ON A NEW METHOD
OF PROCURING THE
CONSOLIDATION OF FIBRIN IN CERTAIN INCURABLE ANEURISMS.

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WITH THE
REPORT OF A CASE IN WHICH AN ANEURISM OF THE
ASCENDING AORTA WAS TREATED BY THE
INSERTION OF WIRE.

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IN the following joint paper the theory of the proposed operation is first described by Mr. Moore. Dr. Murchison furnishes the report of the entire case, with the medical comments upon it. For the concluding surgical remarks Mr. Moore is alone responsible.

I.

As the proposition of a new principle in surgery, and the extension of practice by means of it into a new region of disease, must necessarily undergo discussion, it would have

been advantageous that the principle to be enunciated in this paper should have been further tested before being made public. But the notoriety which the proceeding has obtained, and the inexact reports which have been circulated respecting it, induce me to bring the facts forward earlier than I should otherwise have done. Before the tribunal of the Royal Medical and Chirurgical Society, however, I have every confidence that the principle will be judged apart from the incidents of failure attending its first application. It will be convenient to throw my first remarks into a narrative form.

On the 20th of February, 1863, my colleague, Dr. Henry Thompson, requested my attendance on a case of aneurism of the thoracic aorta which was under his care in the Middlesex Hospital. Notwithstanding all medical treatment, the aneurism was increasing in size, and it had recently protruded on the right of the sternum, in the second intercostal space. In sending for me, Dr. Thompson desired to have the opinion of a Surgeon on the propriety of employing galvano-puncture in the treatment of the case. I stated that I feared that operation would shorten instead of prolonging the patient's life.

As this decision implied the abandonment without help of a disease which, if situated in an extremity, would be accessible to various means of cure, I reviewed carefully the circumstances of a thoracic aneurism, in the hope that there might be some special condition which, in the present state of our knowledge, would suggest a method of relief. To cure—that is, to close artificially—the cavity of an aortic aneurism might well be deemed impossible; yet the following considerations appeared to afford a reasonable ground for hope that benefit might even in such a case be conferred by surgical means.

It was plain, at the first thought, respecting the circumstances of an aortic aneurism, that no treatment could be applied to the artery. Our remedial measures are, consequently, limited to such as may effect changes within the aneurism itself.

For this purpose no treatment is of any value which does not provide for the separation and adhesion of fibrin. It may suffice for the cure of some aneurisms of the extremities to produce consolidation of the entire mass of the blood contained in them, but in those of the aorta any substance except adherent fibrin would certainly be broken up or displaced by the force of the currents. The *first* indispensable condition, therefore, for the cure of a thoracic aneurism is to provide means of eliciting fibrin from the blood.

Perhaps there are no aneurisms in which the deposition of this material is naturally more abundant than in those of the aorta. They are sometimes lined by strata of fibrin of very great thickness. But as the accumulation of it is not always thus abundant, and is too often partial, the wall of the aneurism is either not sufficiently or not equally and uniformly supported, and it yields at some weak spot to the violent impulse with which the blood bursts in from the close proximity of the heart. The power of collecting solid fibrin possessed by such aneurisms is inadequate to effect a cure of them. Some means must be supplied to them for increasing the quantity of adherent lymph where it is insufficient, and for procuring its deposition where it is wanting.

Now, ample as is the supply of fibrin in the blood, and its disposition to separate from the other constituents of that fluid, there is nothing in an aneurism on which it can settle except the wall ; but any quantity which may collect on it is almost invariably insufficient to resist the expansive force of the arterial current. In the centre of an aneurism there is, meanwhile, a space full of blood, with fibrin ready to consolidate upon any apt material. A *second* indispensable condition for relieving an aortic aneurism is, therefore, to extend the surface within it on which fibrin may coagulate.

On combining these two requisitions for the solidification of an aneurism which cannot be treated through the artery, I came to the conclusion that both might be met by one proceeding, namely, by inserting some foreign body into the cavity of the aneurism. The second condition, that of

exposing a broader surface to the blood, would, if attained, ensure the attainment of the first, or the separation and consolidation of fibrin; and from what is known of the manner in which that substance coagulates, it is clear that the rapidity of its deposition would be proportionate to the roughness of the new surface provided for its attachment.

