A C A S E
OF
MULTIPLE EMBOLISM OF THE ARTERIES
OF THE EXTREMITIES

FOLLOWED BY THE
FORMATION OF ANEURISMS.

WITH REMARKS ON THE RELATIONS OF EMBOLISM
TO ANEURISM.

BY

JOHN LANGTON, F.R.C.S.,
SURGEON TO, AND LECTURER ON ANATOMY AT, ST. BARTHOLOMEW'S HOSPITAL;
SURGEON TO THE CITY OF LONDON TRUSS SOCIETY;

AND

ANTHONY A. BOWLBY, F.R.C.S.,
SURGICAL REGISTRAR AND DEMONSTRATOR OF SURGICAL PATHOLOGY AT
ST. BARTHOLOMEW'S HOSPITAL; SURGEON TO THE ALEXANDRA
HOSPITAL FOR HIP DISEASE; SENIOR ASSISTANT SURGEON
TO THE METROPOLITAN FREE HOSPITAL.

Received May 7th—Read November 23rd, 1886.

ALICE D—, æt. 20, was admitted into St. Bartholomew's Hospital on Nov. 2nd, 1885, with a pulsating tumour in the bend of her right elbow, and another in the right popliteal space.

The patient is a domestic servant, and she states that four weeks ago, whilst at her work, she felt an aching and stiffness in the right knee, which she attributed to rheumatism. A week afterwards she complained in a similar manner of her right elbow. She was then seen by a medical man, who ordered her to apply some iodine to the elbow. On November 2nd she attended the sur-

gical casualty department of St. Bartholomew's Hospital and was immediately admitted.

On inquiry into her history, she stated that she has had a winter cough for several years, and has lately suffered from shortness of breath on the slightest exertion. There is no history of syphilis, rheumatism, or chorea. Her family history is good.

She is poorly nourished, has a troublesome cough, and expectorates some viscid frothy mucus. The cardiac area is increased, and there is a double aortic murmur, with a doubtful presystolic murmur at the apex. Resonance over the lungs is good, but there is much rhonchus and sibilus everywhere. Abdomen natural. Situated immediately above the bend of the right elbow is a swelling of the size of a Tangerine orange. The skin over it is rather cedematous and discoloured as if from bruising. The superficial veins are slightly fuller than natural. The swelling is tender to the touch, easily compressible, so that it can be much reduced in size by steady pressure. If after this partial emptying of the tumour pressure be made upon the brachial artery above, it remains collapsed, but fills up quickly again when the pressure is released. It pulsates synchronously with the heart, and the pulsation is distensile in all directions. A distinct thrill can be felt and a loud bruit heard over the swelling. Passing over the aneurism for nearly two thirds of its length can be felt the pulsation of a large vessel, which is deemed to be the brachial artery. This gradually lessens and becomes lost towards the distal end of the aneurism. The pulse at the right wrist can scarcely be recognised. No venous distension or cedema below the swelling. The circumference of the arm over the broadest part of the aneurism is nine and a half inches. The finger-ends of both hands are remarkably clubbed.

In the right popliteal space there is a swelling of the size of a large orange, presenting the same characters as the one in the arm. It is most prominent on the outer side of the ham and behind the head of the fibula. It

extends also to the inner side of the calf to about four inches below the knee-joint. No pulse can be felt in the tibials of the right side or in the femoral artery of the left side, although it can be easily felt in the left tibial vessels. A small patch of extravasated blood is noticed in front of the right outer ankle. Circumference of the limb over the most prominent part of the aneurism is $13\frac{1}{2}$ inches. There is no sign of any similar tumours elsewhere.

The patient was put upon a liberal non-stimulating diet, and confined to her bed.

On the first night after her admission into the hospital her temperature rose to $103\cdot4^{\circ}$, but it fell next morning to normal.

