterectomy might obliterate the trachea with pressure from the outside. In the event of this complication, sometimes, it might be possible that we may even become unable to intubate the patient. This failure can be fatal. Or, during or after the replacement of ascending aorta, any bleeding from suture zones on the graft might lead to pericardial tamponade and this event is highly fatal too. Or, any bleeding after the replacement of other parts of aorta can result in hemorrhagic shock and it can be life-threatening. Bleeding after the peripheral arterial reconstruction with AVGs may cause serious problems related to perfusion of the extremity even if it does not threaten the life of the patient. As a result, bleeding from the needle holes might have serious consequences for any surgery using AVG. Because of these reasons, the problem with needle holes has to be solved.

When checked the current technologies of AVGs which have being used in our daily practice, it can be seen that producer companies have been trying to prevent bleeding problem from needle holes. When compared to products to each other, although there are some better ones than others, it's obvious that this problem is still a big problem and couldn't be overcome for the present yet. So, this issue is open to work on it.

At this point, it would be useful to talk about some new and different types of grafts that could be the solution to this problem. The grafts mentioned below are products that are not already available in the market and are only hypothetical products/inventions of the author of this article.

Mnemotechny artificial vascular grafts

In this group, the graft is produced as a combination of many thin fibers. And the characteristic of each fiber is that it can be "taught". They should also have a "memory".

Thus, even if the needle of a suture pushes a fiber laterally when it passes through the graft, the fiber will try to interfere with this malposition and try to maintain its original position and flatness, which will reduce the diameter of the needle hole.

However, if this characteristic is applied to the whole part of the graft, it might result in a different problem. Because, not all of the arteries are in the same fold and route. So, AVGs must also have a structure that can accommodate any curved course. As a result, this Mnemotechny characteristic of the grafts should be applied in the special parts of the grafts like suture zones.

Another question is who will teach the Mnemotechny AVG? This can be done in two different ways:

a) Mnemotechny AVGs, taught by the producer during its production process. Or,

b) Mnemotechny AVGs, taught by the surgeon during its surgery just prior to its implantation.

The first choice will reduce the operation time but the better results will obtain with the second choice.

Another issue is how to re-activate the memory of Mnemotechny AVGs during the surgery, after its implantation. This can be achieved by applying some physical agents like heating or by chemical or cellular agents like the first contact of the whole blood of the patient. The AVG's memory can be re-activated as a result of communication with either whole blood or any other substance in the blood by means of the blood flow in the graft after implantation. This is

another important point: Because, the rich population group of blood materials will also provide us for looking for different types of fibers for Mnemotechny AVGs. Each of different blood material may react with the different type of fiber products. This gives us many options to discover the best fiber material which has the highest memory, the easiest learning and can be re-activated most accurately.

Sandwich artificial vascular grafts

Sandwich grafts are produced with two different layers at the suture zones.

There are special semi-liquid but never fluid materials between these two layers at the suture zones. This material should behave a semi-solid material, so shouldn't leave its original location. When the needle passed through the Sandwich AVGs, this original material will cover the needle holes. However, this material should not be fluid enough to drip through this hole into the lumen. Otherwise, this event will result in embolism.

As mentioned in the text previously, these graft types are not the products that we've been using them in our daily practice. These products are only the hypothetical inventions of the author of this manuscript. It's clear that this hypothetical article seems like an application form to the ethical committee for some researches on vascular grafts. Scientific knowledge and ideational outcomes in this article have been shared for the benefits of humankind. What the only request of the author of this manuscript is that the readers should cite this article kindly and respectfully after they completed their works and developed a new vascular graft under the light of this manuscript. It's believed that this manuscript will set new horizons in the minds of the researchers working on vascular grafts.

References

1. Oransky I. Michael E DeBakey. The Lancet. 2008;372(9638):530.
2. Illuminati G, Schneider F, Pizzardi G, Masci F, Calio' FG, Ricco JB. Dual antiplatelet therapy does not increase the risk of bleeding after carotid endarterectomy: Results of a prospective study. Ann Vasc Surg. 2017;40:39-43.
3. Woo SY, Joh JH, Han SA, Park HC. Prevalence and risk factors for atherosclerotic carotid stenosis and plaque: A population-based screening study. Medicine (Baltimore). 2017;96(4):e5999.
4. Aronow WS. Peripheral arterial disease of the lower extremities. Arch Med Sci. 2012;8(2):375-88.
5. Altobelli E, Rapacchietta L, Profeta VF, Fagnano R. Risk factors for abdominal aortic aneurysm in population-based studies: A systematic review and meta-analysis. Int J Environ Res Public Health. 2018;15(12). pii:E2805.
6. Vascular graft market size, share & trends analysis report by product (Hemodialysis access graft, endovascular stent graft, peripheral vascular), by application, by raw material, and segment forecasts, 2012 - 2022. Market Research Report.