I was familiar with the fact that fibrin will accumulate in large quantity upon a foreign body placed in a current of arterial blood, having already published some observations on the subject in Holmes's 'System of Surgery.' As they are pertinent, and, indeed, of much importance to the theory I am propounding, I venture to quote them from the essays on "Injuries of Arteries," and on "Atheroma," in the first and third volumes of that work.

"Mr. Laugier presented to the Anatomical Society of Paris, in 1849, the following remarkable case:—A healthy young man died with a needle in the left ventricle of his heart, and with gangrene of the left leg. The needle was found fixed in the apex of the ventricle, with its point directed towards the aortic orifice, and covered with 'decolorized, sanguineous concretions, very coherent and irregular,' which were prolonged into the aorta. The lower end of the aorta and the iliac arteries, on both sides, were filled with an adherent clot. It seemed plain that the plugging of the arteries, and the consequent gangrene, had their origin in the detachment of fragments of the lymph, which had first adhered to the needle."—Holmes's 'System of Surgery,' vol. iii, p. 333.

"No. 1565a, in the Hunterian Museum, is a specimen of the ascending aorta of a man, laid open, and disclosing, in its interior, a large jagged mass of skin and subcutaneous tissue, and a hemispherical socket of lymph, adherent like the skin to the interior of the aorta. Out of this socket a spherical bullet, also covered with lymph, has fallen to the bottom of the vessel. The piece of skin is in contact with the lining membrane of the ascending aorta, about an inch above the valves. The socket of lymph is fixed to the

artery immediately beyond the skin. The rest of the artery is healthy. The account of the case given by Mr. Brunton, Assistant-Surgeon on board the hospital ship in the Mediterranean, and communicated by Sir Stephen L. Hammick, is to the effect that a boat's crew, detached to cut out a vessel, met with determined resistance. Amongst the wounded was a seaman, who affirmed that a musket-ball, striking his oar, had run along it and entered his side. He lost a good deal of blood at the time, and then, almost completing the third day from the injury, died."—Holmes's 'System of Surgery,' vol. i, p. 669.

These facts occurred to my recollection in the course of the foregoing reflections, and they left no doubt on my mind that, if a suitable material for introduction into an aneurism could be found, the deposition of a large quantity of fibrin upon it might be ensured.

The foreign body which our present experience shows to be least irritating to the natural tissues is wire. Its innocuousness when employed for sutures is daily observed, and particularly in contrast with silk, which readily induces suppuration. Wire, moreover, appears adapted to the object in view, since it would present an extensive surface for the accumulation of fibrin in the central part of the aneurism, would be likely to attract the fibrin, as twigs do in the experiment of whipping freshly drawn blood, and would detain and support the fibrin when attracted. If a large quantity of wire could be introduced into the interior of an aneurism, and disposed about it in coils, a corresponding quantity of fibrin would soon accumulate and increase upon it. Progressively, a cure might result by the union of the central and mural lymph. The wire would remain in the aneurism, enveloped in clot, and be harmless.

For such treatment to be of service, the aneurism must be accessible from the surface of the body. It could hardly be employed in an aneurism of the abdominal aorta or of the thoracic beyond the arch.

Moreover, no artery should open from the aneurism; it should have but one aperture. Were the wire exposed in a

violent current of blood, fibrinous clots would certainly break off from it and plug distant arteries. An aneurism at the root of the neck would therefore require the previous performance of Brasdor's operation ; one of the aorta should be a sacculated, not a fusiform, one.

In this, indeed, in any case, the chief danger would consist, namely, that the fibrin, being at first fragmentary and loosely attached to the wire, might break off, or might regurgitate through the aperture in the artery and then break off. This danger must obviously be proportioned to the size of the spaces between the coils, and it would diminish with the quantity of wire used. The chief fault, if failure occurred from the manipulation, would doubtless be not introducing enough wire.

