C A S E
OF
ABDOMINAL ANEURISM
SUCCESSFULLY TREATED BY PROXIMAL PRESSURE
OF THE AORTA.

BY
EDWARD HEADLAM GREENHOW, M.D., F.R.S.,
PHYSICIAN TO, AND LECTURER ON THE PRINCIPLES AND PRACTICE OF
MEDICINE AT, THE MIDDLESEX HOSPITAL.

Received April 8th—Read May 27th, 1873.

IN the year 1864 Dr. William Murray, of Newcastle-on-Tyne, communicated to the Royal Medical and Chirurgical Society the particulars of a case of abdominal aneurism, cured by proximal pressure upon the abdominal aorta. The paper was read, and the patient exhibited, at a meeting of the Society held about six weeks after the operation. In common with many other Fellows of the Society, I examined the patient with great interest and felt the hard pulseless tumour which occupied the site of the previous aneurism. The patient remained well for six years, when by reason of failing to obtain any other employment, he resumed his former laborious occupation as a paviour, and in a very short time began to suffer from violent pain in the epigastrium, which was speedily followed by other symptoms of aneurism in that region.* This second aneurism was, however, found to be situated so close to the diaphragm that it was impossible to compress the aorta between it and

* 'The Rapid Cure of Aneurism by Pressure.' By W. Murray, M.D., &c. London. Page 24.

the heart, and the patient died suddenly in the course of the same year.

Although the details of the post-mortem examination were shortly afterwards published by Dr. Murray, yet, as they are not recorded in the 'Transactions' of the Society, it may be desirable briefly to recapitulate them here. The original aneurism was found to have been situated in that portion of the abdominal aorta from which the inferior mesenteric artery is given off, and its remains consisted merely of a fibrous mass. The trunk of the inferior mesenteric artery had dwindled to the size of the radial artery and its coats were thin and flaccid; the circulation through its branches having been carried on by means of the connection between the colica sinistra and colica media arteries, both of which were enormously enlarged. Complete collateral circulation had been effected by the enlargement of vessels both outside and inside the abdominal cavity. The enlarged vessels on the front and sides of the abdomen had been seen pulsating during life, but they were extremely tortuous and difficult to trace. After death it was found that the circulation outside the abdomen had been carried on by means of communicating branches between the internal mammary and deep epigastric arteries, between the intercostal and deep and superficial epigastric arteries, and between the lower intercostal and superficial circumflex iliacs; all of which were greatly enlarged. The anastomosing branches were very tortuous, and ramified in every direction. One lateral branch, given off from the inner side of the epigastric artery, penetrated the umbilicus; and, running along the free border of the suspensory ligament of the liver, entered the longitudinal fissure of that organ, and anastomosed with a branch of the hepatic artery. Within the abdomen, the circulation had been carried on, as already mentioned, between the colica media branch of the superior mesenteric artery and the colica sinistra branch of the inferior mesenteric artery, including its sigmoid and hæmorrhoidal branches, and also between the upper lumbar

and ilio-lumbar arteries and the lower lumbar arteries and circumflex iliacs.

Last year a second case of abdominal aneurism, cured by compression of the aorta above the umbilicus, was communicated to the Society by Dr. Moxon and Mr. Durham of Guy's Hospital. A similar case, cured in the same manner by Dr. Heath, of Newcastle-on-Tyne, was referred to by Dr. Murray in a paper read by him before the British Medical Association at Dublin in 1867,* but the details of this latter case have, so far as I can ascertain, never been published. The same remark applies also to several other cases briefly referred to by Dr. Murray in his pamphlet on the rapid cure of aneurism by pressure, and some of these, moreover, were cases of compression of the aorta, not for aneurism of the aorta itself, but of vessels below its division into the iliacs.

Thus, the two cases published in the 'Medico-Chirurgical Transactions' are the only two cases of cure of abdominal aneurism by proximal pressure upon the aorta which have, as yet, been fully reported. These cases, indeed, may be considered to have sufficiently proved both the possibility of compressing the abdominal aorta above the umbilicus without causing serious injury to neighbouring organs; and, also, the fact that the circulation may be efficiently maintained through collateral vessels, even when the passage of blood through the abdominal aorta is shut off above the inferior mesenteric artery. Nevertheless, I venture to hope that the communication to the Society of a third case, also successfully treated upon Dr Murray's plan, may not be considered superfluous; more particularly as, in my case, some of the results of the compression applied over the aorta appear to have an interest apart from that belonging to the cure of the aneurism.

