THE SEROUS COAT OF BLOOD VESSELS COMPARED WITH THE PERITONEUM.*

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It seems to me that the most important part of our new surgical work with blood vessels in general, and much of the old work with aneurysm in particular, depends upon the similarity of the serous coat of blood vessels to the peritoneum. The serous coat of blood vessels, like the peritoneum, throws out plastic lymph promptly for purposes of repair. The surfaces when irritated and brought together have a tendency to adhere, and septic processes in the serous coats of blood vessels give rise to many of the changes which occur in the peritoneum under similar circumstances. If the serous walls of an artery are merely brought together by a ligature, occlusion occurs quite as promptly and more safely than if the ligature is tied so tightly as to cut one or more coats of the artery. Torsion of blood vessels also causes such quick plastic occlusion from the serous surfaces, that arteries of the third class even may frequently be treated in this way, instead of by ligature. The methods of treatment of aneurysm by digital pressure, by the introduction of coils of wire, or by the introduction of electric needles, in the same way lead to rapid exudation of plastic lymph from the serous coats, and this exudation results in causing adhesion of opposed surfaces, or the lymph coagulates from the serous surfaces proceed to engage the coagulates of the blood in the aneurysm in such a way as to cause rapid clot formation.

The new work in the suturing of blood vessels depends for its safety upon the prompt plastic repair of the serous coats. The new work in aneurysm brought forward by Matas gives us a striking object lesson bearing upon this kind of repair.

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At the same time, may we not take a warning from our experience with the peritoneum? When we first began to appreciate the promptness of repair which was carried on by the peritoneum, it was given an exaggerated value which led to mistakes. In the abdominal incision the peritoneum was sometimes drawn up between the muscular layers of the abdominal wall in such a way as to insure immediate closure of the opening; but with the danger of absorption of the products of plastic exudation in a short time, leaving the muscular and fibrous structures unrepaired, owing to the mechanical obstacle to repair which the surgeon had introduced. In our work with aneurysm, in which the construction of patent channels is contemplated, we must remember this lesson from our experience with the peritoneum. In our suturing of blood vessels generally we must remember that a weak point will be left at the site of the slightest depression of the serous coat, unless the other coats are treated in a way to fortify the weak point. There seems to be no doubt that Ziegler in his text-book on pathology was the first to liken the interior of a blood vessel to that of a serous cavity. The growth of the tunica intima after ligation he compared with the plastic inflammation of a serous membrane. Ballance and Edmunds in their "Ligation in Continuity" 1891, seem to have disputed for the first time the claim that endothelial surfaces unite with difficulty when brought in contact, and they made experiments which showed that most endothelial surfaces adhere with very little provocation. On the other hand, Meigs in his "Human Blood Vessels in Health and Disease" 1907, tends to upset what we are now building upon. He states that there is no endothelial layer which is commonly present in the human arterial system. Perhaps the presence of a fine endothelial layer, or its absence, has no necessary connection with the reparative processes carried on by the tunica intima. Practically, however, we seem to be dealing with an endothelial layer in blood vessels, which acts very much like the endothelial layer of the peritoneum. Delbet in 1906 quotes the experiment of Jensen in 1903, when a steril-

ized piece of catgut, traversing both walls and the lumen of the main carotid, was found after eighteen days to carry no trace of a clot, but that portion of the catgut which was free in the lumen of the artery was swollen at the ends and evidently covered with endothelium.

The idea that arteries can be sutured was first conceived by Lembert, about 1750, and Hallowell, under the direction of Lembert, closed a punctured wound of an artery by a winding suture, successfully. In 1772 Assmann made four experiments with winding sutures on the femoral arteries of dogs, and the animals, killed six weeks later, were found to have the arteries obliterated. There was no more vascular suturing done from that time until the development of asepsis, about 1882. Delbet impresses the point that in suture of blood vessels we must remember that everything excepting blood, in contact with the serous coats, is a foreign body, and that the endothelium resents intrusions. He states that the two conditions absolutely necessary for successful work are asepsis and integrity of endothelium. Thrombosis which forms at the site of suture is due to infection. In aseptic work, the ferment thrombi produced by leucocytes and coagulates are not formed. Small wounds in the endothelial coat, and foreign bodies, including toxins, may produce small coagula which tend to enlarge, then to contract, finally to obliterate the blood vessels. The endothelium has a strong tendency to proliferate, but a very little septic infection arrests this proliferation in blood vessels as it does in the peritoneum. The rapid multiplication of endothelium is probably able to arrest coagulation. Delbet in 1889 studied the influence of antiseptic solutions upon peritoneal endothelium and vascular endothelium, and found that the latter was more sensitive than the former. Proliferation was hindered to such an extent that antiseptic solutions were shown to actually prevent healing of arterial wounds. This observation is one of great importance for our consideration in the new work with the arteries. Petit and Jensen demonstrated the harmlessness of aseptic sutures. Etling has never seen any evidence of thrombosis or inflamma-

tion at the site of aseptic tears of the tunica intima, but he has seen proliferation of endothelium at the lower edges of wounds and necrosis at the upper edges, so that in spite of efforts at repair, slight depressions were left. Blood pressure acting upon such slight depressions would have a tendency to develop aneurysm, although Peyton in 1907 sums up the whole subject of aneurysm as a matter of the middle coat alone.

In conclusion, I wish to impress the point that in our new surgical work with blood vessels in general, and with aneurysm in particular, we are to consider the serous coat of blood vessels as acting like the peritoneum, in carrying on immediate repair. We must be even more careful about leaving depressions of the tunica intima without fortification, than we need be in leaving depressions of the peritoneum, for the reason that the blood current will take advantage of such depressions more quickly and more continuously than is done by intra-abdominal organs.

In a case which I reported previously in the ANNALS OF SURGERY, temporary cure of a very large popliteal aneurysm was obtained by transforming the sac into a canal similar to the original artery. Recurrence of aneurysm began later at the site of a small depression apparently, and continued to increase from that point, although the greater part of the sutured area remained strong. I mean to suture other large aneurysms,—even of the aorta, if such a case comes for treatment, but the little pit in the tunica intima is the one into which we are likely to fall, in this new sort of work.