ALARMING
SYNCOPE,
FROM THE ADMISSION OF AIR INTO A VEIN DURING AN
AMPUTATION AT THE SHOULDER JOINT.

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READ DECEMBER 12TH, 1843.

ELIZ. COUSINS, æt. 19, single, was admitted into Guy's Hospital on the 17th of May 1843, under my care, for an enlargement in the middle third of the right humerus, the swelling being particularly prominent on the outer and posterior part of the arm.

The general aspect was pale, the frame somewhat emaciated, her hair and eyes dark; in short there was every indication of a strumous diathesis. She stated that she has generally resided in London, that her health has been pretty good, although never robust, and that she has always enjoyed ample means of support. Three years since, she had an abscess in the left axilla, which, on being opened, quickly healed. Her friends describe her as being quite free from hysteria, but on her admission into the hospital her manner certainly portrayed an hysterical tendency.

She dates the commencement of her present disease eighteen months previous to her admission into the hospital, and states that the first symptom was a peculiar gnawing pain like rheumatism, extending from the shoulder to the right hand. This symptom continued until about six weeks ago, when the upper arm began to enlarge, more especially about its centre. The pain now increased to such an extent, and more particularly at night, that her rest was broken ; and at the same time the swelling gradually enlarged, until it attained its present size.

On examination, the tumour afforded to the touch a firm and uniform hardness, attended with slight pain when pressed. The bone, above and below the swelling, did not appear to be implicated in the disease ; but she complained of aching pain along the fore-arm ; the glands in the axilla were slightly enlarged. The integuments over the swelling were healthy. There was impaired motion both of the elbow and wrist joint.

After a careful examination of every circumstance connected with the case, I came to the conclusion that it was a malignant disease of the bone, and that the only chance of saving the life of the patient was by amputating the limb at the shoulder joint, which I considered preferable to sawing through the diseased humerus, although there was sufficient space to have allowed of such an operation.

I thought it advisable, however, to keep the patient for a few days in the hospital, before I subjected her to this operation, and therefore prescribed the fol-

lowing treatment :—Twelve leeches to be applied to the affected part ; a grain and a half of calomel, and half a grain of opium, to be taken at bed time, and a draught of iodine and iodide of potassium in the infusion of gentian, twice a-day. The pain was relieved by the application of the leeches, and better nights obtained from the influence of the calomel and opium. In the use of these remedies she persisted until the 23rd of May, on which day I removed the arm at the shoulder joint. The operation was performed by making a double flap, the subclavian artery being commanded' by pressure upon the first rib ; it occupied less than a minute ; there was no loss of blood, and the patient bore it with great fortitude.

The subclavian artery was immediately secured ; but compression was still retained upon the first rib as there were small vessels requiring ligature. I then proceeded to remove a gland from the axilla, which was somewhat enlarged, and while dissecting it from its cellular attachments, I distinctly heard a peculiar gurgling noise, like air escaping with fluid from a narrow-necked bottle, and at the same instant the patient fell into a state of collapse, threatening immediate dissolution : the countenance was deadly pale, the pupils fixed, and inobedient to light ; the pulse quite small and fluttering, although at intervals regular ; the respiration hurried and feeble, and, at irregular intervals, attended with a deep sigh. The patient was directly placed in the horizontal posture, the flap covered over the wound,

and retained by plaister. Cold water was dashed over her face, ammonia held to the nostrils, and a sponge filled with wine applied to the lips ; but an hour elapsed before she was sufficiently recovered to be removed from the Operating Theatre.

Upon being placed in bed, she passed her fæces and urine involuntarily ;—some wine and camphor julep, with half a drachm of laudanum, were given to her. During the reaction coming on, she uttered a continual whining cry, and maintained a constant motion of alternate flexion and extension of the right leg, while the left remained perfectly quiescent. She continually complained of pain, extending up the right side of the head and neck. Her feet being cold, warm bottles were applied, and twenty drops of *liq. opii sedativus* given. At four o'clock the wound was dressed, when some small vessels were secured, and a nerve liberated which had been included in one of the ligatures ; and to which, perhaps, the pain in the neck and head might be partly attributed. The edges of the wound were brought together and maintained in apposition by silk sutures and adhesive plaister. Twenty drops of laudanum were ordered : to be repeated if necessary.