Three days afterwards she was seen in consultation, when Mr. Langton stated that he believed the aneurisms to be embolic in their origin, and the result of secondary changes taking place in the arterial walls from the presence of the emboli. He proposed gentle compression of the main vessels above the aneurisms, but not upon the sacs themselves, as they gave the impression of being thin walled, and probably not consisting of the coats of the vessels. Moreover, long delay was not advised, unless manifest improvement resulted, before proceeding to ligature the arteries. In this opinion, both of the nature and the treatment of the aneurisms, he was substantially supported by his colleagues.

November 6th.—Pressure was applied to the brachial and the femoral arteries by pads and bandages, the latter being gently continued over the aneurisms. The following day it was observed that the pad failed to control the pulsation of the popliteal swelling, so a tourniquet was applied very gently. Towards the evening the patient complained of much burning pain in the foot.

9th.—Has a good deal of pain in the arm, but slept well after a morphia draught. Measurement of the popliteal aneurism a quarter of an inch smaller, of the elbow tumour a quarter of an inch larger.

12th.—Since the application of pressure, the elbow tumour has diminished to its size on admission, and is manifestly firmer. Altogether the patient is much relieved.

14th.—No pulsation can be detected in the aneurism at the bend of the elbow. On examining the front of the right knee pulsation is detected in the arteries, which are much enlarged, and with the stethoscope a bruit can be heard. There is also slight pulsation in both tibial arteries of the same side. Circumference of the popliteal tumour is $11\frac{1}{2}$ inches, and of the elbow, $9\frac{1}{2}$ inches.

17th.—The elbow tumour yesterday suddenly enlarged to $10\frac{1}{2}$ inches, and this morning measures $11\frac{1}{2}$ inches.

19th.—The patient had last night a sudden remission of pain in the elbow, and to-day there is a brownish discolouration of the skin over the tumour, due probably to blood leaking through the walls of the aneurism. Ligation of the brachial artery was determined upon, and was performed a short distance above the aneurism, by tying the vessel with carbolised catgut ligatures in two places and dividing the artery between them. All pulsation ceased, and the edges of the wound were brought together by carbolised catgut sutures, the operation being performed antiseptically throughout.

21st.—The patient has been much more comfortable generally and locally since the operation; sleeping and eating well. The arm was dressed, all the sutures were removed as the wound had united throughout its entire length. The measurement of the popliteal aneurism remains as before.

27th.—The popliteal tumour having increased during the night with the same discoloration over it as was noticed in the elbow, the superficial femoral artery was tied at the apex of Scarpa's triangle in the same manner as the brachial a few days before.

December 1st.—She is able for the first time since admission to bend her right elbow. To-day the crural wound was dressed and had united except at the upper

part. No pulsation can be detected in either of the aneurisms although they both remain of the same size.

7th.—The wound over the ligatured femoral artery has re-opened, and was dressed with a stimulating lotion, as the granulations were pale and flabby. Circumference of the popliteal aneurism $10\frac{1}{4}$ inches, of elbow, $9\frac{1}{2}$ inches.

11th.—Last night about seven o'clock the patient became suddenly faint and pulseless. Half an ounce of brandy was administered, and on her rallying it was observed that her mouth was drawn to the right side. When seen early in the morning she was quite conscious, but complained of great pain in the back of her head. She had lost all power of the left half of her body, although she could raise her right leg. She had no reflex action of her left leg. There was conjugate deviation to the right side; mouth much drawn to the right, and on protruding her tongue it inclined to the left side. She perspired profusely over her forehead, more upon the left than upon the right side. No pulsation could be detected in the right common femoral artery. Both aneurisms were smaller and softer.

12th.—Passes urine involuntarily. Several gangrenous spots were noticed to-day for the first time on the dorsum of the right foot and on the leg, and over the patella. A few bullæ have appeared on the plantar surface of the three inner toes of the left foot.

18th.—The whole of the foot and the greater part of the leg on the right side are involved in the gangrenous process, and numerous bullæ have formed in different parts of the limb. At times the patient is delirious. She sank and died on December 28th.

Post-mortem examination.—The body was much emaciated. *Thorax, lungs, and pleura* normal. *Pericardium* normal.