Christopher Fawcett, a strong-looking, well-nourished man, æt. 28, by occupation a warder in the House of Correction at Kendal, but who had previously been a sailor,

* 'British Medical Journal,' 1867, vol. ii, p. 287.

was admitted into the Middlesex Hospital under my care on May 20th, 1872.

When eight years of age he had been struck by lightning and had remained blind for three weeks afterwards, and at seventeen years of age he had suffered from rheumatism in the shoulders, knees, and ankles; but, in all other respects his health had been good until the commencement of the ailment for which he was admitted.

In December, 1868, being then an able-bodied seaman on board H.M.S. Princess Charlotte, stationed in China, whilst drawing water from alongside he suddenly felt something give way in his abdomen. This was followed by severe pain shooting downwards, and by faintness; both of which, however, shortly subsided. Two days later he became conscious of slight pulsation in the epigastrium, he felt weak and soon began to lose flesh. He was sent into hospital, where he remained five weeks, and was then invalided and sent home. Very shortly after his return to England he obtained his present employment as a warder. In December, 1871, he began to suffer from pain in the loins, creeping round towards the groins and testicles, and gave up work for some weeks, during most of which time he confined himself almost entirely to bed. During this period of rest he improved very much, lost the pain, thought himself well and resumed his duty; but, at the expiration of a short time, the pain in the back returned and presently extended to the legs, rendering him again unfit for work, and he was sent up to the hospital.

On admission he complained of pain in the abdomen as well as of almost constant aching in the loins, with pains shooting downwards to the groins and testicles, and sometimes down the thighs. The organs situated in the chest and abdomen were found to be normal. The urine was acid, had a specific gravity of 1020, and was free from albumen. The pulse was 56, the temperature 98°. The left radial and also the left femoral pulse beat more strongly than the right. The heart's action was regular and its sounds were clean, but rather accentuated, and a feeble thrill was some-

times felt with the impulse. A distinct but diffused pulsation, synchronous with the radial pulse, was both seen and felt above the umbilicus. On examination, a somewhat globular pulsating tumour, about the size of a large orange, was found in the abdomen immediately above the umbilicus. It extended more to the right than to the left of the median line, and beat forcibly with an expanding lateral as well as with a forward impulse. On deep pressure a thrill was also felt with the pulsation. On auscultation over the tumour no murmur was heard. Firm pressure over the aorta above the tumour, when the patient was sitting up in bed and inclining forwards, stopped the pulsation for the time being.

On the day after his admission the patient was seen by my colleagues, Dr. Henry Thompson, Mr. De Morgan and Mr. Hulke, who all agreed with me as to the nature of the tumour, and the propriety of endeavouring to effect a cure by the application of pressure upon the aorta above the aneurism, until the contents of the tumour should have coagulated. Mr. Hulke kindly undertook to apply and manage the tourniquet. The patient's bowels having been thoroughly cleared out on May 24th, the administration of chloroform was commenced at a quarter to three o'clock on the afternoon of May 25th. Ten minutes later Lister's tourniquet was screwed down between the tumour and the xyphoid cartilage, until pulsation ceased both in the tumour itself and in the femoral arteries. Vomiting, however, very shortly supervened, and after the pressure had been alternately relaxed and reapplied several times it was finally withdrawn, on account of the retching, at twenty minutes to four o'clock.

May 26th.—The patient had slept well and had passed urine abundantly. He complained of nothing but acidity on the stomach. His pulse was 79. The tumour was now more defined, extending two inches to the right, and one inch to the left, of the umbilicus. The impulse remained as before, but the tumour felt rather more solid; and a faint murmur, synchronous with the impulse, was heard at the

upper part of the tumour where the stream entered from the aorta.

