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Professor Fergusson -
with R. D.'s best regards

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Ligature of the Subclavian Artery, in a Case of Hemorrhage from the Axillary Artery. By R. J. Mackenzie, M.D., F.R.C.S.E.

The following case appears to me worthy of being placed on record, not from the fact of its being one of simple deligation of one of the larger arteries having been followed by a favourable result, but from the interest which attaches itself to it, as an injury of an unusual nature: and, more especially, I think it may prove of interest, from the fact, that a very small number of cases (amounting only to six or seven) have been recorded, in which a ligature has been placed on the subclavian artery for the purpose of arresting hemorrhage from a direct wound of the axillary artery, and as I believe that the practice to be pursued in similar circumstances, would still be a matter of considerable doubt in the minds of most surgeons.

John Forrester, a married man, of thirty-five years of age, a warehouse clerk, of temperate habits.

On the 5th of November 1845, this man, on returning in the evening from his employment, found his children amusing themselves with a red-hot poker, which they had put into the fire, from which it had just been removed as he entered the room. He immediately snatched the poker with his left hand from the boy who held it, and, in making after the young delinquent to chastise him for his misdemeanour, he stumbled and fell forwards. In trying to save himself from the fall, he stretched out his left hand, which bringing the butt end of the poker to the angle of the room, where the wainscot and floor met, he fell with his whole weight on the red-hot point, which entered the right axilla, immediately behind the tendon of the great pectoral muscle.

The poker was instantly withdrawn from the deep and scorched wound, from which a few drops of blood escaped. The pain was described as extreme for about five or ten minutes, when he was greatly relieved by the application of a bread and water poultice. Great redness of the surrounding integuments supervened, with a considerable degree of fever, which confined him to bed.

The application of poultices was continued till November 13th (eight days after the occurrence of the accident.)

On the forenoon of that day, a large eschar was separated, and, on its coming away, a sudden and copious gush of blood took place from the axilla, which was partially arrested by stuffing the wound with rags, till a surgeon in the neighbourhood arrived, who applied a compress of lint, soaked in an astringent solution. As the hemorrhage, however, was not altogether arrested, further assistance was sent for from the New Town Dispensary, and Dr William Robertson soon afterwards saw the patient. The lint was then removed, and the bleeding effectually kept in control by the careful application of a compress and bandage. It was difficult to estimate the quantity of blood which had been lost, but it had probably not exceeded twenty ounces.

On the evening of the same day, as he complained greatly of the pain caused by the compress in the wound, it was removed, and, there being then no return of the bleeding, and the whole surface of the cavity having a sloughing appearance, water-dressing with oiled silk was applied. A considerable degree of fever existed, for which an antimonial solution with sulphate of magnesia was ordered.

At Dr Robertson's request, I visited the patient the following day, when I found him free from fever, and suffering little pain. The surface of the wound, which was situated in the axilla, immediately to the inner side of the biceps, and behind the tendon of the great pectoral muscle, was about two inches in length and an inch in breadth, was covered with a gray slough, and secreting a thin watery discharge. The skin in its neighbourhood was of a dark-red colour, and there was considerable hardness and infiltration around the shoulder and upper half of the arm.

As the impropriety of making any further examination of the wound was evident, I re-applied the water-dressing, and explained to Forrester's wife, that, should the bleeding return, it was to be repressed by removing the dressing, and firmly pressing her finger to the bottom of the wound. I likewise pointed out the spot where the subclavian artery might be compressed in the neck.

At seven o'clock the following morning, (Nov. 15), I was sent for on account of a return of the hemorrhage, which had occurred in a full stream on his turning himself in bed. On entering the room, I found him lying in bed in a large pool of blood, his wife on her knees over him applying most effectual pressure on the subclavian artery over the clavicle, by which means she had suc-

ceeded in having the bleeding entirely under her control. The moment the pressure was relaxed, a profuse flow of arterial blood took place, which I checked by the application of a firm graduated compress in the wound, supported by a bandage applied from the fingers to the shoulder. The quantity of blood lost appeared to be from twenty-five to thirty ounces.

On the following day (16th) there was no return of the bleeding, but he complained severely of pain in the wound, and in the whole ulnar side of the arm. He was feverish, but had slept for several hours during the night.

