ON A CASE
OF
ANEURISM OF THE SUBCLAVIAN ARTERY

TREATED BY

AMPUTATION AT THE SHOULDER-JOINT AND THE
INTRODUCTION OF NEEDLES INTO THE SAC.

BY

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THE treatment of subclavian aneurism by amputation at the shoulder-joint and ligature of the main artery on the face of the stump was suggested many years ago by Sir William Fergusson, who, however, had no opportunity of putting the suggestion into practice. He says ('Practical Surgery,' p. 542): "It is known that amputation at the shoulder-joint is generally a very successful operation; as far as the wound is concerned, then, there might be little to apprehend, but the effect on the tumour is not so easily foretold. Ligature of the axillary artery on the face of the stump might be reckoned like Brasdor's operation, yet there is a vast difference, for in the latter case the same amount of blood which previously passed towards the upper extremity would still find its way down, and probably part of it would run through the sac, whereas were the member removed, as the same

quantity would no longer be required in this direction, the tumour might be much more under the control of pressure."

Professor Spence carried out this suggestion in 1864 on a naval engineer, in whom, six months before, the right arm began to feel cold and numb, and the ring and little fingers insensible, but who was unaware of any tumour until fourteen days before admission, when he was found to have a pulsating tumour commencing in the interval between the two heads of the sterno-mastoid, extending outwards and occupying the whole subclavian space. Mr. Spence amputated at the shoulder-joint on April 6th, and secured the axillary artery at the lower border of the pectoralis minor. On June 24th, the patient being convalescent, compression of the aneurism was begun by means of plaster, and iodide of potassium was administered, with the result that the aneurism became "very decidedly smaller and harder," but was not cured. The patient lived four years after, but the aneurism did not disappear, and dying at a distance from Mr. Spence no post-mortem examination was obtained. (Spence's 'Lectures on Surgery,' vol. i, p. 610, and 'Medico-Chirurgical Transactions,' vol. lii, p. 306.)

Mr. Luther Holden, in November, 1876, amputated at the right shoulder-joint in the case of a man aged 44, suffering from a subclavian aneurism, after the failure of direct pressure and restricted diet. The aneurism at first diminished in size and became harder. The main ligature came away on the twenty-fourth day, at which time there was considerable swelling, heat, and tenderness over the aneurism. The patient got pleurisy and bronchitis, the sac of the aneurism gave way, and the patient died on the thirty-seventh day. ('St Bartholomew's Hospital Reports,' 1877.)

Mr. Henry Smith has obliged me with the unpublished notes of a case in which, in February 1877, he performed amputation at the right shoulder-joint for an aneurism of the subclavian which had resisted proximal and distal pressure, complete rest, and the use of Esmarch's elastic bandage to the arm. The pulsation greatly diminished

for some days after the operation, and then increased again, and the patient died suddenly three weeks after the amputation from a thoracic portion of the sac giving way into the lung.

These are the only cases, so far as I am aware, prior to my own, and it must be allowed that the results are not encouraging, for, at the best, Mr. Spence's case was only relieved, and in the other cases the improvement was very temporary.

My own case is remarkable, in the first place from being distinctly traumatic, the consequence of a broken clavicle, and, secondly, from the fact that failing to obtain a cure by the amputation, consolidation of the contents of the sac was induced by the introduction of needles.

For the very elaborate report I am indebted to a former distinguished student of University College, Dr. Easmon, now of Sierra Leone.