27th.—Urine neutral, sp. gr. 1006, free from albumen. A large enema was given in the morning to empty the bowels, and at a quarter before seven in the evening, chloroform was administered by Mr. G. Everitt Norton. At the end of seven minutes the patient was thoroughly under its influence, and Mr. Hulke applied the tourniquet firmly over the aorta about two inches below the xyphoid cartilage, with the effect of at once arresting all pulsation in the tumour and in the femoral arteries. This pressure was maintained for a period of four hours with two brief intermissions. About eight o'clock the clamp had to be readjusted, which caused a momentary interruption of the pressure, when a wave accompanied by a thrill was felt to pass through the tumour. Again, about ten o'clock, at the expiration of three hours from the commencement of the operation, the instrument was intentionally withdrawn for a few moments in order to ascertain the effect which had been produced. A thrill was again perceived, but the tumour felt decidedly more solid, as though some coagulation of its contents had taken place. During the first hour, the pulse varied from 80 to 100, and the respirations from 36 to 48, in the minute; during the latter part of the time the pulse ranged from 100 to 120, and the respirations from 44 to 56, per minute. The breathing was very shallow and somewhat gasping. After the pressure had been maintained for some time there appeared marked lividity of the lower extremities which, as well as the lower half of the abdomen, became quite cold. The temperature taken between the first and second toes was 90°.

Sphygmographic tracings of the radial pulse, taken from time to time during the maintenance of the pressure, shewed, when compared with tracings of the same pulse taken before and after the application of the tourniquet, an increased degree of arterial tension; the upstrokes being much shortened and the summits rounded off. The removal

of the pressure at eleven o'clock was immediately followed by a marked change in the breathing, which having for some time been very short and shallow became at once much deeper and longer; the pulse resuming at the same time almost its normal force and frequency. There was still well-marked forward pulsation in the tumour, but the lateral expansion was much reduced. Three quarters of an hour after the withdrawal of the tourniquet, the patient vomited about half a pint of grumous, dark brown fluid. The pulse was then 104, forcible and of good volume; the respirations were 32.

28th.—The patient had throughout the night been almost constantly vomiting small quantities of brown fluid. It had been nearly four o'clock in the morning before he entirely recovered from the anæsthesia produced by the chloroform. He was much depressed, said he felt very bad, and complained of "pins and needles" in the feet and of a sensation of soreness in the stomach. There was a tender red bruise in the epigastrium at the spot on which the pressure of the tourniquet had been exerted. The pulsation in the tumour was undoubtedly decreased; the upward impulse being much less forcible and the lateral expansion only slight. The pulsation in the femorals was very feeble. The feet were numb, and the patient could but just feel when they were touched. Pulse 72. Temperature 99°. Urine acid, sp. gr. 1025, very considerably albuminous.

The vomiting continued more or less until June 1st. For two days the vomit contained altered blood, but afterwards it consisted of frothy, watery fluid, mixed with any liquid food he had taken. On May 29th the urine had a sp. gr. of 1030 and deposited a copious precipitate of lithates, but was free from albumen. The pulse has ranged from 60 to 68, and the temperature from 98·6° to 100°. The bruise and the feeling of tenderness in the epigastrium had disappeared. The patient still complained of numbness and pain in the right leg; the right limb was cold and livid, the left much less so. On May 31st pulsation

was distinctly felt in the left femoral and posterior tibial arteries, but none could be felt in those of the right limb.

The treatment consisted in the hypodermic injection of one sixth of a grain of morphia each day, and in the restriction of the patient's diet to milk with lime water or soda water, eggs, arrowroot, and beef tea. Strong beef-tea enemata were also administered during the two days that he was entirely unable to retain food. The legs were wrapped up in cotton wool and the lower end of the bed was slightly elevated in order to keep the feet in a raised position. ‡

June 1st.—Patient had slept well; could now take an egg beat up in tea, or some toast and coffee, without being sick. Pulse 80; temperature 99·6°. Bowels had acted once. Urine sp. gr. 1015, alkaline, free from albumen. Patient said he felt very well and very hungry. The numbness was much decreased in the right leg which now felt warm, but the foot continued cold and livid. Pulsation, though quite distinct in the left femoral, could still not be felt in any of the arteries of the right limb. The pulsation in the aneurism had very greatly decreased; there was slight lateral expansion, but the forward impulse over the tumour was scarcely greater than over the aorta above it.

5th.—Patient complained of a burning sensation in the right foot, which had become warmer and less livid and was perspiring; the great toe alone remaining cold. There was distinct pulsation in both superficial pubic arteries, in the left superficial epigastric, and right circumflex iliac arteries, and also in the right femoral artery between Poupart's ligament and the middle of the thigh. The pulse in the left femoral appeared to be weaker than formerly, and scarcely any impulse could be felt in the aneurism.

8th.—A very feeble impulse could be felt two inches above the umbilicus, accompanied on auscultation by a faint blowing murmur. Pulsation was also felt in the dorsal artery of the right foot.