On visiting him the following afternoon (17th), I found the bandages again saturated with blood, and he complained of increased pain and tightness in the neighbourhood of the wound, with a feeling of cold and numbness in the hand and forearm. I removed the dressings, and the instant I took the compress out of the axilla, a copious gush of arterial blood took place, which was immediately arrested by a fresh compress, secured as before. No bleeding took place that evening, but on the following forenoon (18th), the dressings were again becoming gradually more stained with blood.

Having previously narrated the details of the case to Mr Syme, and having had the benefit of his advice as to the measures which I had already pursued, I now obtained his opinion as to the proper course to be adopted, as it was evident that compression could not be much longer continued without great risk to the patient.

It was thought, that if, on careful examination of the wound, the bleeding point could be discovered to be not far distant from the external orifice, the opening should be freely dilated, and the vessel, if possible, be tied at a sound point above the opening in its coats. In the event of this being found impracticable, one of two courses remained to be pursued, the application of a ligature to the subclavian artery, or amputation at the shoulder joint. The performance of the latter operation was certainly that attended with the greatest chance of success, and with least danger to the patient. The vessel would probably have been divided, in the incisions, above the injured point; and the patient was in a state by no means unfavourable for the performance of such an operation. Again, the free anastomosis, existing between the branches of the axillary and subclavian arteries, rendered the propriety of trusting to ligature of the latter vessel, as a means of arresting the hemorrhage, very questionable. As the patient, however, from his employment, depended for the means of subsistence on the use of his right arm, Mr Syme was of opinion with myself, that the ligature of the subclavian should be first adopted, when, in the event of a recurrence of the hemorrhage, amputation might be performed as a last resource with as much safety as before the application of the ligature.

Shortly afterwards, I visited the patient with Dr Duncan,

when we proceeded to examine the wound, with the view of ascertaining the state of the parts in the axilla. On removing the compress, no blood flowed from the wound, the edges and surface of which were sloughing, and the dressings were saturated with a thin and fetid discharge. On introducing the finger into the opening, it was found to pass upwards and inwards into the axilla, to the depth of about three inches, and at the bottom of the wound the axillary artery and surrounding nerves were found lying bare, the vessel being exposed to the extent of about half an inch. The parts in the neighbourhood were much infiltrated with blood, and the shoulder and upper part of the arm were considerably swollen and ecchymosed.

The depth of the wound and infiltrated state of the tissues rendering any operation here (at any time perplexing,) now one of extreme difficulty; and, moreover, the chance of our being able to reach the vessel at a sound point being very small, the idea of resorting to this proceeding was at once abandoned, and Dr Duncan readily concurred in the proposal to place a ligature on the subclavian artery above the clavicle.

As the room, where the patient resided, was small, ill ventilated, and badly lighted, it was thought advisable to remove him, previously to the operation, to a comfortable lodging in my own vicinity, which was accordingly done on the same afternoon. Previous to his removal, however, the compress was replaced in the axilla, and the limb supported by a bandage carefully applied from the fingers to the shoulder.

When I visited him the following morning, he was pale and exhausted, restless, and anxious that something should be done for his relief. He complained of the tightness of the bandages, which had again become saturated with blood during the night. He willingly assented to my proposal of tying the vessel, and expressed himself as anxious for the performance of the operation as soon as possible.

The operation was performed at 10 o'clock, A.M. (Nov. 19th), in the presence of Dr Davidson, Dr Duncan, Dr William Robertson, Dr Graham Weir, Dr H. Douglas, and Mr Howden, to whom I was much indebted for their kind and able assistance.

The integuments being drawn down by the hand of an assistant, an incision was made over the clavicle, the skin divided, extending from over the outer border of the clavicular portion of the sterno-mastoid for about three and a half inches outwards, parallel with the clavicle, and about half an inch above that bone. A few fibres of the platysma-myoides were divided, and the external jugular vein, which lay in the outer third of the wound, was slightly separated by the knife from its cellular connections, and held by a copper spatula to the outer side of the incision. The rest of the platysma engaged in the wound, and a few fibres of the clavicular portion of the sterno-mastoid were next divided. After a little