James S—, æt. 48, was admitted under Mr. Heath on September 12th, 1878, with comminuted fracture of the left clavicle and simple fracture of the six upper ribs on the same side. While under treatment bronchitis supervened, but he was discharged on September 27th and made an out-patient. Previous to November 1st, 1877, patient had never had a fit, but since then he has suffered from epileptic attacks. In May, 1878, he was attended by his medical man for "weakness of the legs" without any actual paralysis, though difficulty in walking was experienced. His arms, however, were "all right." He had never suffered from rheumatic or scarlet fevers, but twenty-seven years ago had an attack of gonorrhœa (?) followed by a rash on the face, accompanied by sore throat. No history of any sore on the penis at this time or of enlarged glands in the groins. At present no scars on the genitals can be seen. It was during one of the above-mentioned fits, in September, 1878, that he fell down and was run over by a van, sustaining the injuries for which he was admitted. On admission the radial pulse on the injured side was normal. There was myosis.

Since September 29th he had attended as out-patient regularly, but it was not till October 31st that any undue pulsation was noticed. The surgical registrar, Mr. S. H. Burton, is quite certain that on September 21st no evidence of an aneurism of the subclavian existed.

The patient was re-admitted on October 31st, 1878.

Present state.—Occupying the lower part of the left posterior triangle of the neck and extending beneath the clavicle for a short distance is a pulsating tumour, the pulsation of which is expansile, and most marked at the upper part; the tumour is about the size of a Tangerine orange, the centre of its upper margin being about two inches above the clavicle. A perpendicular line drawn along the inner margin of the tumour strikes the clavicle an inch and a half from the sternal end. At a point two inches outside this a similar line drawn from its outer margin strikes the clavicle. The lower border is felt half an inch below the clavicle. There is apparently union of the fractured clavicle, the extensive external provisional callus being now to a great extent absorbed. Distinct pulsation is felt over the clavicle, and a double bruit heard, the systolic being the louder.

The left radial pulse is much smaller than the right, and the left temporal also smaller than its fellow of the opposite side. There is some œdema of the left arm. (It has been in a confined position for some time since the accident.) The veins over the left shoulder are more visible than on the opposite side. There is no pain in the tumour, nor shooting sensations down the arm, but the left arm is almost completely paralysed. The muscles look and feel flabby; the degree of wasting is not quite evident on account of the œdema.

Chest.—Lungs present no abnormal or adventitious phenomena. Heart: apex-beat in normal position, but the impulse is more forcible than natural; no murmur. Base: systolic murmur at pulmonary cartilage, none over aortic; second sound, however, accentuated.

Abdomen.—No evidence of disease.

Urine.—No sugar, no trace of albumen, no deposit.

General appearance.—The patient is of short stature and short-necked. His face has a bloated appearance and the eyes are somewhat prominent. He is fairly well-nourished and possesses no deformities. His expression is listless and vacant; muscular power below par. He looks too old for his age. No rigid arteries observed.

The aneurism increased considerably in size after the patient's admission, and it was found to be impossible to apply any pressure on the proximal side. The sac being apparently likely to give way and the arm being completely useless from paralysis, Mr. Heath recommended the patient to lose the limb, and amputated at the shoulder-joint on November 4th, being so well assisted by Messrs. Barker and Godlee that very little blood was lost. The axillary artery was secured with a catgut ligature, but was not dissected out at all, and the whole proceeding was conducted with antiseptic precautions.

November 5th.—The pulsation of the upper part of the tumour is as marked as before, but diminished at the lower part and over the clavicle, due to diminution of arterial tension. The whole tumour seems to have diminished in size, but as the clavicle is raised, the extent of this cannot be appreciated with exactness. The top of the aneurism seems to be not so high above the clavicle as before the operation. Temp. 99°. He is to have extra strong beef-tea, and two-drachm doses of brandy every hour. No respiratory disturbance.

6th.—Passed a quiet night. Pulse improved in character, 100. No sickness. Tongue slightly furred. Temp. 99°.

8th.—Stump dressed at 2 p.m. and looks well. Small drainage tube substituted for the larger. The aneurismal tumour has increased in size both laterally and upwards, and pulsation is more marked. Superficial veins over and about the shoulder more evident. Much hiccough (which last night had to be relieved by hypo-dermic injection of morphia), probably due to carbolic acid poisoning. The

urine is dark coloured, but less smoky, slightly acid, no sugar. Albumen equals one eighth.