Wednesday, Eight o'clock, a.m.—When she awoke, all the symptoms were much relieved ; pulse 150, small, irregular, and compressible. Tongue moist and white ; profuse perspiration over the whole body—keeps her eyes constantly closed.

Two, p.m.—The symptoms much the same as in

the morning ; still continual action in the right leg, with apparent loss of motion in the left. Pulse 140, feeble—seems inclined to dose, but answers perfectly coherently when spoken to—pupils still somewhat dilated—tongue moist—diaphoresis not so profuse. Beef-tea and arrowroot with wine ordered for her, when she desired it, as she takes nourishment freely.

Eight, a.m., Thursday.—Has had a better night ; dosing, but waking up at intervals with a whining cry—continues to keep her eyes constantly closed—diaphoresis less—pulse 140—still irregular and feeble—tongue moist—bowels have not been opened since the operation, but she voids her urine freely—action of the right leg continues ; the left still motionless.

On the 26th, the stump was dressed—pus of an unhealthy character exuded from the wound, which, however, at the upper part had united for two inches.

Her state was variable for the following six or seven days ; the nights were restless, and there were occasional febrile exacerbations. The action of the right leg continued, and, on one occasion, there were involuntary flexions of the left, which she had not the power of extending.

Opium was given freely with much relief, and she was allowed a nourishing diet.

On June 3rd, she was much better, and from that time rapidly improved. Tonics and support of every kind were freely exhibited ; the stump con-

tinued progressively to heal ; and on the 20th day after the operation, the ligature came away from the axillary artery.

On the 25th day she was able to sit up in a chair and take her dinner. Complains of great numbness and loss of power in the left leg, which she drags after her ; but it is as sensitive as the right, and while lying in bed, if pinched, she forcibly draws it up. On the 3rd of July, she was sufficiently recovered to leave the hospital, having no other unfavourable symptom than a slight dragging of the left leg. I have seen her several times since at Guy's in perfect health, and looking infinitely better and stronger than she did at the time of her admission.

This patient was re-admitted into the hospital the latter end of November 1843, for a tumour on the left scapula, of a similar morbid structure to that in the right arm, for which amputation had been performed. This tumour gradually increased until the period of her dissolution—the end of January 1844 ; when it had reached the upper part of the dorsal region of the spine. After having experienced, for a day or two, great pain in the lower extremities, they became paralysed, and she had, at first, inability to void her urine, and afterwards incontinence of it, with torpor of the bowels. She had a constant cough, and pain in the right hypochondrium, extending to the pit of the stomach. There was dullness on percussion in the right side of the chest ; and a few days after that had been

observed, a small hard tumour appeared over the fifth rib on this side. The treatment consisted chiefly in giving sedatives, with occasional mild laxatives.

Post mortem examination, forty hours after death, January 26th, 1844.—A large fungoid mass was found, occupying a great extent of the right cavity of the chest. The tumour growing from the left scapula and extending to the posterior part of the vertebral column, adhered principally to the second dorsal vertebra, the arch of which was pressed inwards, so as to encroach upon the vertebral canal at that part. The medulla spinalis appeared quite healthy, although it must have been slightly compressed by the vertebral arch, at the point above mentioned. The structure of the brain was perfectly healthy, as was that of the viscera generally.

Remarks.

Upon a mature consideration of the anomalous symptoms described in the case recited, I have no doubt in my own mind that they are to be attributed to the admission of air into the axillary vein during the operation; but whether the effect it produced upon the constitutional powers of the patient are referable to its influence upon the heart, brain, or both, I must leave to the consideration of the Society to decide.