Another danger might arise from the projection of a coil or end of wire into the artery through the aneurismal opening, which would lead to the breakage of fibrinous strings and their propulsion along the stream. It would hence be important to ascertain the position of the aperture of communication with the artery, and to avoid it in introducing the wire, as well as to use wire which would not bend within the area of an artery.

Upon considering what might be expected to become of the wire, it appeared to me—1. That if completely coated with fibrin, it would be a pretty firm skeleton-like support for the soft lymph. In course of time it might with the lymph be hammered out against the wall of the aneurism, when it would form a firm sieve-like layer, lining the sac and materially strengthening the wall. 2. If iron were selected, and it should become partly uncovered, it might eventually be dissolved. 3. It might move with the blood, until a flexure of it intruded into the artery. This was likely to be avoided by using fine wire, which would be little stirred by either current, to or fro ; while, if it all became coated, the force of both currents would be lessened directly as the coating thickened. If bulky wire were used, though of silver, it would be difficult to tangle, and would resist the subsequent collapse of the sac after the consolidation of its

contents. The delicacy of the wire should bear some relation to that of the lymph it is to ensnare and to support.

The method of performing the operation.—Choose wire which is stiff enough to pass the canula without bending, but so fine as to bend easily when pressed against the wall within the aneurism. Provide a straight, short canula of thin silver, sharply pointed at one end, expanded at the other, and let its tube be somewhat larger than is sufficient to give ready passage to the wire. Let there be also a thicker wire, which fills the canula, and is flattened at the end. This is for use as a probe.

Puncture with the canula some part of the aneurism which shall not be opposite to the presumed situation of the aperture from the artery. Introduce the probe, and ascertain the position and size of the arterial opening, as well as the dimensions of the aneurism itself. This would determine the directions in which the fine wires should be introduced, and the quantity which the aneurism might be expected to hold. Push in the fine wire, directing its point against the opposite wall of the sac, and, whilst introducing more wire, divert the end of the canula. The wire must bend from its fixed extremity in a curve determined by the direction given to the canula. Continue to introduce wire and to move the canula, and coils of wire will be formed of any required shape, and in any part of the sac.

In withdrawing the canula the wire must not be suffered to remain in the puncture. If it did so, the issue would probably be fatal hæmorrhage. The last part of the wire must be pushed fairly into the aneurismal cavity with the flat end of the probe. The canula may then be withdrawn upon the probe, on the removal of which, last of all, the skin would slide back again over the tumour, and the puncture in the sac would not correspond with that of the skin. The puncture might be covered with collodion.

I put my proposal in writing the same evening, and the next day communicated it to my colleagues, Mr. De Morgan

and Dr. Henry Thompson. I had no opportunity, however, of putting it in practice in the case by which it was suggested, as the patient, on the 21st of February, quitted the hospital without leave.

No new example of the disease in a hopeless state presented itself to me until November, 1863, when I was requested by my colleague, Dr. Murchison, to see an advanced case of thoracic aneurism which was under his care in the Middlesex Hospital.

The proposed method of treatment being untried and incapable of correction and proof by experiments on the lower animals, I did not press for its adoption so long as the patient's life was likely to be prolonged without it. In January, 1864, however, changes in his state had occurred which appeared to justify the operation. These will be best understood by Dr. Murchison's report of the case.

II.—*Report of a Case of Saccular Aneurism of the Ascending Aorta projecting through the Anterior Wall of the Left Side of the Chest.* By CHARLES MURCHISON, M.D.

Daniel D—, æt. 27, became a patient at the Middlesex Hospital, under my care, on November 10th, 1863. Eight years before, he began to suffer from palpitations and dyspnoea, and after some months he had an attack of hæmoptysis. The hæmoptysis recurred at intervals, and in November, 1862, he first noticed a pulsating swelling in front of the chest, to the left of the sternum. This increased with considerable rapidity, and the patient now became subject to severe attacks of angina pectoris. At the time he first came under observation, the tumour was situated in the angle formed by the left clavicle and the left margin of the sternum; it measured ten inches in circumference at its base, and projected about two inches from the wall of the chest; its surface was rounded, and tolerably uniform, except at the upper part, where there was a tendency to point. Over the whole surface of the tumour dis-