12th.—Urine, sp. gr. 1010, acid, slight trace of albumen. No sugar. Hiccough gone. Stump dressed and looks well, flaps united except for drainage tube. Slight discharge. Drainage tube removed altogether. Temp. 98°. Pulse 99.

14th.—Hæmorrhage took place at 6.30 p.m. from the stump, the quantity of blood lost being, according to the house-surgeon, about four ounces. Dressings were removed and ice-bag applied. The general condition does not appear to be affected. Temp. 98°. Pulse 100.

18th.—Temp. 99°. Much discharge from the opening where the drainage tube had been inserted. Stitches giving way and edges of wound swollen and red. Passed a good night. Urine, sp. gr. 1010, acid, with still a trace of albumen. Evening temperature 99.2°.

26th.—The tumour appears somewhat larger. The area of pulsation measures $2\frac{1}{2}$ inches in its transverse diameter, and $1\frac{3}{4}$ antero-posteriorly, occupying the middle $\frac{2}{3}$ ths of the clavicle.

29th.—The size of the aneurism still increases gradually, but the patient's general condition improves. The amputation wound is nearly healed, except at the extremities. The sac of the tumour is much attenuated at its most superficial upper and inner border, the skin over which is slightly reddened. The ice-bag is still applied. The temperature for the past week has been about 98.2°, on an average, at 10 p.m. Pulse 100.

December 3rd.—Wound progressing favorably, very little discharge. The size of the tumour is, if anything, slightly increased. Temp. 99°. Pulse 88, of fair volume, but still compressible.

6th.—To-day the patient was fitted with a leaden shield prepared as follows:—A cast of the shoulder was taken in leather, from which a model of plaster of Paris was made, and upon this the lead, lined with wash-leather on its under surface, was moulded. The wound doing well. The size of the tumour does not diminish. Temp. 98°. Pulse 95.

12th.—The tumour having continued to increase in size Mr. Heath injected yesterday at 5 p.m. two drops of a solution of ergotin (= one grain of the alkaloid) subcutaneously at the *outer* border of the tumour, which to-day appears larger and somewhat flatter at its most superficial part, although the pulsation is decidedly diminished. The area of pulsation, which now assumes a more globular form, measures 3 inches transversely, and $3\frac{3}{4}$ inches antero-posteriorly, the flattened superficial part measuring in the same direction $1\frac{1}{4} \times \frac{3}{4}$ inches, and being a little more to the inner and anterior aspect of the whole tumour.

18th.—The size of the aneurism has increased to a very perceptible extent, but the pulsation is not appreciably increased, though it is somewhat more distinct than on the 12th instant. The total area of pulsation measures $3\frac{3}{4}$ inches transversely by $4\frac{1}{2}$ antero-posteriorly. The more prominent superficial part is also increased in area and is of a rectangular form, and measures $1\frac{1}{2} \times 1\frac{1}{4}$ inch. The skin over it is not tender or thinned, but slightly reddened. A vein is noticed crossing from its external border inwards. Urine, sp. gr. 1015, slightly acid, no sugar, faintest trace of albumen.

25th.—Aneurism has increased in size to a slight extent. General condition not affected.

January 1st, 1879.—During the past month the temperature of the patient at 10 a.m. was $98\cdot2^{\circ}$. To-day it is 99° , this being due to inflammatory action in the tumour, the size of which has greatly increased, and its walls are consequently getting much thinned. Mr. Heath introduced into the sac three pairs of fine sewing needles with sealing-wax heads, each pair being made to cross internally. Except for the inflammatory action about the parts, the patient makes no complaint.

5th.—Tumour much harder and flatter, pulsation less distinct. Needles removed to-day. In connection with two only was there bleeding, which was easily arrested, and the pad and shield were continued. Temp. $98\cdot4^{\circ}$. Tongue moderately clean.

