

unable to lift the patient over the threshold of appreciable immunity.

That the vaccines may have had some nonspecific value, comparable with that of the vaccine used at Camp Upton, cannot be denied. However, the burden of the proof rests with the originators of these vaccines, and their value should be weighed on the merits of the vaccines alone. Such a judicial decision is, at this time, of prime importance. We have not passed through the pandemic of influenza with its sequelae; we are passing through it. If the history of the last great pandemic²⁷ is to be of any value, it should teach us to be on the alert for the recrudescences that must occur throughout this year, as well as in the following three or four years.

It is a better policy to use one instrument, if one is thoroughly familiar with it, limited though its uses may be, than to use a wide variety of unfamiliar, complicated ones.

We feel that pneumococcus lipovaccine is such an instrument. We feel that we have definite assurance that it will prevent infection by Types I, II and III. Epidemiologic studies of localized epidemics, that would justify the addition of purely local types to the vaccine, are to be encouraged. The lipovaccine is such that much additional pneumococcus material may be added, without increasing its toxicity.

The advantages of such a vaccine—its lack of toxicity, its simplicity of administration, and the high degree of immunity conferred—should, during the remainder of this winter, and during the next several years, when we shall most probably be called on to combat recrudescences of the pandemic, with its attendant pneumonia, be a useful weapon. Not only should it have its place in the Army, but also it should be seriously considered by those physicians in charge of industrial ventures, such as mines, steel mills, ship yards and the like. Such a vaccine must come from a source that is unquestionable and one that is capable of massive production. Such a demand from civilian sources might be satisfied by the Army, if the necessary arrangements could be made, until the supply would be forthcoming from normal channels.

CONCLUSIONS

1. Prophylactic pneumococcus vaccination is successful over an extended period of time for those groups represented in the vaccine.

2. A pneumococcus lipovaccine, of slight toxicity, to be given at one injection, has been elaborated, and has had widespread use. Early reports indicate its usefulness.

27. Epidemic Influenza, Therapeutics, THE JOURNAL A. M. A., Oct. 5, 1918, p. 1136.

Maternal Nursing and the Sculptor's Model.—Rickets, a disease of nutrition, still too common with us, is but rarely seen in Italy, where it is the universal custom for mothers to suckle their infants, and whence accordingly come those shapely human forms that are chosen by our sculptors and artists for their models. Mothers unquestionably suffer in health and happiness from the suppression of a function which should form a pleasurable and wholesome episode in their existence, and it has been suggested that the prematurely aged and withered appearance of the married women in the manufacturing districts is in some degree attributable to the check imposed on the lacteal process in them by their employment, when that process has been once fully established.—Sir James Crichton-Browne, *Journal of State Medicine*, May, 1918.

AN EXPERIMENTAL STUDY OF THE SURGERY OF LARGE ARTERIES: ANEURYSM

THE PLACING OF MUSCULOFASCIAL INSERTS WITHIN
AND THEIR USE IN PATCHING ARTERIES

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It is well known that exposure of blood to extravascular tissue favors clotting. This fact is often used, especially in surgery of the brain, for the control of small bleeding points. However, the ability of normally circulating blood within the arteries to withstand the coagulum-producing influence of foreign tissue has not, to my knowledge, been given special study.

The object of this research was, therefore, to investigate the occurrence of clotting about an intravascularly placed piece of foreign tissue (muscle and fascia). The first conception was that such a condition would rapidly produce clotting, and if the tissue placed within the vessel were of appreciable size, thrombosis would likely occur.

The results of this research, however, have not upheld this first conception, and it has been found that relatively large musculofascial inserts may be placed within arteries (as the aorta of a dog) without producing serious obstruction to the blood current.

The breadth of application of this fact to the surgery of aneurysm or the repair of large blood vessels is evident:

1. The wiring of large aneurysms is inaccurate, and even when, by chance and experience, the wire coils properly, the results have been encouraging in only a few cases. Both the wiring operation and Halsted's rings placed proximally to the aneurysm are foreign bodies in the tissues, and comprise the disadvantages of such measures. The use of musculofascial inserts at the opening of aneurysmal sacs for closing the openings, or so placed as to limit the size of a sac or fusiform aneurysm, is a possibility and led to this research. Furthermore, instead of measures such as Halsted's rings about a large vessel proximal to the aneurysm, it was found that tissue inserts may be used to control the volume of blood passing through the vessel and hence to the aneurysm. The great variety of aneurysms was well appreciated, and the fact was well apparent that much work would be necessary for the application of the method to the different forms of sacs.

2. In the repair of injured vessels, direct intimal apposition has been thought necessary. In the light of this research a patch of fascia, muscle or both may be placed over an injured artery, covering a defect without producing thrombosis of the vessel.