Heart: Weight $15\frac{1}{2}$ ounces; left side much hypertrophied. Muscular substance natural. Tricuspid and pulmonary valves natural. Mitral valve natural. The aortic valves were hidden in a mass of recent clot, which

adhered loosely to numerous vegetations. On washing off this clot it was found that one of the cusps was almost completely ulcerated away. The two other cusps were covered by numerous vegetations, some of which had undergone calcareous degeneration, and formed large, pendulous growths, loosely attached to the valves by slender pedicles, and swaying to and fro when subjected to a gentle stream of water. The aortic valves themselves were softened and lacerable. They had evidently been the seat of recent inflammation.

Immediately beyond the valves the *aorta* was dilated into three pouches or aneurisms corresponding to the sinuses of Valsalva. The largest of these was behind the left posterior segment, and bulged so as to come into close proximity to the left auricular appendage. It was as large as half a walnut and of about the same shape. In none of the pouches was there any clot, ulceration of the endothelium, or evidence of atheroma. Extending up the *aorta* from these three aneurisms were some granulations, some old, others apparently of recent date. They were very thick near the valves, but rapidly thinned further up the vessel, the highest granulation being placed about one inch and a half from the aortic orifice. At this level there was a small ulcer the size of a split pea, which had completely penetrated the inner and middle coats of the *aorta*, and had encroached upon the outer coat. Beyond this point the *aorta* in its whole extent, as well as all its main branches to the neck, arms, and trunk, was perfectly healthy.

Abdomen : Liver much enlarged considering the emaciated state of the patient. It weighed 82 oz. and was fatty and congested.

Spleen enlarged ; weight 18 oz ; surface puckered and scarred from old infarction. No recent infarcts.

Kidneys : Surface puckered from old infarcts.

Intestines natural.

Uterus, ovaries, and vagina natural.

The brain : Upper surface natural. The right middle

cerebral artery was occluded at its first bifurcation by a small calcareous embolus, which completely blocked the vessel at this spot. A little farther on another branch of the same vessel was filled with a firm, but not calcareous embolus. At both of these places the vessel was much dilated. A couple of inches beyond the last embolus, another plug had been lodged in a small branch, whilst a fourth embolus was found in a branch of the right anterior cerebral artery.

The right lenticular nucleus was in a pulpy condition, and the softening had extended to the white matter in its immediate neighbourhood, and to the convolutions of the island of Reil.

Right upper extremity.—In front of the elbow was an oval swelling extending equally above and below the level of the joint. From this the skin was reflected, and all the tissues around the aneurism, together with the brachial, ulnar and radial arteries were removed. On laying open the brachial artery it was found to be in a perfectly natural condition as far as a point about two inches above the elbow-joint. Here it was quite occluded and matted to the surrounding tissues. It was at this spot that the ligatures had been applied. From here to its termination the vessel was filled with blood-clot partly decolorised and adherent to the endothelium. Just above the bifurcation the brachial artery on its anterior surface was perforated by a small hole, not much larger than a pin's head, blocked by a firm, dark, and closely adherent clot. On the removal of the latter, the whole was found to open directly into the swelling in front of the elbow already mentioned.

This swelling was composed of a mass of blood-clot encapsuled merely by the soft tissues of the part condensed by pressure. The clot was firm, but its outer layers only showed a slight trace of lamination. In no part was it limited by an expansion of the artery, or of its sheath.

Immediately below the aperture in the brachial artery, the ulnar and radial vessels were found to contain the

remains of an embolus, consisting of calcareous material of precisely the same nature as that met with on the vegetations attached to the aortic valves, and hidden to a great extent by blood-clot. The greater part of this calcareous matter was found in the ulnar artery, and here it formed a very distinct and hard lump. The wall of the radial, however, had been completely ulcerated through, and small portions of gritty material here protruded through its walls into the tissues outside the vessel. Below the seat of embolism both the radial and ulnar arteries were very small, and filled with clot as far as the middle third of the forearm.

Vessels of the Right Lower Extremity.