7th.—Complains of a little pain in the aneurism, which feels harder. The skin over it is not so red as on the 5th inst., having been relieved by the application of belladonna and glycerine. Patient has slept well. Began the following yesterday :

R Potassii Iodidi, gr. xxx ;
 Infusi Quassiae, ℥j.
 fiat haustus ter in die sumendus.

9th.—Patient has an acute attack of coryza ; conjunctiva injected and watery ; nose very watery ; face seems bloated. The œdema over the tumour is greatly increased, extending anteriorly and externally toward the stump, which it also invades. Redness, heat, and pain increased. Glycerine of belladonna applied. Temp. 99°. Pulse 115.

Urine.—Sp. gr. 1010, neutral, slightly turbid, albumen = $\frac{1}{10}$ th, no sugar, small amount of phosphates.

Heart examined.—The systolic bruit at base already described is rather faint.

11th.—There is much redness about the parts. Temp. 99°. Pulse 135. Discontinue iodide of potassium and take the following :

R Pilulæ Scillæ compositæ, gr. v.
 nocte maneque.

14th.—Pulse 88, of good volume, and not readily compressed, but slightly irregular. Respirations 32, rather short, and diaphragmatic, but alæ nasi working only slightly. Coryzal symptoms are decreased. Temp. 98.6°. Patient does not complain of pain. His back was examined by the surgical registrar (Mr. Silcock), but no pneumonia detected. Belladonna is still applied to the tumour.

15th.—The redness of the skin over the aneurism is almost gone. The œdema, slightly diminished, is still evident. The whole tumour feels harder and firmer and though no distinct pulsation can be made out, yet the most prominent (apical) part of the tumour (externally) exhibits distinct fluctuation. The wound of arm still

secretes a little pus, and the house-surgeon thinks this is increased upon pressing on the aneurism (?).

Tongue deeply coated with a yellowish-white fur, except at apex and edges (due probably to milk coagulated). He seems altogether weaker. Bronchitis continues, but no evidence of pneumonia.

17th.—During the night the patient suffered from dyspnoea and dysphagia. He is now almost moribund. Diarrhoea is profuse and vomiting present. Temp. 98·8°. Pulse 106, very irregular, small, feeble, and compressible. Patient is now suffering from extreme dyspnoea.

In the afternoon Mr. Heath noted that during expiration the cardiac impulse was transmitted to the tumour, and further, that when the patient coughed the parts about the tumour became more tense. He was still able to feel fluctuation over the tumour at the point before described.

18th.—The dyspnoea increased during the night, and with it profuse diarrhoea. Exhaustion soon became extreme and the patient comatose. At 3.20 a.m. he died.

Autopsy, thirty-one hours after death.—Rigor mortis well marked. Some post-mortem lividity. Subcutaneous fat considerable. The second, third, fourth, fifth, and sixth left ribs strongly bent in at their junction with the cartilages, and fractured three inches posteriorly to those joints.

Lungs.—Collapsed, emphysematous, and crepitant throughout, with much congestion at bases. Large quantity of serosity is poured out, especially on squeezing, particularly from the lower lobes. No part sinks in water. Right weighs 26½ oz., left 18 oz. *Left pleura* contains about 2 oz. of a bloody serous fluid in its cavity, with some old adhesions. *Right pleura*.—A few old adhesions posteriorly at apex, and about 3 oz. of serous fluid.