tinct pulsation could be felt, each beat corresponding to the impulse of the heart. Nothing resembling an aneurismal bellows-murmur could be heard; but both cardiac sounds, and particularly the second, were louder over the tumour than at the base of the heart. There was dulness on percussion to the right of the tumour, over a space measuring two inches transversely and three inches from above downwards. The apex of the heart could be felt beating between the fifth and sixth ribs. The cardiac dulness was slightly increased, but the sounds heard on auscultation were normal. There was no inequality of the arterial pulse on the two sides of the body. The voice was normal. The patient had an occasional cough, and expectorated a viscid mucopurulent matter, but there was nothing peculiar in the character of the cough. Over the whole of the left side of the chest there was comparative dulness on percussion, with harsh, at some places tubular, breathing, and subcrepitant râle. On the right side of the chest the percussion was clear and the breathing puerile. The appetite and digestion were good, and the bowels regular. There was no dysphagia, and no pain or tenderness at any part of the spine. The pupils were of normal and equal size. On November 20th, and again on December 28th, the urine was ascertained to be free from albumen.

After the patient was admitted into the hospital, on the 20th of November, the attacks of angina almost entirely ceased. The pulse varied from 104 to 116 when the patient sat up, but would fall to below 100 when he lay down. The size of the tumour continued to increase, until, on the morning of January 7th, 1864, it measured sixteen inches and three quarters at its base, and projected two inches and two thirds from the wall of the chest. The tendency to point at its upper part became more decided, and the integuments at this part were much attenuated, and assumed a dusky red discoloration, while occasionally they were the seat of pricking pains, and were slightly tender. These changes were most marked during the last week of December and the first week of January. The patient's

general health, notwithstanding, did not suffer. He ate and drank well; he got up daily, and walked about the ward. On the evening of January 6th he played a game of draughts with another patient, and on the following morning he was up and walking about as usual.

Early in January it became obvious that the bursting of the aneurism through the integuments could not be long delayed. It was accordingly resolved to recommend to the patient Mr. Moore's proposed operation. During the month of December this operation had been carefully considered, but it was then deemed inadvisable to have recourse to it. It was now explained to the patient that the procedure in question offered some chance of prolonging his life, although in itself it was not free from danger. The patient at once assented, and the operation was performed on January 7th, at half-past 1 p.m.

The operation consisted in the introduction of a quantity of fine iron wire into the aneurism, with the object of inducing coagulation. A small pointed canula was inserted into the tumour, and the wire was passed in through this without difficulty. The operation occupied one hour, and the quantity of wire introduced was twenty-six yards. It gave rise to no pain or inconvenience excepting a slight and transient feeling of faintness. The quantity of blood lost did not exceed half a fluid ounce.

The immediate effects of the operation were a reduction of the pulse from 116 to 92, an almost complete cessation of the pulsation in the tumour, and a diminution in its size. Immediately before the operation the circumference of its base was sixteen inches and three quarters; at the close of the operation it was sixteen inches. These changes began to be noticed soon after the commencement of the operation, and became more marked as it was proceeded with. At a quarter past 11 p.m. the patient was asleep, and his pulse was only 78. He slept comfortably during the night, and had no bad symptom until the following morning.

On January 8th, at 9 a.m., the patient was seized with

a fit of rigors lasting three quarters of an hour, and followed by great pain in the back of the neck, and some pain in the tumour. At 1 p.m. the pulse had risen to 144, and was full and bounding. The action of the heart was tumultuous, and all the arteries of the body could be felt throbbing with considerable force, but there was no difference in the force or volume of the beat on the two sides of the body. The patient complained of great pain in the tumour when he moved. The tumour was already somewhat larger than before the operation, and the dusky discoloration was of a deeper tint. There was intense thirst and great restlessness, the skin was dry and very hot, and the respirations were 40. At twenty minutes past 1 p.m. the patient was bled to the extent of eighteen ounces, and at half-past 3 p.m. twelve ounces more blood were abstracted. After the second bleeding twenty minims of Battley's sedative solution were administered.