dissection, and the opening of the deep cervical fascia, the lower border of the posterior belly of the omo-hyoid was brought into view, below which a mass of adipose tissue protruded ; this being rather in the way of the knife in clearing the deeper parts, was dissected out and removed, when a branch of the brachial plexus was seen running across the bottom of the wound. On now introducing the finger, the insertion of the scalenus anticus into the tubercle of the rib was easily recognized, and the artery was felt pulsating to its outer side. A blunt hook being now introduced at the inner part of the wound, and the parts slightly retracted towards the sternum, a very slight dissection exposed the coat of the artery. This was laid bare to the extent of about a sixth of an inch, and a common aneurism needle easily passed around it from within outwards. The ligature was then tightened, and tied with a double knot. The edges of the wound were brought together by three points of suture, and a piece of lint, moistened in cold water, applied. One small vessel was divided at the first incision, which was twisted. The patient bore the operation remarkably well, and showed his want of consciousness of the tightening of the ligature, by inquiring, after the knot was secured, if "the tying of the thread would give him much pain."

An opiate, consisting of a drachm of solution of muriate of morphia was given. Some oozing of blood took place about two hours after the operation, by which slight tension of the sides of the wound was produced. Had the stitches been then divided, and the coagula removed, the wound might have been left in a more favourable state for union ; but, as the patient, though willing to submit to any thing which might be thought proper, was rather alarmed at any further interference, I thought it better to be satisfied with the continuance of the cold applications.

At 8 P.M., he felt quite comfortable, and had slept for three hours in the afternoon. Pulse 80; skin cool. He complained a little of heat in the arm and hand of the side on which the vessel had been tied, and the temperature of the surface of these parts was higher than the rest of the skin. The bandages, which were saturated in blood, had become dry and hard, the oozing from the axilla having evidently ceased. The compress was left *in situ*, but the bandages retaining it were cut, so as to remove, as far as possible, all pressure from the axilla. There was faint pulsation perceptible in the brachial and radial arteries. The opiate, as above, was repeated at 11 o'clock, P.M.

20th.—Slept nearly all night, and expresses himself as being free from pain and much better. Pulse 72; tongue clean and moist. The bandage was taken off from the arm and hand, and the compress gently removed from the wound in the axilla. The surface of the arm felt hot and dry, and on raising himself to sit up in bed, the limb assumed a livid colour from venous congestion. On laying him down, however, and slightly raising the

arm, the limb very soon assumed its natural colour and appearance. The edges of the axillary wound were covered by pale granulations, but the deeper part of the cavity seemed to have an unhealthy or sloughing surface. The discharge was copious and healthy. A small quantity of dry charpie was laid in the wound. Water-dressing, with oiled silk, was applied to the wound over the clavicle, which looked well. The same dressings were repeated in the evening.

21st.—Passed a restless night, but slept for two hours towards morning, and in the forenoon he appeared very well. Pulse 76; tongue clean and moist; skin cool; suppuration commencing in the wound over the clavicle. One of the stitches was removed, and a bread and water poultice applied. The arm and hand are of natural temperature and colour. The wound in the axilla, as deep as can be seen, is covered by pale granulations. Discharge healthy and diminished in quantity. The cavity was gently cleansed by means of a syringe and warm water, and charpie applied as before. Bowels freely acted on to-day by medicine.

23d.—Was rather feverish yesterday, with heat of skin and dry tongue. Both wounds, however, progressed favourably. He was ordered an antimonial solution, with sulphate of magnesia. To-day he feels much better, having slept for several hours during last night. Pulse 72; tongue clean and moist. There is a considerable degree of hardness, with slight redness around the wound over the clavicle, and strong pulsation is felt over the inner side of the incision. The remaining stitches were removed, and bread and water poultices continued. The wound in the axilla is now covered with healthy granulations, from which there is a copious discharge of healthy pus.

25th.—Going on well in all respects. Pulse 72; tongue clean and moist; bowels opened twice yesterday by medicine; sleeps tolerably well at night. A considerable quantity of coagulated blood has been discharged from the wound over the clavicle, the surface of which is now granulating and contracting, being dressed with a sulphate of zinc lotion. Axillary wound contracting, the discharge being considerably diminished. He complains of a prickling pain in the wrist and fingers, which is relieved when the discharge has free vent from the axilla. The pulsation of the radial artery is now very distinct.