10th.—The patient was allowed to sit up for a short

time, but almost immediately after rising he experienced severe aching pain, accompanied by a sense of heat commencing in the loins and spreading forward to the crest of the ileum and downwards to the feet. On returning to bed he had a profuse sweating. A day or two later he was again allowed to sit up, and did so without experiencing any return of pain in the loins; but the right foot again became somewhat cold, and there was pain and tenderness in the great toe, which also presented a livid hue.

24th.—The pulsation in the tumour having decidedly increased again in force during the previous week, it was agreed in consultation with Mr. Hulke and my other colleagues to renew the application of pressure upon the aorta above the aneurism. The bowels were accordingly cleared out by an enema early in the morning of the 25th, and the usual precautions were taken to avert sickness from the chloroform. Mr. Morris, who had been present and had administered the chloroform from the end of the first hour on the previous occasion, again rendered us his assistance, and at half past eight in the evening the patient was brought thoroughly under the influence of the anæsthetic. Five minutes later Mr. Hulke skillfully adjusted Lister's tourniquet so as thoroughly to compress the aorta. The pressure was maintained for three hours continuously, with the exception of five minutes, during which it was intentionally relaxed a little before nine o'clock. Also, whilst the hand which held the tourniquet was being changed in position at a quarter past nine, a wave of blood was felt to pass through the aneurism. Immediately before the administration of chloroform was begun the radial pulse beat 79, and the respirations were 20 in the minute; both pulse and breathing being regular and quiet. Within ten minutes after the application of the tourniquet the pulse rose to 100, and the respirations to 40, in the minute; these latter, as well as the sphygmographic tracings of the pulse, being of the same character as during the former operation. Soon after the commencement of the pressure the right foot was observed to have become much colder than the left. When the

tourniquet was removed at thirty-five minutes past eleven o'clock there was violent forward pulsation in the tumour, but no lateral expansion could be detected; no murmur could be heard and the tumour felt firmer and more solid. One sixth of a grain of morphia was injected hypodermically half an hour after midnight.

26th.—Patient had slept most of the night, but had been sick several times. The matter vomited consisted only of clear, greenish fluid and presented no appearance of blood. Pulse 84, respirations 22. Three ounces of acid urine had been passed, sp. gr. 1025, containing one fourth, by measure, of albumen and a large number of casts, chiefly hyaline, but a few granular and a few others with epithelial cells adhering to them. The impulse of the tumour was much lessened, and no pulsation could be detected in either femoral artery. A rather large artery was found beating on the right side of the epigastrium.

During five days the sickness continued to recur at frequent intervals. At first it was quite uncontrollable, and the patient felt so weak and faint that it was necessary to give him an enema of beef tea, half an egg and a table-spoonful of brandy every three or four hours.

28th.—He became slightly jaundiced, but it only lasted two or three days. The urine continued albuminous for two days, and then became normal again. Both feet remained cold and livid for several days, but the patient was able to move them freely. The pulsation in the aneurism continued to diminish and was exclusively forwards. The tumour felt more solid and its margin became more defined, especially on the right side.

July 1st.—The impulse in the aneurism could not be seen and could scarcely be felt. The patient was allowed to sit up on July 10th, and was well enough to be discharged on July 14th, in consequence of the necessity of closing the hospital for repairs. A day or two later he returned home to Kendal.

On September 20th the patient, in accordance with my request, made when discharging him in July, returned and was readmitted into the hospital. He stated that since

his leaving it he had had no return of pain in the back or groins, but that for some time after his return home he had frequently at night felt "pins and needles" in his feet, and more especially in the right foot, compelling him to hang his legs over the bedside. He had also, after taking walking exercise, suffered from pain in the calves and from a sensation of coldness in the feet. He was carefully examined by Mr. Hulke, Mr. De Morgan, Mr. Morris and myself. No pulsation was found in the seat of the aneurism, neither was there any distinct tumour remaining; but immediately above the umbilicus, a little to the right of the median line, there was an undefined hardness which appeared somewhat movable. Posteriorly, a slight degree of dulness on percussion was found over a limited area of the lower ribs on the right side. On auscultation over the left loin an indistinct pulsation was heard, accompanied by a humming or buzzing sound. No pulsation nor aortic sound could be detected in the aorta from an inch above the umbilicus downwards. Below the epigastrium a murmur, unaccompanied by any impulse, was heard, which was probably communicated from neighbouring arteries. No pulsation was found in the femoral, popliteal, or anterior tibial arteries; but there was feeble pulsation in the left posterior tibial artery, and, Mr. Morris thought, in the right also. Pulsation was felt, and had been noticed by the patient himself, in the seat of the deep epigastric arteries on both sides. A superficial vessel about the size of the radial, was felt beating in the walls of the abdomen, about two inches above the umbilicus. Small vessels were also felt pulsating near the crest of the ileum and the trochanter major. No pulsation could be detected about the buttocks, but Mr. Norris found with the finger in the anus three or four large arteries of the size of crowquills beating very distinctly. The lower limbs were somewhat emaciated, but healthy in colour and perfectly warm.