Although the inflation of the veins has long been known as a means of destroying life in the lower animals, and notwithstanding the series of experi-

ments made by M. Nysten in 1811, undertaken for physiological purposes, still it was not until the year 1818 that the attention of surgeons was first invited to the subject of the entrance of air into the veins of the human subject during the performance of surgical operations, by M. Beauchêne, and, according to his opinion, one of the causes of death.*

The Royal Academy of Medicine of Paris considered the subject as one of such importance that they instituted a Commission to inquire into the circumstances under which air could be taken into the veins—what the symptoms indicating its presence, —and what the remedies to be adopted.

To ascertain the conditions necessary for the entrance of air into the veins, a series of experiments were performed upon animals, principally dogs, which seemed to prove that when an opening is made into a vein, at any point where there is regurgitation of blood into it from the force of the heart's action, (termed venous pulse,) that air is immediately admitted, and that even at a short distance from this point an admission of air may take place. But if the opening be made at a greater distance, and beyond the influence of this pulsation, no air will enter although the opening be not closed. From these experiments we may also learn that the venous pulse does not exist in the brachial and

* It seems, however, that the fact of an injurious influence from the admission of air into the veins was known to Morgagni as long back as 1517, but had been forgotten, notwithstanding he has related a case.

axillary, but is present in the subclavian and lower third of the jugular veins. It therefore follows, that although, in certain positions of a limb, air may enter an opening high up in the axillary vein, as being so near to the subclavian, yet it is not found, by experiments on lower animals, that it is capable of entering the brachial veins, nor indeed in any point a little removed from the site of the venous pulse, not even if the opening in the vein be kept patent.

The Commissioners found that the sound indicative of the passage of air into the veins was similar to that produced by the lapping of a dog or cat, and that this sound was synchronous with the inspiration; but sometimes, when more frequent, accompanied the diastole of the right ventricle, and may be heard occasionally by auscultation after the air has been admitted as a "*bruit de soufflet*," and then is synchronous with the action of the heart, and not with respiration. The constitutional symptoms observed in the human subject differ somewhat from those in lower animals: in the former, faintness immediately supervenes, the pulse is weak, small and fluttering, the respiration laborious and embarrassed, epileptic symptoms occur, and, unless reaction takes place, death quickly follows. In the latter, on the contrary, on the spontaneous admission of air into the veins, the symptoms of embarrassment do not show themselves until a longer period has elapsed from the first introduction of the air: the animal then utters cries, convulsions and

tetanic spasms follow, an involuntary discharge of urine and fæces takes place, and soon after, death ; although sometimes even after these urgent symptoms the animal will recover.

From the experiments alluded to, it appears that to destroy life in an animal, not only must the quantity of air injected into the veins be considerable, but it must be thrown in with a certain degree of force. Now in the cases recorded, where persons have been destroyed by the admission of air into the veins during surgical operation, neither force could be employed, nor can it be supposed that any very large quantity could have been admitted. Does it not therefore argue that there must be a certain condition of the patient induced to facilitate the entrance of the air, depending partly perhaps upon the oppressed, if not suppressed, action of the heart and lungs, suspended in their function from the effects of fear upon the nervous system, a state from which the lower animals are comparatively exempt ? May not also this moral influence alter the point of venous pulsation, so as to render wounds of the veins in the human subject more dangerous than in the lower animals ?

The symptoms in the case which I have had the honour to read this evening, are so similar to those related as the result of the experiments by the French Commissioners, on the introduction of air into the veins of the lower animals, as well as in the cases recorded of death in the human subject from the same cause, that I conceive there can be little

or no doubt of the diagnosis which I have formed. Indeed, the absence of any other sufficient cause for the production of such overwhelming symptoms would alone render the case sufficiently clear, without dwelling on the fact of the peculiar sound which I so distinctly heard, and at the moment the pressure was taken off the vessels.

It may also be recollected that all the symptoms corresponded to those which have been observed to occur in cases of the entrance of air into a vein, and in some of which, examination *post mortem* afforded an opportunity of ascertaining the cause of death to have arisen from this circumstance.