HISTOLOGIC STUDIES OF THE INTERNAL MAMMARY ARTERY AFTER IMPLANTATION INTO THE MYOCARDIUM

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The internal mammary artery after implantation into the left ventricular myocardium of the dog develops new branches. These newly developed branches enter the myocardium and form a connection with the left coronary circulation. This fact has been proved by injection studies, serial sections, plastic casts, and physiologic evidence. When a large anastomosis exists between the implanted internal mammary artery and the left coronary circulation—it protects against death and infarction after sudden ligation of the anterior descending branch of the left coronary artery.

Chronic coronary artery insufficiency has been experimentally produced successfully treated by an internal mammary artery implant. In spite of the functional evidence of the value of an internal mammary artery implant, some doubts have been raised as to the size of the anastomosis and as to its duration. Glenn and associates suggested that the new branches were composed of granulation tissues, and like granulation tissue they tended to disappear at the end of six weeks. Shortly after the publication of Glenn paper we re-examined our serial sections in order to determine the duration and character of the internal mammary coronary anastomosis.

DURATION OF ANASTOMOSIS

The data shown in Table I indicate that there has been no tendency for anastomosis to disappear at the end of six weeks. Actually the average duration of anastomosis studied by us was eleven weeks. One of our animals was sacrificed at the end of fifty-eight weeks and a large functional anastomosis proved.

HISTOLOGIC STUDIES

In this paper re-examination of serial sections of coronary-mammary anastomoses in seven different animals is reported. The shortest time after implant was twelve weeks and the longest was fifty-eight weeks.

In two animals. Number 6 and Number 8, respectively, the original sections were restained by special techniques. The objective of the histologic studies was to determine whether or not the branches of the implanted internal mammary artery were simple granulation capillaries or had become vessels of a higher order.

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In order to study the nature of the wall of arterial branches, the following stains were used: (a) Masson trichrome (b) Hemalum, Phloxin, Saffron. Both stains (a) and (b) were combined with Weigert’s elastic stain. (c) Mallory’s phosphotungstic acid and hematoxylin. These stains all show smooth muscle, collagen, and elastic fibers with great specificity.

Newly formed arteries have certain definite histologic characteristics. These are most evident in the newly formed muscular and elastic coats. Using the usual hematoxylin-eosin stain, it may be very difficult to differentiate between smooth muscle, collagen fibers and elastic fibers. These structures however are clearly demonstrated by the above mentioned special stains. Thus, it has been possible to visualize and to assess the exact nature of the various structures which compose the wall of newly formed branches of the implanted internal mammary artery.

**OBSERVATIONS**

The serial sections prestained by hematoxylin-eosin of the implanted internal mammary artery were re-examined in seven different animals. The internal mammary artery in each case had branched. A large branch or branches

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Could be followed in the serial section into the ventricular myocardium away from the parent vessel. As we have mentioned the hematoxylin-eosin stains did not differentiate the various structures in the arterial walls. Because of this it was impossible to state with certainty that the structures which were seen leaving the internal mammary artery were similar to arterial branches. Deductive evidence based on functional studies and casts made of the anastomoses indicated that these branches were newly formed.
The serial sections of dogs Numbers 6 and 8 stained originally with hematoxylin-eosin were restained by the special aforementioned stains to show the characteristics of the vessels. A study of the sections showed that the branches of the implanted internal mammary arteries which had been followed in the hematoxylin-eosin stains were newly formed arterial ranches. The walls of these vessels contained a muscular coat composed of several muscle cell layers intermingled with elastic and collagen fibres. The lumen to wall-thickness ratio was about 6:1. This was found to be true in dog Number 8 after four months of implantation (Figs. 1 and 2) and dog Number 6 approximately thirteen months after implantation.

The internal mammary arteries examined were lying in the myocardium and seemed to excite very little reaction around them. The small amount of scar tissue present which surrounded the implant appeared to have reached full maturity and thus it would seem had reached its maximum of contraction.
Histologic studies of these sections make it seem improbable that the implanted internal mammary artery with its branches would occluded by contraction of the perivascular scar tissue. In this respect, the newly formed branches differ from those vessels that are formed in granulation tissues and tend to disappear with the lapse of a relatively short period of time. Moreover their structure is more highly organized than the vessels found in simple granulation tissue.

CONCLUSIONS

Our recent histologic studies confirm the previous physiologic and histologic studies made on internal mammary artery implants. ‘There is no doubt that the internal mammary artery branches after implantation into the ventricular myocardium. These branches develop into true arteries containing elastic tissue and muscular coats within their walls, and like the ramification of the coronary arteries can be traced until they disappear between the muscle fibers of the ventricular myocardium. Our findings do not support Glenn’s observation that these new branches of the implanted mammary artery are similar to the vessels of granulation tissue and tend to disappear at the end of six weeks.

REFERENCES

Fig. 2: (Dog Number 8.) A high power microscopic view of the branch shown at 7 o’clock in Fig. 1. This shows the structure of the wall of the new branch of the Internal mammary artery. Note the elastic tissue and double layer of muscle cells.

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REFERENCES


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