Mr. Noble, of Kendal, who had originally sent up the patient to the Middlesex Hospital, wrote me word later in the autumn that the man was in perfect health and had re-

turned to his duty as warder in the House of Correction. All trace of pulsation in the site of the aneurismal tumour was obliterated.

It will have been observed in the history of this case that the pulsation in the aneurism continued for a considerable number of days after the last application of pressure to the aorta. In this respect it resembles Dr. Moxon's and Mr. Durham's case, but differs from Dr. Murray's. In the latter case, although some very slight pulsations were felt when the tourniquet was removed, the tumour had become perfectly pulseless by the evening of the same day, and every indication of pulsation in the aorta below it was found to have disappeared.* In Dr. Moxon's and Mr. Durham's case, on the contrary, pulsation in the aneurism continued for a month.†

Another fact in the history of the present case, deserving of particular notice, is the gradual relapse after the period of favorable progress which followed the four hours compression of the aorta on May 27th. For some days the impulse in the aneurism had been gradually subsiding, until on June 10th it was scarcely perceptible, and the patient was allowed to sit up for half an hour. Then it again began to increase and on June 24th it seemed obvious to us that, unless the pressure were reapplied, the tumour would soon return to its original condition. It seems to me now very possible that if the patient had been kept perfectly at rest for some time longer, the consolidation, which had partially taken place during the latter days of May, might have continued to progress, and the cure might have been completed without any further compression. But I was then unacquainted with the details of Dr. Moxon's and Mr. Durham's case, and knew only the history of Dr. Murray's, in which very rapid coagulation took place; and, therefore, as a stream of blood still continued to pass through the aorta, I did not expect the cure to be completed without again having recourse to compression. It would

* Loc. cit., p. 20.

† 'Med.-Chir. Trans.,' vol. lv, p. 218.

now, however, appear certain that the process of cure in these cases, by coagulation of blood in the sac of the aneurism, is not necessarily a rapid process, but may go on so slowly that the passage of blood through the aneurism may not cease for many days, nor in some cases until after the lapse of weeks.

The results, in the present case, of the compression over the aorta, which appeared to me to have an interest apart from that belonging to the actual cure of the aneurism, were the effects produced, first upon the general circulation, and, secondarily upon particular organs.

The effects upon the pulse were very remarkable, both as felt by the finger and shown by the sphygmograph. It became much more frequent, whilst the short upstrokes and rounded summits presented by the sphygmographic tracings indicated diminished expansion and delayed collapse of the artery. At the same time the breathing became shallow and the respiration frequent.

These characters of the pulse and respiration supervened almost as soon as the pad of the tourniquet was screwed down, and disappeared quite suddenly the moment the pressure was removed.

The organs secondarily affected by the results of the pressure upon the general circulation were the stomach and kidneys. Hyperæmia of these organs from the forcible distension of their capillaries, consequent upon the sudden shutting off of the ordinary supply of blood to the arteries below the compressed portion of the aorta, was undoubtedly the cause of both the hæmatemesis and the albuminuria which followed the operation. The prolonged and for some time uncontrollable vomiting, which on both occasions followed the operation, was likewise, in all probability, partly due to gastric hyperæmia, for it can scarcely be regarded as having proceeded altogether from the chloroform. It is, however, very probable that pressure on the solar plexus of nerves may have contributed to the result.

The occurrence of such symptoms appears to me to suggest, that the intense arterial distension, produced by the

treatment, might be attended with serious danger in persons suffering from any kind of organic disease.

The three patients whose cases are now fully recorded were all healthy young men, and in each of them the aneurism seems to have arisen from a mechanical cause. Had any one of them been the subject of arterial atheroma, of valvular disease of the heart, or of disease of the lungs or kidneys, there appears to me to be grounds for apprehending that the case might have terminated less favorably.