From these measures the patient derived temporary relief, but he had a restless night, and at 6.30 a.m. the following morning (January 9th) he had a second attack of rigors. At 1 p.m. he had a third attack. At 1.30 p.m. he was in great distress, owing to pain referred to the tumour and to the back of the neck. The tumour was extremely tense, and decidedly tender, particularly at its upper part. Its circumference at the base measured an inch and three quarters more than before the operation. Distinct pulsation could be felt again at its upper part. The pulse was 136, and soft; the action of the heart was less tumultuous, and there was no abnormal cardiac sound. Large and repeated doses of opium and digitalis were now commenced. At 10.30 p.m. the pulse had fallen to 126, but the patient complained of being afraid to cough, on account of a severe jerking pain in the tumour, which the effort to cough always induced.

On January 10th, at 10 a.m., the patient had taken seventy three minims of tincture of digitalis, and the equivalent of almost ten grains of opium, during the preceding twenty-one hours, and the result was that he was in

less pain, the pulse had fallen to 104, and the tumour was slightly reduced in size, its circumference being half an inch less than on the preceding day. At 7.30 p.m., however, he was seized with a severe burning pain in the tumour, and a feeling of tightness, as if it were going to burst. The tumour was larger and more tense than ever; the pulse rose to 132; the heart's action was again more impulsive, and there was intense thirst. To-day it was noted for the first time that the pulses in the right temporal and radial arteries were slightly fuller than in the corresponding vessels on the left side.

Opium in large and repeated doses, along with digitalis, was persisted with. In the course of two days and a half (commencing on January 9th) as much as the equivalent of twenty-seven grains of opium was administered. The treatment, however, failed to give relief. The tumour increased rapidly in size, and on the 11th distinct pulsation could be felt at several parts of its surface. The radial pulse was 128, small and compressible, and still fuller on the right side. The beat of the right anterior tibial artery was also decidedly fuller and stronger than that of the left. The cardiac impulse was extremely feeble. The respirations were performed chiefly by the diaphragm and the muscles on the right side of the chest; the left side of the chest was almost motionless. The whole of the left side of the chest in front, unoccupied by the tumour, was dull on percussion, and no respiratory sound could be heard on this side, except immediately below the clavicle. Brandy and other stimulants were now given, but without any decided result.

On the morning of the 12th the patient was evidently sinking. The pulse was about 136, but was so weak as to be counted with difficulty. The circumference of the tumour at its base was now three inches and a half more than before the operation, and the urine passed during the night was found to be loaded with albumen. At 11 a.m., four days and twenty hours and a half after the operation, the man died.

An autopsy was performed a few hours after death. The walls of the external tumour were formed by the integuments and fibres of the pectoral muscle, infiltrated with serum. They were nowhere less than a quarter of an inch in thickness. The skin covering a great part of the tumour presented a deep livid hue. The interior of the tumour was filled, for the most part, with a fibrinous coagulum, enveloping and imbedded in the coils of wire, and firmly adherent to the surrounding walls. The rest of the cavity contained fluid black blood. The interior of the outer tumour was nowhere lined with a prolongation of the arterial coats, but it communicated with the proper aneurismal sac within the chest by two large openings in the first and second left intercostal spaces, the intervening rib being bare and eroded, and at one place broken through. The aneurismal tumour within the chest was about the size of a man's fist. It lay immediately behind the sternum; it encroached slightly upon the upper lobe of the left lung, and inferiorly it rested upon the right auricle. It was partially filled with a fibrinous coagulum, which was continuous with that in the outer tumour, and was adherent at one part over a space measuring about one third of an inch in diameter. None of the coils of wire had entered the inner sac. The inner surface of the sac was rough from the presence of firmly adherent patches of fibrinous deposit. The sac communicated by a circular opening, scarcely so large as a sixpence, with the ascending aorta. Through this opening a clot projected from the aneurism into the vessel, and extended upwards into the arch. The greater part of this clot was evidently of a post-mortem date; but part of it, close to the opening, was pale, firm, and laminated. There was considerable atheroma of the coats of the thoracic aorta. The pericardium contained about eight ounces of turbid serum, and its opposed surfaces were coated with a thin layer of recent lymph. The upper part of the parietal pericardium presented a patch of livid discoloration, about the size of a florin; and at the centre of this patch the cavity of the pericardium was merely separated