3. In the replacement of segments of vessels, pieces of other vessels have always been used. In dogs, by maintaining a certain part of the circumference of a vessel the balance may be built up with fascia and functionates perfectly, and thus an intimal lining is formed. Its source is open to question and is a problem for further research.

4. In some cases a definite plug of muscle and fascia may be placed against a circumscribed opening in an artery.

The subjoined experimental protocols form a preliminary report:

PROTOCOLS OF EXPERIMENTS

The first series was begun, Nov. 10, 1917, at the Cleveland City Hospital.

EXPERIMENT 1.—A small fox terrier was anesthetized with ether, a midline abdominal incision was made, the intestine was pushed to the right, and the aorta exposed. A No. 2 chromic ligature was passed around it in two places, 1 inch apart between the origin of the renal arteries and the bifurcation, and its pulsations were controlled by traction. A fine dulox skin needle, with silk attached, was passed through the aorta, including the anterior third as a sector. Under traction on this suture, a fine pointed knife was entered beside it, making a slit 1 mm. long in the aorta. A strip of external oblique fascia attached to the thread was drawn through the aorta by means of these two openings. After the passage of the fascia, although the slits had been made, there was absolutely no bleeding. The fascia projected 0.5 cm. on each side. The abdomen was closed in three layers. The dog recovered rapidly from the anesthesia. There was a well marked femoral pulse of 200.

Necropsy.—Jan. 15, 1918, sixty-five days after operation, the dog was killed. When the aorta was slit open through the point of operation, there was no clot present. A piece of intima-colored tissue projected into the lumen 3 by 3 mm. thick.

EXPERIMENT 2.—A medium sized mongrel was anesthetized with ether, the aorta was exposed, and a piece of fascia and muscle 3 mm. wide was passed through it. A single suture was placed on each side of the vessel wall at the proximal end of the opening to control hemorrhage around the transplant. Closure was made in three layers. The femoral pulse after operation was 160.

Necropsy.—Feb. 10, 1918, sixty days after operation, when the aorta was slit open through the site of the insert, the same condition was found as in Experiment 1.

EXPERIMENT 3.—A medium sized mongrel was anesthetized with ether and the aorta exposed. The pulse was controlled by traction sutures. A fine bladed knife was passed through the aorta and a piece of tissue composed of external oblique fascia, muscle and peritoneum was passed through the aorta. The piece was three-fourths the size of the aorta. However, when passed through on tension it was probably not more than half the size of the aorta. Its ends were held together in front of the aorta by one stitch. It was noticed that very slight traction on this tissue in any direction except transversely readily produced hemorrhage around it, but immediately on ceasing to pull and allowing the tissue to contract, the hole in the aorta was plugged and bleeding stopped. Closure was made.

Necropsy.—Feb. 12, 1918, forty days after the operation, the condition was found to be the same as in the two preceding experiments. The amount of tissue present within the lumen was equal to one-fourth the lumen. No clot was present.

The foregoing series was interrupted by my receiving orders for military service. An opportunity did not present itself for continuance of the work until a change of station took me to Fort Des Moines Base Hospital as chief of the surgical service. During my six weeks at this post, the following experiments were completed:

EXPERIMENT 4.—July 30, 1918, a small fox terrier was anesthetized with ether, the aorta was exposed, and a piece of fascia and muscle two-thirds the size of the aorta was passed through it. Three stitches were necessary on the left side proximally to the insert, distally and at a midpoint. A good pulse was present with a thrill over and distal to the insert. July 31, a good femoral pulse was present. The dog was sick. August 1, it died.

Necropsy.—Two days after operation the cause of death was found to be general peritonitis, through some fault in technic. The aorta was slit open over the insert. A clot was present which might be called an icicle clot, since it suggested such a formation. Its base started from and surrounded the insert, from which it tapered slightly to its blunt tip 6 mm.

distally. Extending proximally was the same formation 7 mm. long. A pair of lumbar arteries 1 mm. in diameter opposite the clot was not thrombosed.

EXPERIMENT 5.—July 27, 1918, a large brindled bull was anesthetized with ether, the aorta was exposed, and a piece of muscle and fascia two-thirds the size of the aorta passed through its center. Bleeding occurred from the corners of the incision, but was entirely controlled by four stitches. A good aortic pulse with a thrill was present distal to the insert. July 28, the dog was in good condition; there was no weakness of the legs, and a good femoral pulse was present. July 31, a good femoral pulse was present. Under ether anesthesia the abdomen was opened and a good aortic pulse distal to and over the insert was verified.