The right common iliac artery was occluded immediately above its bifurcation by a large embolus, composed chiefly of calcareous matter similar to that found on the aortic valves. Around this was some recent blood-clot. The common iliac above the seat of embolism was perfectly healthy, but where the embolus was lodged the artery was thinned, and distinctly bulged to the outer side. On partly separating the embolus from the vessel, the endothelial lining of the latter was found to be irregular and pitted, as though from recent inflammation or ulceration.

The internal iliac artery was patent, and its walls natural.

The external iliac artery was shrunken, and filled with dark firm clot.

The common femoral was in a similar condition.

The superficial femoral was filled with clot in its upper two inches, and below this, for about a similar distance, the artery was represented by a fibrous cord. It was at this place that the ligatures had been applied, but no traces of them could be found. The vessel was filled with clot in almost the whole remainder of its course, but the popliteal artery was patent.

Immediately below the bifurcation of the latter vessel, the posterior tibial artery was shrunken and filled with clot, and, at a distance of about half an inch from its origin, was perforated by a small aperture, similar to that already described in the brachial, and leading into a large swelling in the calf. This swelling contained several ounces of dark and rather soft clot, confined merely by the surrounding tissues, and nowhere very definitely circumscribed. The posterior tibial artery was in no way dilated; on the contrary, below the spot where it communicated with the collection of clot it was not possible to trace the vessel, and no remains of an embolus were to be found.

Vessels of the Left Lower Extremity.

The common iliac was healthy.

The internal iliac was also healthy, but, relatively to the other vessels, was large.

The external iliac in its upper two inches was universally dilated, so as to form an aneurism of globular shape the size of a pigeon's egg. The sac of this aneurism appeared to be composed of all the coats of the vessel except at its most anterior part. Here the sac had partly given way, and the contents were limited by the superjacent sheath and fascia. The inner surface of the sac was quite smooth, and there was no appearance of athroma. The sac contained dark soft blood-clot. There was no laminated fibrin.

Below the aneurism the external iliac and the upper part of the common femoral arteries were so contracted that it was difficult to find them. They were not as large as a normal radial, their calibre was practically obliterated, and they contained a slender cord of decolourised fibrin, in which were embedded granules of calcareous material similar to that found in the right common iliac and brachial vessels.

The lower part of the common femoral, and the superficial and deep femoral vessels, were all patent and healthy.

A microscopical examination of the diseased vessels revealed the following conditions.

Several portions of the right common iliac were examined, including the outer and thinnest part of the vessel where it was most distinctly bulged. The whole arterial wall in contact with the embolus was the seat of an inflammatory process, and, in its whole thickness, was infiltrated with cells. This cell-infiltration was most evident in the inner coat, and in almost every section examined the latter was found to be distinctly ulcerated,

FIG. 1.—Section of common iliac at the seat of embolism. *a*. Middle and outer coats infiltrated with cells. *b*. Portions of calcareous embolus. *c*. Clot with fibrin mesh-work.

its endothelium being destroyed and the subendothelial tissue and fenestrated membrane crowded with cells. Where the arterial wall was thinnest this ulceration had entirely penetrated the intima and involved the middle coat. The muscular fibres of the latter had been exten-

sively destroyed, and the sections consisted rather of the products of inflammation than of the normal structures.

Sections were made of one of the plugged branches of the middle cerebral, the most distal one being selected.

FIG. 2.—Section of plugged anterior cerebral artery, showing destruction of arterial wall in the neighbourhood of the embolus.
a. Lumen of vessel. *b.* Clot. *c.* Arterial wall partly destroyed.
d. Embolus (calcareous).

The embolus was in parts calcareous, but was surrounded by decolourised clot. The vessel wall, in about three fourths of its circumference, was only slightly infiltrated with cells, and the endothelium was intact. At one part, however, the coats were considerably destroyed, the inner coat being entirely removed, and the muscular coat partially ulcerated. At this point the arterial wall was extensively infiltrated with cells.