Heart.—Pericardium contains about ½ oz. of almost clear serous fluid. Its opposed surfaces are adherent by recent bands of lymph, and both its layers injected and covered at most parts with fibrinous exudations, which in some parts appear quite recent, in others old. Heart weighs

15½ oz. The walls of the *left ventricle* are hypertrophied, measuring $\frac{3}{4}$ in. at thickest part. Its cavity not dilated. Mitral valves healthy. Circumference of orifice = 4½ in. Aortic valves normal, except for a small patch of atheroma on the posterior semilune, which, however, is not incompetent. *Left auricle* normal. *Right auricle* and *ventricle* normal. The consistence of the walls of the heart everywhere is natural. Præcordial fat abundant. *Aorta* exhibits patches of atheroma around the orifices of the coronary artery and opposite the edges of the semilunar valves. The arch of the aorta is also extensively atheromatous, especially about the origin of the great arteries of the head and neck and upper limbs. In some parts this has broken down into ulcers of sizes varying from a pin's head to a bean; in other parts of the transverse parts of the arch calcareous plates are seen; in fine, every stage of the atheromatous process may be observed.

The *abdominal aorta* exhibits patches here and there of atheroma, but less both in extent and stage of development than in the thoracic portion. At the bifurcation, and in the common iliacs, hardly any patches are observed. The *left subclavian* and *carotid* arteries, except close to their origin, exhibit only an occasional patch. The *innominate* artery shows more.

Abdomen contains 3 oz. of clear fluid in its interior.

Spleen rather soft and congested, weighs 2½ oz.

Liver normal, 57 oz.

Kidneys.—Capsules adherent, and so also the fat around them; each weighs 4¾ oz. On removing capsule a portion of kidney substance is torn with it, opening small cysts thereby. Surface granular, and covered with small cysts of varying sizes, from microscopic to that of pea, the larger ones formed by coalescence of the smaller. Section shows the cysts to be most numerous in the cortex, which varies in thickness from one third to half an inch. The pyramids seem smaller than normal, and are surrounded by a zone of congestion, their outline ill-defined and

pressed upon by the hypertrophied interpyramidal portions. The whole organ is tougher and firmer than normal, and measures about $4 \times 2\frac{1}{2}$ in. (at widest part).

Stomach, intestines, bladder, and urethra normal, *i.e.* macroscopically.

Brain normal, except for thickening of the membranes and general increased consistency.

The tumour.—On dissecting from above, the skin and subcutaneous tissue are found matted together, and the points of entrance of the needles can be traced deeper than the skin. Some parts of this matted tissue are deeply stained, and notably the posterior and outer part of the sac. Apparently, the sac of the tumour seems to be formed by condensed layers of cervical fascia.

Irregularly lobulated and somewhat solid in feel, and situated at the posterior aspect of the middle third of the clavicle, is the tumour, extending partly above and partly below the clavicle, between it and the first rib, for about equal distances each way. Overlapped anteriorly by the scalenus anticus and parts of sterno-mastoid, trapezius, scalenus medius and posticus muscles, it rests below on the outer half of the supra-spinous fossa, on the supra-spinatus, and upper border of subscapularis muscles; and stretched over the upper surface the omo-hyoid and platysma, scarcely recognisable, are observed. The cords of the brachial plexus at the inner and lower border are pushed aside by, and closely adherent to, the sac, and seem flattened out, as if by pressure.

There had been a comminuted fracture of the clavicle about three inches and a half from its sternal end, *i.e.* a little to the outer side of its centre, the innermost fragment overlapping the external for quite an inch. This fracture is now firmly united, and at the lower margin—close to the communication between the artery and sac—a spiculum of bone projects. The sac of the aneurism is closely adherent to the clavicle at the seat of fracture. The first rib was found to be fractured close to the subclavian groove, the fracture being ununited.

The aperture of communication of the artery with the aneurism is about an inch and a half from the thyroid axis, and measures about, but not more than, one third of an inch, and is situated on the upper and anterior part of the vessel.

The supra-scapular artery could not be found. The external jugular vein was represented by a thick fibrous cord passing over and adherent to the sac. The subclavian vein was also adherent to the sac and impervious beyond the clavicle.

The wound from the amputation had healed except for sinuses leading to the glenoid cavity, wherein the cartilage was still visible, absorption commencing in the centre.