This observation was made because it was thought possible that the femoral pulse might result from a collateral circulation more easily established in dogs than in man. The pulse, however, was present over and immediately distal to the insert. There was no collateral circulation present. In later experiments, when a thrombosis was intentionally caused, the dogs showed weakness of the hind legs for a variable time after operation.

Necropsy.—Four days after operation, the aorta was slit open through the site of the insert. An icicle-shaped clot was found extending 9 mm. from the insert distally. There was some irregular clot proximal to the insert, attached to it. A pair of small lumbar vessels branching opposite the middle of the distal clot was thrombosed.

EXPERIMENT 6.—Aug. 6, 1918, a large white mongrel was anesthetized with ether, the right carotid was exposed, and two pieces of tissue taken from the neck were passed through it transversely 2 cm. apart. The proximal insert consisted of muscle and cervical fascia 2 mm. in thickness. The distal insert consisted of cervical fascia with some fat attached, 2 mm. in diameter.

August 11, five days after the operation, the carotid was exposed under ether anesthesia; a full pulse was present over and distal to the inserts. The carotid was excised and slit open. The inserts were both present, 2 mm. wide, projecting into the lumen, reducing it by approximately one half. No clot was present.

EXPERIMENT 7.—Aug. 5, 1918, a female (the same animal as in Experiment 8) was anesthetized with ether, the aorta was exposed, and a piece of muscle fascia was passed through a slit 4 mm. long. No sutures were necessary. A good pulse was present below the insert with a marked thrill. From August 6 to 10 the animal was in good condition with a good femoral pulse.

August 11, six days after the operation, under ether the abdomen was opened, and a good pulse over and distal to the insert was verified. When the aorta was slit open, no clot was found. The large insert was present, of the same color as the intima. When it was placed through the aorta at operation, the sides of the vessel had apparently been drawn together and held there, so that only a small segment of insert presented itself to the blood stream, and the lumen of the vessel had been reduced by one third. Thus it is possible to reduce the caliber of an artery markedly by this method. If done proximally to an aneurysm it would greatly diminish the volume of blood passing into the sac as well as the speed of its passage through the sac. This would appear to be a good method for bringing about such a condition of circulation. Whether such a procedure is preferable to the direct attack on an aneurysm by transplants should be later worked out, for the same technic might be used in reducing the size of the sac or its opening. And here seems to be one of the lessons learned by this study: By passing musculofascial transplants, transversely, obliquely and longitudinally, one or all, through an aneurysmal sac, the latter's capacity can be lessened. This, together with the clot-producing power of such tissue when exposed to blood under other conditions favoring clotting, can be used to thrombose entirely an aneurysmal sac. From observations in some of these experiments it seems possible so to place these inserts in a sac that a proper current would be left for vessels branching from it.

EXPERIMENT 8.—Aug. 2, 1918, a small terrier was anesthetized with ether, the aorta was exposed, and a strip of

rectus muscle and fascia one-fourth the size of the aorta was passed through the midpoint transversely. No stitches were necessary. A good pulse with a thrill was present over and below the insert. Closure was done. August 3 to 10 there was a good femoral pulse.

August 11, nine days after operation, under ether, the abdomen was opened and a good pulse over and distal to the insert was verified. When the aorta was slit open, no clot was found. The insert measured 6 by 2 by 2 mm., and was the same color and appearance as the intima. It reduced the lumen of the aorta by fully two-thirds its volume.

EXPERIMENT 9.—July 17, 1918, a large female mongrel was anesthetized with ether, the aorta was exposed, a slit 0.5 cm. long was made longitudinally through both walls, and a piece of external rectus sheath and muscle equal to the diameter of the aorta was passed through. There was no bleeding around the insert. There was a pulse, distal to the insert, with a thrill. Closure was done. There was a good femoral pulse. July 18, the dog was active; a full femoral pulse was present. The condition continued the same till July 31 (fourteen days after operation). Under ether anesthesia the abdomen was opened. A good pulse was felt in the aorta immediately distal to the insert and at the site of the insert, where the vessel was felt thickened and a moderate mass of adhesions was present.

Necropsy.—The aorta was slit longitudinally through the insert, and the insert was accidentally cut. The insert was 6 mm. in diameter, the aorta, 1 cm. in diameter. No clot whatever was present.

EXPERIMENT 10.—July 16, 1918, a small fox terrier was anesthetized with ether, the aorta was exposed, the circulation was controlled as above, a slit 1 cm. long was made through both walls laterally, and a piece of anterior rectus muscle and fascia equal to the size of the aorta was passed through the aorta. Four stitches at the ends of the slits were necessary to control the bleeding. A faint pulse was felt distal to the insert. Closure was made. A very faint femoral pulse was present. From July 16 to July 24, no femoral pulse could be felt. July 25, a faint femoral pulse reappeared. July 25 to August 8, the femoral pulse increased to normal volume. August 8, the animal strangled herself on her tie rope; she had been very well and active.