Sections of the wall of the aorta taken from one of the aneurismal pouches showed a general disorganisation of the ordinarily dense structure of the vessel, and an infiltration with inflammatory products. The endothelium also was partially destroyed.

Sections of the sac of the aneurism on the left external iliac presented precisely similar appearances.

Remarks.—In studying this case the state of the heart and aorta is the first consideration.

It is evident that, in spite of the absence of any marked symptoms of septic infection, “ulcerative endocarditis” was in progress immediately before death. It is further evident that the aortic valves had been long previously diseased, for the calcareous masses, at least, must have been of some years’ standing, and it must therefore be concluded that the recent destructive inflammation attacked, as it so frequently does, valves which had been formerly damaged.

It seems to us probable that the emboli were due to ulceration and destruction of the valvular attachments of the vegetations, which, together with the calcareous masses adherent to them, were thus cast loose into the blood stream, and, looking at the large calcareous concretions yet left on the two aortic valves which are least destroyed, and the very extensive destruction of the remaining valve, it is likely that the large calcareous mass in the right common iliac was derived from the latter valve.

The condition of the aorta already described is evidently due to an extension to it of the inflammatory process which attacked the valves; and it is to the softening of the walls caused by inflammation that we attribute the aneurismal pouches we have mentioned. Aneurisms such as these, in connection with aortic valvulitis, have previously been described, and a very good specimen is in the museum of St. Bartholomew’s Hospital.¹ The ulcer on the aorta, which had nearly penetrated the vessel, we attribute also to the same cause. It is evident that the process by which the valves themselves were destroyed might, by extension to the aorta, cause the formation of an ulcer in its walls. It is worthy of remark that this ulcer is beyond the reach of direct mechanical irritation by the diseased valves, or by the calcareous masses attached to them.

There can be no reasonable doubt that the calcareous embolus in the right common iliac artery was derived

¹ No. 1430 A.

from the diseased aortic valves, and it is of much interest and importance to note accurately the changes in the artery where it had lodged ; for a microscopical examination shows that it had been the seat of extensive inflammation, which had not only resulted in softening of its walls, but, in parts, had almost completely perforated them by a process of ulceration. In consequence of these changes, the artery at the time of death was actually in process of aneurismal dilatation.

The occlusion of the left external iliac and common femoral vessels we consider to be of long standing, and for these reasons : that they are extremely small and shrivelled ; that their contents are not recent clot but old, adherent, decolourised fibrin with calcareous matter ; and that whilst the patient was under observation the circulation in the left lower extremity was generally good and the pulse in the tibials strong. Whether the occlusion of these vessels was due to the lodgment of an embolus in past years it is impossible to say for certain ; nevertheless, considering the condition of the heart, the presence of calcareous matter in the occluded artery, and the embolism of other vessels, we consider such an explanation to be probably correct.

The aneurism on the left external iliac we consider to be of more recent origin than the obliteration of the vessels beyond it, for its sac was thin ; the tissues over it were but little matted or adherent ; there was no laminated fibrin in it, and it contained merely soft recent clot. It also may have been caused by the lodgment of an embolus. If so, the latter must have been subsequently disintegrated.

The aperture in the right brachial artery appears to have been certainly due to the lodgment of an embolus. It was situated immediately above the bifurcation. The vessel in the rest of its course was perfectly healthy, and even immediately around the aperture there was no disease, whilst in the vessels below, and in the tissue immediately around the hole, we found the remains of a calcareous embolus which could scarcely have come from any

other situation than the valves of the heart. This calcareous material was certainly not derived from the wall of the vessel itself, for, apart from the fact that calcification of arteries is never met with at the early age of nineteen, the vessels in question, as we have already said, were healthy. Finally, to the best of our knowledge, idiopathic ulceration of an artery at a single spot has never been seen except, as we shall presently show, in vessels which have probably been plugged. We therefore conclude that the artery wall was ulcerated at the place where it was plugged, and that the blood, escaping into the surrounding tissues, at first in small quantities, formed a so-called false aneurism, without there being any true dilatation of the vessel wall itself.