from that of the aneurism by a delicate membrane. It was at this part of the aneurism that the coagulum was adherent. The heart was slightly hypertrophied. Its valves and muscular tissue, and likewise the coronary arteries, were healthy. The left lung was everywhere firmly adherent, and its pleura much thickened. On section, numerous cavities were observed, evidently resulting from dilatations of the bronchial tubes. In the intervening spaces a firm fibrous tissue took the place of the normal vesicular structure. The right lung was for the most part healthy. Both kidneys contained a number of circumscribed abscesses, varying in size up to that of a small pea, and containing characteristic pus corpuscles. A cluster of six of these small abscesses was found at the apex of the left kidney. Each abscess was surrounded by a zone of vascular injection. In the cortical substance of both kidneys a number of patches of yellowish deposit, of a larger size, but less defined outline, were also observed. On microscopical examination, this appearance appeared to be due to the presence of a granular exudation deposited between the uriniferous tubes. The liver was large and fatty. The other parts of the body could not be examined.

III.—*Surgical Remarks.* By C. H. MOORE.

I purpose limiting my remarks on this case to the operation, with its results, and to a review of the theory on which it was founded.

The operation was attended with no difficulty, and, excepting the prick of the canula, with no pain. The contact of the wire with the interior of the sac at first occasioned neither soreness nor inconvenience, no sensation even being produced by it but that of the creaking of the coils against one another. The wire passed in easily, meeting no obstacle to its introduction until many coils had accumulated, and, large as was the quantity inserted, none of it was pushed through the opening in the wall of the chest.

This last fact entirely removes the fear of one of the dangers for which I had prepared, namely, the entrance of a coil into the canal of the artery. No opening from an artery into an aneurism is likely to be so wide as that which connected these two sacs. The other principal danger which had appeared likely to be incurred was, perhaps, not entirely escaped, since some minute fragments of the fibrin may have been detached from the main clot, and propelled along the current of the arteries. To such impacted fragments the recent changes in the kidneys may have been due, but there was no other distinct sign of their existence in any part of the body, and in the incomplete examination of it which was made none were detected with the naked eye. Further, the minute puncture in the aneurism healed with little difficulty, although the canula had remained and had been moved freely in it for the period of an hour. The hæmorrhage was slight.

The immediate result of the operation, and the early progress of the case after it, afforded a confirmation of the theory which was even more satisfactory than had been looked for. The external aneurism, when first probed, gave the impression of containing a small quantity of very loose clot near its surface, and this clot probably prevented the issue of a jet of arterial blood through the canula, but it was so loose as not perceptibly to obstruct the entrance of the flexible wire, and it certainly in no degree interfered with the pulsation of the aneurism. At the end of an hour, however, notable changes had taken place; the aneurism had ceased to beat, it had lessened in size, and the pulse, which had ranged at about 112 for weeks, and which reached 120 before the operation, subsided to 92 and at night to 78. It could hardly be doubted that a large mass of fibrin had been already entangled amongst the coils of wire, whilst the rapidity and completeness with which the action of the heart was subdued, appeared in striking contrast with the previous failure of medicines to reduce the pulse. It showed, moreover, that the effect of the introduction of the wire was in the first instance not inju-

rious, but tended towards health and cure. It is important to dwell on these facts, because their value, though in no degree altered, may be obscured by the course which the case eventually took.

The influence of the operation upon the life of the patient was twofold. During the few days, and especially for twenty-four hours, preceding the operation, very rapid changes were occurring in the external tumour. The changes were such as indicated the approaching rupture of the aneurism, and these the operation arrested; but while it averted imminent death in one way, in another it appeared to provoke a painful inflammation, which proved fatal by involving vital parts.

The manner in which the operation actually determined the fatal result is far from being clear. In circumstances so unprecedented it is difficult to discern what was the actual sequence of the morbid events from the morning after the operation until the patient's death; but the early outbreak of the symptoms, and their distinct connection with the chest, associate their origin with the external tumour and its new contents.