Necropsy.—Twenty-three days after operation, a section of the aorta, including the iliacs, was excised. The aorta was slit open; no clot was present. The insert was found; it measured 3 by 3 mm.; it was firm, was closely adherent to the anterior wall of the aorta and had a gray, glistening appearance indistinguishable from the intima. It reduced the aortic lumen by two thirds.

EXPERIMENT 11.—July 7, 1918, the same animal as in experiment 4 was anesthetized with ether, the right carotid was exposed, and with a fine knife the anterior half of the vessel wall was excised for 1.5 cm. A piece of external rectus muscle and fascia 3 mm. thick was removed and sutured as a patch over the carotid defect with the muscle surface projecting into the lumen.

July 28, the wound was clean. August 11, twenty-four days after operation, under ether anesthesia, the carotid was reexposed and found to have a full pulse throughout its extent. A small sacculated aneurysm was present, with an opening 4 by 4 mm., a depth of 2 mm., and its cavity 5 mm. at the widest point, occupying the position of the musculofascial patch. The carotid was removed and slit open. There was no clot whatever present. The patch had held firmly but had bulged out to a depth of 2 mm. It contained no clot. The inference from this case is that such a patch, if applied in man, would give rise to an aneurysm. The fate of transplanted tissue is well known, and the resulting scar tissue in this case must be very firm and strong in order to withstand arterial pressure. It looks as though intra-arterial or intra-aneurysmal transplants would be of greater value in the treatment of aneurysm.

A complete report on the foregoing work, with photographs of the specimens and histologic examinations of the tissues will be made later. The exigencies of active military service render such studies difficult. The following conclusions seem fair, and I regret that

lack of time will not permit a discussion of the many points of value that have been observed.

SUMMARY AND CONCLUSIONS

1. Strips of rectus fascia with muscle attached of varying size up to three-fourths that of the aorta of dogs may be placed through a dog's aorta or carotid without causing permanent clot or thrombosis. In certain cases no clot at all is formed.

2. In over half the experiments, the contraction of the aortic walls about the inserts and of the inserts against the slits in the aorta entirely controlled hemorrhage. In the remaining cases, from one to four simple sutures controlled bleeding from the corners.

3. These inserts diminished the lumens of the aortas to approximately one-third to three-fourths their former volume.

4. Such inserts may be used to diminish the volume of a large artery, to diminish the orifice of a sacculated aneurysm, to favor thrombosis of the aneurysmal sac by being placed through it, or to limit the size of a fusiform aneurysm by being placed so as to exclude certain sectors from the current.

5. In no cases have symptoms of embolism been noted. The only pathologic observations to exclude such an occurrence were: (a) In two cases examined at necropsy within six days, no clot was formed at all. (b) In four cases examined at necropsy later than six days, no clot was present. (c) In all cases but one, when a clot was formed it took a uniform, blunt tipped icicle shape, was quite firm, and would not easily break off.

6. A patch of fascia or muscle may be sutured to an arterial defect with perfect functional results.

7. The sac of an aneurysm or the vessel proximal to it may be lessened in volume by such inserts.

8. An arterial patch of muscle and fascia in a dog is consistent with perfect function of the artery.

CHRONIC ARSENIC POISONING ON A FARM

REPORT OF A CASE

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History.—A woman, aged 22, seen by Dr. Samuel Ayres of Kansas City, Mo., to whom she was referred by her local physician in Summers, Ark., complained of sore mouth, indigestion, weakness and general tenderness. She had been married two and one-half years; she had had no children nor miscarriages. She had had mumps, measles, whooping cough and scarlet fever during childhood; there had been no operations. Previous to her present illness she had been entirely well. She had had a well-balanced diet. She lived on a farm and had no other occupation aside from her household duties. Prior to five years before she had been employed in a fruit drying factory for three years, where she said that she was exposed to sulphur vapor. She also spent a great deal of time spraying fruit orchards, and said that she ate fruit which had recently been sprayed. The spray, she thought, contained arsenic. This immediately preceded her present illness, which began five years before. On questioning, she was quite sure that she had not been exposed to arsenic during the past five years. She had moved away from the fruit orchard. There was no family history of tuberculosis. A year and a half before, the patient's brother, who was then 22 years old, was operated on for appendicitis, following several intermittent attacks of severe abdominal cramps. The operation gave no relief, and the attacks of cramps had per-