A considerable number of cases are now on record in which aneurisms occurring in young subjects have been associated with aortic valvular disease, and this coincidence, together with the situation of such aneurisms at the bifurcation of arteries, has suggested the probability that the disease of the vessels has been the result of their occlusion by an embolism.

In the great majority of cases no embolism, however, has been actually discovered at the seat of aneurism, although vessels in other parts of the body have been plugged. As far as we are aware, Ponfick is the only writer on this subject who has found an embolus in the diseased vessel itself, and there are yet many surgeons who doubt the direct relationship between embolism and aneurism.

The following is a list of arteries in which aneurisms have been found on post-mortem examination and have been attributed to embolism :

Axillary.—Guy's Hospital Museum, No. 1502²⁰.

Brachial.—Goodhart, Pathological Soc. Trans., vol. xxviii, 107.

Ulnar.—Ogle, Brit. and Foreign Med.-Chir. Rev., vol. xxvi, p. 500. Guy's Hospital Museum, No. 1503²⁰.

External iliac.—Moore, Path. Soc. Trans., vol. xxxiv,

p. 71. St. Bartholomew's Hospital Museum, Heart, No. 1299^A, Artery, No. 1460^A.

Common femoral.—Parker, Med.-Chir. Soc. Trans., vol. lxxvii, p. 57. Museum, Royal College of Surgeons, Heart, No. 3017^B, Artery, No. 3241^A. Bryant, Path. Soc. Trans., vol. xxvii, p. 98, and specimen in Guy's Hospital not yet added to the Museum. Guy's Hospital Museum, No. 1519²¹.

Popliteal.—Bryant, Path. Soc. Trans., vol. xxviii, p. 98, and Guy's Hospital Museum, No. 1519³⁹. Tufnell, Dublin Quart. Jour., 1853, p. 371.

Posterior tibial.—St. George's Hospital Museum, No. 129.

Superior mesenteric.—Wilks, Path. Soc. Trans., vol. xi, p. 44, and Guy's Hospital Museum, No. 1504⁴⁵. Guy's Hospital Museum, No. 1504⁴⁶. Ogle, Path. Soc. Trans., vol. viii, p. 168.

Splenic.—Guy's Hospital Museum, No. 1504⁴⁷.

Internal carotid.—Holmes, Path. Soc. Trans., vol. xii, p. 61.

Cerebral arteries.—Church, St. Bartholomew's Hospital Reports, vol. vi, p. 107. Goodhart, Path. Soc. Trans., vol. xxviii, p. 107. Several specimens in Guy's Hospital Museum. Ponfick, Virchow's Archiv, 1873, vol. lviii, p. 528.

The various authors who have written on this subject are not agreed as to the exact manner in which the aneurism is produced. Some maintain that the artery above the seat of embolism becomes dilated, others believe that the vessel yields at the seat of plugging itself. In all cases, however, except that recorded by Ponfick, the process of formation of the aneurism has not been demonstrated.

We believe that in the case recorded by us the mode of formation of the aneurisms is clearly demonstrated. An examination of the specimen both by the naked eye and by the microscope reveals that where the embolus has lodged the artery wall has been inflamed. The inflam-

mation has progressed to softening and ulceration of the vessel, and in those arteries which had been most recently plugged, as evidenced both by the clinical symptoms and by the post-mortem examination, the ulceration was in progress at the time of death.

In the arteries of the arm and leg, on the other hand, the ulceration had caused complete perforation of the vessel, and, the blood escaping into the surrounding tissues, a sac had been formed by their condensation and by the clotting of the extravasated blood. In the left external iliac artery, however, the wall had merely been softened and had become the seat of an aneurismal dilatation. In the brain one artery at least had ulcerated at the seat of the embolism, and its condition was such as to render it probable that, had the patient survived, complete penetration would have followed.

In the right common iliac the arterial wall was both ulcerated and dilated.

We believe that in the case we have described it is proved that embolism may cause aneurism, and that the disease and subsequent dilatation of the vessel occur at the seat of the lodgment of the embolus and not above it.