The tumour was removed, with the scapula and clavicle and first rib, and preserved for careful dissection. The following is an account of it after dissection :

There is an irregularly lobulated heart-shaped tumour situated behind the clavicle opposite the middle, and extending above it for an inch, and below for an inch and a half. The widest and thickest part of the tumour is internal *i.e.* towards the spine. It measures in its greatest length $3\frac{1}{2}$ inches. The breadth about the centre is about $3\frac{1}{2}$ inches also, but at the inner part (base) it measures $2\frac{1}{2}$ inches, and at the outer or apex $1\frac{1}{2}$.

There can be little doubt that this patient was syphilitic, and therefore predisposed to arterial disease. It is impossible that the artery can have been punctured by the comminuted clavicle, for no immediate symptoms were observed, but it seems probable that the vessel may have been bruised or stretched by the broken first rib, and that a diseased spot in its coats may then have yielded. It will be noted that the aneurism is very distinctly sacculated, the opening into the artery being very small, whereas spontaneous aneurisms of the subclavian are more generally tubular.

The rapid progress of the aneurism, the impossibility of applying pressure on the proximal side, and the paralysed condition of the arm, seemed to justify a resort

to amputation, and I do not think the patient suffered materially from the proceeding. The effect upon the aneurism must, however, be confessed to have been negative, for any little modification of the pulsation noticed during the first few days rapidly disappeared, and the sac continued to increase in size. It will be seen in the specimen that the main artery is secured at some distance from the sac, and with a large subscapular and other branches intervening; and it may be suggested that a ligature should have been applied higher, as in Mr. Holden's case. I was deterred, however, from attempting this, both by Mr. Spence's experience, and by the difficulty which would have been experienced in controlling any hæmorrhage should it have occurred. The proceeding partakes more of the character of Wardrop's than of Brasdor's operation, and we know that the presence of intervening branches does not militate against the success of the former operation. Seeing, however, the want of success, as regards cure of the aneurism, which has followed the adoption of Sir W. Fergusson's suggestion in four cases, it may, I submit, be doubted whether the proceeding should be any further entertained.

The application of ice and the subcutaneous injection of ergotin having no effect in staying the progress of the disease, I had recourse to the introduction of steel needles into the sac, a plan by which my colleague, Mr. Marshall, had on more than one occasion produced temporary clotting to a considerable extent in an aortic aneurism. Three pairs of needles introduced obliquely so as to cross one another must offer some obstruction to the flow of blood, and favour the commencement of coagulation, and the very well-developed masses of fibrine seen in the preparation are mainly due, I believe, to their presence. The introduction of needles in the manner described was first suggested by Velpeau, and unsuccessfully practised by Dunville and Agnew (*vide* 'Agnew's Surgery,' vol. 1, p. 568, Philadelphia 1878). The method appears to me to have all the advantages claimed by the

late Mr. Charles Moore for iron wire, and by Mr. Bryant for horsehair, introduced into the sac of an aneurism, while it has the great advantage that the needles can be withdrawn at any moment. In withdrawing the needles on the fifth day there was only slight hæmorrhage from two of the openings, which was readily arrested with collodion.

I did not have recourse to galvanism, because I do not think we yet know enough of its action in relation to aneurisms. In the cases in which I have seen it employed there seemed to be considerable risk from the development of gas in the sac and the caustic effect upon the walls of the aneurism.

The administration of iodide of potassium in thirty grain doses, which was begun two days after the withdrawal of the needles, was undertaken partly on account of the reputation of the salt as a coagulator of the blood, but more as an antisypilitic. The coryza which rapidly supervened necessitated the discontinuance of the medicine, and the general low condition of the patient forbade its resumption. The chest symptoms, which gradually supervened and proved fatal, were dependent partly upon the severity of the weather and partly upon the generally weakened condition of the patient, whose nervous system became latterly so enfeebled that it was difficult to obtain information from him as regards his sensations.