Whether the first inflammation was induced by the presence of the wire, or, independently of the wire, by the accumulation through mechanical means of so large a mass of fibrin, is a question of no less interest than obscurity. Before the occurrence of this case we possessed no facts demonstrating the effects of a rapid and copious deposition of fibrin from the blood without previous inflammation. It now appears probable that inflammation will arise as an early local consequence of it, and a constitutional effect be also produced which is manifested in acute febrile symptoms of proportionate severity. While closely watching the progress of an aneurism, I have observed it become red, hot, and tender, without sufficient variation of the circulation of the limb to account for the change, and have conjectured that the symptoms arose from the recent addition of a layer of fibrin on the wall. If this explanation should prove to be correct, there was enough in the unlooked-for abundance of the fibrinous mass in this

aneurism to account for the local inflammation, as well as for the constitutional excitement.

Two principal pathological changes followed this first inflammation, viz., acute inflammation of the pericardium, and of portions of the kidneys. Neither of these changes appears to be clearly traceable to its cause. The pericardium was not continuous with the inflamed external tumour, and the inner aneurism, with which it was in the closest contact, which had indeed almost burst into it, was uninfamed. Both pleuræ also were free from inflammation. The coronary arteries contained no fibrinous impacted plugs.

The state of the kidneys may be ascribed to the introduction of fragments of fibrin into them from the aneurism with the arterial current, and I am not prepared to deny that this may have taken place. The certainty of the occurrence, to any large extent, would render the operation improper. But it appears to me premature to conclude either that it did occur to a fatal extent, or that it positively did happen at all. It is to be observed that similar isolated inflammations had taken place in these kidneys many times before without a fatal result; that such appearances are not usual in kidneys to which detached fragments have been distributed from diseased mitral valves; and that they are equally intelligible as a result of the activity required of renal organs, already so scarred and obstructed, upon the occurrence of a severe inflammation in a distant part.

However the extra-thoracic inflammation may have originated, whether in the tissues about the fibrin or with the fibrin itself, both it and the general symptoms must equally be ascribed to the operation. Not so, however, the pericarditis. That appears to have been an indirect result of the operation, a mechanical consequence of a febrile excitement of the circulation. It was, as such, not an inevitable or an essential result of the operation, and it proved fatal only because of the incidental connection of that aneurism with the pericardium. The theory, nevertheless, was still proved

to be erroneous, in so far as it included the presumption that a foreign body of the quality and size which was inserted into this aneurism would be harmless. By it or by the clots containing it inflammation was set up. But that inflammation was limited to the immediate vicinity of the foreign body; it was in itself not mortal, and it afforded no proof that in an uncomplicated case a patient might not recover with benefit from the operation.

It remains to inquire what encouragement to repeat the operation is furnished by the case which has been related, and with what modifications, if any, it may be practised in future.

If our judgment on these questions must be decided by the fatal issue of this single case (notwithstanding or because of the performance of the operation), or by the painfulness of the mode of death—and still more if in the original idea of the operation we can fix upon some condition of inevitable failure—the attempt is needless to improve the method which I adopted in the endeavour to save this man's life. But if there be no manifest and essential fault in the proceeding, I cannot think it right to abandon an operation, which was so promptly followed by the most marked and positive improvement. On the contrary, I regard its early results as strikingly confirming the main part of the theory, and as affording for other cases a substantial promise of advantage, from which future thought has but to eliminate the cause of ill success. The very condition which it is our chief desire in the management of an aneurism to obtain was here obtained, since within an hour a large quantity of fibrin had accumulated.

Two other circumstances in the present case confirm my hope of eventual success. Of these one is the firm adhesion which was found to have taken place between the fibrin enclosing the wire and the wall of the aneurism. The adhesion was inseparable without dissection, and the mass of wire and fibrin together was only removed by tearing through the latter. Some future observation may disclose the period at which this adhesion may have taken place. If it

should be found to occur soon after the introduction of the foreign body, the fact will enable us to dispense with the permanent support of the wire. The present case, however, leaves that question undetermined, as the clot was found thus adherent in an inflamed sac, and on the fifth day from the operation.