The next point for consideration is the reason why, in the vast majority of cases, embolism should not cause aneurism, or rather, why it should only exceptionally do so?

It may be argued that the causation of aneurism is purely fortuitous, and that in any given number of cases of embolism a certain percentage will result in the development of aneurism, just as in the case of ligature of vessels in their continuity, aneurism has resulted in a few instances.

We believe this reasoning to be defective, and first we would point out that although aneurism has occasionally occurred after ligature of an artery in its continuity or in a stump, there is no evidence to show that the aneurism has been produced by the mechanical dilatation of a healthy vessel above the seat of the constriction. It is probable that the aneurisms that have followed ligature,

have resulted either from a softening of the artery walls by suppuration, as in the cases recorded by Mr. Symonds in the Clinical Society's 'Transactions,' vol. xix, p. 140, 1886, and in the Pathological Society's 'Transactions,' vol. xxxv, 1884, p. 146 ; or from a failure to obliterate the vessel at the point of ligature, as in the case recorded by Mr. Thomas Smith, in which the ligature of the superficial femoral with catgut for the cure of a popliteal aneurism failed in its object, and also produced an aneurism at the site of the operation.

We would therefore urge that not only is there no proof that an artery ever becomes mechanically dilated behind an embolus, but we deny that such an event as mechanical dilatation has ever been known to follow the obstruction offered to the blood-stream by a ligature.

Again, it will be readily conceded that, considering the frequency of embolism, the percentage of cases which result in aneurism is infinitesimal, and it is difficult to suppose that in a single individual two arteries should be completely ulcerated through and several others in process of destruction at the time of death without the presence of some specific cause.

It appears obvious to us that the theories of dilatation occurring above the seat of embolism, of the distension of the vessel by the current of blood through an artery which is narrowed and not obliterated, and others which have been propounded, are not sufficient to meet the case.

Two other explanations remain : the one originally suggested, we believe, by Dr. Goodhart, is that aneurism only occurs when the embolus is the "product of a fungating endocarditis in which the vegetations are large, and often, though not always, accompanied by ulceration ;"¹ the other is that of Ponfick, who attributes the formation of aneurism to the calcareous nature of the embolus, and argues that by its mechanical irritation it produces an ulceration of the vessel at the seat of plugging.²

¹ 'Path. Soc. Trans.,' vol. xxviii, p. 107.

² 'Virchow's Archiv,' vol. lviii, p. 528.

Taking the last of these theories first, we think that the explanation applies to Ponfick's cases alone, and not to any of the others to which we have alluded in the appended table, for in none of them was any calcareous embolus found, nor, with one exception, were the vegetations on the valves noted to be calcified.

On the other hand, we find that of twenty-five recorded cases in which the condition of the heart was mentioned, there was ulcerative endocarditis in progress at the time of death in ten, and recent endocarditis with production of warty vegetations, such as are described by Dr. Goodhart, in twelve others. From the descriptions given, it is probable that in several of the latter there was ulceration of the valves, but this is not definitely stated. In the three remaining cases there was certainly some recent endocarditis, but whether warty or ulcerating is not clear from the descriptions.

Further, it is noteworthy that although Ponfick attributes the aneurisms in his cases to the calcareous nature of the emboli, yet in all of them he describes the heart as being the seat of "recurrent warty endocarditis," and in two of his six cases he describes ulceration as being present.

In our own case, although the emboli were calcareous, we do not attribute the formation of the aneurisms to this fact, but rather to the presence of a distinct "ulcerative endocarditis," and a corresponding septic condition of the emboli.

In support of this view we submit the following arguments :

- 1st. The aneurisms of the sinuses of Valsalva were not due to ulceration of the arterial walls, but to their softening by inflammation. This could not result from the mechanical irritation of a calcareous embolus, and consequently must be considered to be due to an extension to the aorta of the diseased condition of the valves. This proves that the infection of the vessel may result in softening and dilatation without pre-existing ulceration.