29th.—A sinus was to-day discovered running from the wound in the axilla behind the humerus, which, when the patient lay on his back, allowed the matter to collect behind the posterior border of the deltoid muscle. A counter-opening was made at this point to give free issue to the matter. The discharge from the axilla has continued to be copious, but the surface of the wound is contracting, and is covered by healthy granulations. The wound over the clavicle is entirely cicatrized, except at the small

opening, where the ligature hangs out, from which point there is a slight healthy discharge.

December 7th.—The discharge from the counter-opening, which was at first pretty copious, gradually diminished, and in three or four days ceased, when the small wound closed. Since then the discharge from the axilla has been greatly reduced, and the wound in that part is now merely a superficial granulating surface, of the size of a shilling. Although the patient has a blanched appearance from loss of blood, his health has been very slightly impaired, and he now feels strong, and submits unwillingly to the necessary restrictions of diet. His only complaint is of a distressing prickling pain in the little finger and the ulnar side of the ring finger and hand. This he suffers from generally when he awakens from sleep, or after lying for a long time in one position, speedy relief being obtained by a change of posture, and slight muscular exertion of the hand and arm.

Dec. 8th.—This evening (20th day from the operation) the ligature was found lying loose in the wound, and was removed.

Dec. 22d.—The day after the separation of the ligature, the wound over the clavicle was found to be entirely healed. The axillary wound contracted rapidly, and has now been for some days firmly cicatrized. The patient has nearly quite regained his former robust health, and has resumed his occupation, being now able to write as well as before the occurrence of the accident. He still occasionally complains of slight prickling pain in the ulnar side of the wrist and hand; but this, he says, is gradually diminishing, and is already very trifling. Pulsation is entirely absent in the brachial, radial, and ulnar arteries; nor can the existence of the inosculating arteries be perceived by the finger, on careful examination of the limb.

In considering the facts of this case, it is evident that the untoward symptoms, which were to be apprehended after the application of the ligature, were gangrene of the limb, or a renewal of the bleeding from the wounded vessel, under either of which circumstances amputation must have been performed. The swollen and infiltrated state of the arm, with the feeling of cold and numbness of the hand, were conditions by no means promising for the vitality of a limb, in which the supply of blood was to be cut off from its main arterial trunk. The pressure of the compress upon the vessels and nerves of the axilla could not, I believe, have been much longer continued without producing mortification of the limb; and the possibility of diminishing, with safety, or altogether removing this pressure after the application of the ligature appeared to me to render the risk of gangrene much smaller by removing this obstruction to the venous circulation of the limb. The diminution of the swelling, which rapidly followed the cutting of the bandages and removal of the compress, showed this to be the case.

A return of the hemorrhage from the axilla was certainly the danger to be most apprehended, and was, perhaps, the only real cause of anxiety for the issue of the case. The free anastomosis, existing between the branches of the axillary and subclavian arteries, is sufficient, in general, to admit of a return of pulsation in aneurismal tumours in this situation, at a shorter or longer period after ligature of the subclavian artery. Had the re-establishment of the circulation, in the present case, proved sufficient to renew the hemorrhage, amputation must have been immediately performed, as further pressure in the axilla would then have been inadmissible.

The destruction of the coats of the vessel, however, I believe to have been of very limited extent, as rapidly fatal, and much more copious hemorrhage than appears to have taken place in the present instance, often occurs from a very trifling lesion of the arterial coats.

The surface of the wound, after the separation of the eschar, was healthy, and, as far as could be seen at the time of the operation, showed no further disposition to unhealthy action, than was probably induced by the pressure of the compress.

These circumstances led me to believe that the shrinking of the artery after the application of the ligature, and the contraction of the wound, which would probably take place after the removal of the compress, would prove sufficient to close the opening in the vessel, before the collateral circulation was established.

Had the opening in the vessel, on the contrary, been of larger size, and produced by unhealthy or phagedænic ulceration, the prognosis must undoubtedly have been much less favourable than under the conditions above mentioned.

The risk of secondary hemorrhage, at the separation of the ligature, was comparatively small, seeing that the artery at the point where the ligature was applied was sound; and all suspicions of that chronic disease of the arterial system, which is such a frequent cause of dread in similar operations for aneurism, were here absent.

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