The last valuable fact is the exemption of the intra-thoracic part of the aneurism from inflammation; or, if it were really inflamed, the far slighter severity of the process in it than that exhibited by the outer sac. The latter was lined by no smooth membrane, and the rough tissues around it were found full of a copious inflammatory effusion of serous lymph. The inner aneurism, on the contrary, had a distinct sac, and the smooth structures composing it presented no cognisable traces of recent inflammation. These differences were unmistakeable, and they justify the hope that a smoothly lined aneurism would resent the introduction of a foreign body much less than that which was filled with wire in the present case, or that it might even not be irritated at all.

By these foregoing considerations the prospect of benefit from a repetition of the operation is both pointed out and restricted. Fibrin, it seems, in any quantity, can be attracted by a foreign body inserted into an aneurism, but the result of its accumulation will be inflammation. This result may possibly follow, whether the foreign body which elicits the fibrin from the blood be left within the aneurism or withdrawn from it. In any future operation the object must therefore be to diminish the severity of that process. What inflammation attends the natural deposition of fibrinous strata in an aneurism is always moderate, never dangerous to life, whilst that in the present case was of needless severity. The deposition of fibrin, like many of the great changes effected by disease, is tolerated if not brought about tumultuously; and its deposition by artificial means would also be tolerated if procured in a manner more resembling the natural method, whether

in successive portions or in a smaller quantity on one occasion.

Three modifications of the operation occur to me. Either the quantity of wire employed should be less, or it should be inserted for a certain time and withdrawn again. For the latter purpose it would be desirable to use slender needles, with round, not lancet-shaped, points, instead of the wire and canula. They might be thrust into or across the cavity of the aneurism, the adjoining needles being inserted from opposite sides alternately. They would require to be removed with great gentleness, and all together. It might be hoped that in two or four hours a considerable quantity of fibrin might have collected on the needles, which would on their withdrawal be left in the aneurism. I do not feel competent to speak positively on the consequences of such a proceeding. It might prove more safe than that which I adopted, and may consequently supersede it. In that hope I suggest it, although at the same time I cannot but think it hazardous to presume upon the possibility of the fibrin acquiring in two or four hours a firm adhesion to the aneurismal wall, and hardly less hazardous to make so many punctures as might be needed, were all made at once; while if only a few needles be inserted at a time there would be grave reason to fear the detachment and escape of fragments of the fibrin so soon as the support of the needles was withdrawn.

The second suggestion, which also is drawn from the rapidity with which fibrin appears to have collected in the aneurism, is that it may be possible to effect an equal consolidation with a less quantity of wire. The filling of the cavity with fibrin would take a longer time if the surface exposed for it were less, but the wire would remain to support the soft substance, which would thus be the less liable to break off. Should this method be adopted, it would be important so to manipulate the wire as to ensure its coiling in the cavity, and not merely lying in circles against the wall.

By a third modification of the operation a smaller quan-

tity of wire might be introduced and left in the aneurism; and at the same time, or on successive occasions, needles might be passed in various directions among the coils of wire. After having served to increase the fibrin adhering to the wire, the needles might be withdrawn again.

It must be determined by future experience whether the amount of irritation following the operation would be materially less if, instead of iron, a wire of steel, silver, or gold, were employed.

Postscript, by Mr. MOORE, August, 1864.—Since this paper was read, I have become aware that, when making experiments on the possibility of obliterating arteries by transfixing them with needles from the surface of the body, it occurred separately to M. Velpeau and to Mr. Benjamin Phillips, that aneurisms might be treated in a similar manner. M. Velpeau's publication on the subject is in the '*Mémoires de l'Académie des Sciences*,' for December, 1830; Mr. Phillips's, in the '*Medical Gazette*,' 1831, p. 499, and in a pamphlet, entitled '*A Series of Experiments for the purpose of Showing that Arteries may be Obliterated without Ligature, Compression, or the Knife*,' 1832. Although their suggestion was not founded on the principles set forth in the first portion of this paper, and their operation consequently differed from that which I adopted, yet there is sufficient connection between their thoughts and my own on the subject to make it just to refer to their writings upon it.