2nd. The ulcer in the aorta just above the valves was independent of either mechanical irritation or the lodgment of an embolus. It was evidently the result of an extension to the artery wall of the ulceration which was in progress in the valves themselves, thus showing that in an artery ulceration may result from infection by contact with, or in proximity to, valves affected with ulcerative endocarditis.

3rd. It is well known that in pyæmia and allied conditions emboli are capable of conveying to distant parts septic particles which infect the tissues in which they lodge, and set up in them changes of a precisely similar nature to those which are in progress in the part from which they themselves have been derived. Considering that direct extension to the aorta of the valvular inflammation is capable of causing both softening and dilatation as well as ulceration, we submit that it is eminently probable that the ulceration of the brachial and posterior tibial vessels, the ulceration and dilatation of the right common iliac and cerebral arteries, and the dilatation of the left external iliac, were all alike due to an inflammatory process set up in them by infective emboli, some of which were found *in situ* after death.

4th. The fact that in a very great proportion of all published cases the form of heart disease, found after death, was warty or fungating, and in 40 per cent. combined with ulceration and destruction of the valves, affords the strongest argument in favour of the theory that not only in our case but in all others of aneurism due to embolism, the peculiar form of heart disease present is the real explanation of the arterial lesion.

5th. Of fourteen specimens examined by the writers, exclusive of that which is the subject of this paper, the diseased artery has seemed to be distinctly ulcerated and not the seat of aneurism in three instances, viz. :

Ulnar artery.—Guy's Hospital Museum, No. 1503⁸⁰.

Axillary artery.—Guy's Hospital Museum, No. 1502⁸⁰.

Common femoral artery.—Guy's Hospital Museum, not numbered.

In the following cases an examination rendered it probable that the artery was ulcerated rather than dilated. This could not, however, be distinctly proved.

Common femoral artery.—Guy's Hospital Museum, No. 1519³¹.

Popliteal artery.—Guy's Hospital Museum, No. 1519³⁹.

Superior mesenteric artery.—Guy's Hospital Museum, No. 1504⁴⁶. St. George's Hospital Museum, No. 115.

Posterior tibial.—St. George's Hospital Museum, No. 129.

The ulceration in the case recorded by us, and in the other cases to which we allude, certainly cannot be the result of a mere mechanical distension, and, in our opinion, affords strong evidence in favour of a specific action of the embolus itself.

In conclusion, we beg to submit the following propositions :

1st. Embolism may undoubtedly cause the formation of an aneurism.

2nd. The aneurism is developed at the seat of embolism and not above it.

3rd. The aneurism may be due to an inflammatory softening and consequent dilatation of the artery, or to its ulceration, and the subsequent formation of a sac by the surrounding soft tissues.

4th. Aneurism only occurs when the emboli are derived from a heart, the valves of which are affected by a special form of disease, resulting in the production of fungous growths, and often of ulceration and destruction of the valves themselves.

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,' New Series, vol. ii, p. 154.)

DESCRIPTION OF PLATES IV, V, AND VI.

(A Case of Multiple Embolism of the Arteries of the Extremities, followed by the formation of Aneurisms. By JOHN LANGTON, F.R.C.S., and ANTHONY A. BOWLBY, F.R.C.S.)

PLATE IV.

The left side of the heart, showing warty growths on the aortic valves with ulceration of one of the cusps, and the formation of an aneurismal pouch behind the left posterior segment; the aorta is in part covered by granulations, and about an inch above its origin presents a small ulcer.

PLATE V.

The aorta, with the iliac and femoral vessels. The right common iliac contains a calcareous embolus just above its bifurcation, and in this situation the vessel is a little bulged and its wall ulcerated. The left external iliac is the seat of an aneurism, and the left common femoral is shrunken and filled with an old adherent clot.

PLATE VI.

The right brachial and ulnar vessels. A bristle has been passed through an ulcerated aperture in the brachial, just above its bifurcation, into the sac of a diffused aneurism. The radial and ulnar arteries contain portions of a calcareous embolus. The brachial artery has been tied a little above the place where it is ulcerated.