THE TREATMENT OF WOUNDS OF THE AIR PASSAGES.

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This subject does not appear to have received quite so much attention as it merits, and hence, having had opportunities of observing an unusually large number of cases, I venture to record my results, together with a brief account of certain improved details of treatment. Until a few years ago almost all authorities discountenanced the use of sutures in wounds opening the air passage. The risks to the patient were thereby greatly increased, and death often occurred from septic broncho-pneumonia or other inflammatory complication; at the best convalescence was tardy, and permanent aërial fistula or stenosis of the larynx or trachea frequently resulted. In 1892, however, Henry Morris¹ recorded a number of cases in which he had applied sutures with success, and Pollard² advocated the same treatment; but although other surgeons have from time to time reported isolated successful cases, it would appear that a large number of these wounds are still treated by the older method of non-suture.

During the two years whilst I was resident surgical officer at the Manchester Royal Infirmary 35 patients suffering from suicidal wounds of the throat were admitted to that institution. In 10 of the number the air passages were injured, and in 25 the wound was comparatively superficial. A brief outline of the cases in which the air passage was opened, is as follows:

CASE I.—Male, aged 55, admitted December 7th, 1894. Large wound above hyoid bone reaching on left side to posterior border of sterno-mastoid muscle. Genio-hyoid and genio-glossi muscles divided, and pharynx opened. No sutures applied; wound packed with lint soaked in warm lotion, and patient placed in a steam tent. He sank gradually, and died from heart failure eight days after admission.

CASE II.—Male, aged 34, alcoholic, admitted June 10th, 1895. Wound of thyro-hyoid membrane. Aperture in larynx closed by catgut sutures; also skin, except slightly at angles of incision; no tracheotomy tube used. Wound healed by first intention; never any rise of temperature; patient discharged ten days after accident quite well. Fifteen months later I heard that he had had no further trouble from his throat, and was in good health.

CASE III.—Male, aged 52, admitted June 18th, 1895. Skin wound 3 inches long; cut through thyroid cartilage into larynx $\frac{1}{2}$ inch long; second cut through crico-thyroid membrane 1 inch long. Wound in thyroid cartilage closed by one suture; silver tracheotomy tube introduced through opening in crico-thyroid membrane and rest of wound closed around it. Tube removed on fourth day; the opening left by it was nearly a month in closing. There were never any bad symptoms. The patient was seen fifteen months afterwards, and he was then quite well, and had had no subsequent trouble from his throat.

CASE IV.—Male, aged 32, admitted October 5th, 1895. Wound 5 inches long; left sterno-mastoid three-fourths divided, right sterno-mastoid half divided. Thyro-hyoid membrane close to thyroid cartilage opened for 1 inch. High tracheotomy performed; wound in larynx closed. Some of the sutures gave way, and an aërial fistula formed in thyro-hyoid membrane, but it had almost closed when patient was discharged, twenty days after admission. A month after discharge, I saw the man, and he was then quite well. In November, 1896, I heard from his medical attendant that "beyond the scar, he seemed none the worse for his escapade."

CASE V.—Male, aged 31, admitted December 28th, 1895. Wound $2\frac{1}{2}$ inches long; trachea, $\frac{1}{2}$ inch below cricoid cartilage, divided, and muscular fibres of œsophagus exposed; divided ends of trachea separated for 1 inch. Ends of trachea approximated by six catgut sutures, a tracheotomy tube being put in anterior part of wound. Tube removed on fifth day; a few days later the sutures holding the trachea gave way; as the wound healed, dyspnoea came on and the tube had to be replaced. On February 4th, an examination was made under chloroform and the trachea above the tube was found to be almost obliterated by cicatricial tissue. The patient was discharged on February 17th, 1896. He was readmitted on March 30th, and on April 6th, low tracheotomy having been performed, an attempt was made to remove the cicatricial tissue and to bring together the ends of the trachea on each side of the stricture: this was only partially successful, and the man was discharged on April 20th, still wearing the tracheotomy tube. His subsequent progress could not be ascertained.

CASE VI.—Female, aged 27, admitted April 2nd, 1896. Wound in crico-thyroid membrane $\frac{1}{2}$ inch long; closed with silk sutures, no tracheotomy tube. Primary union; patient discharged eleven days after admission quite well. January 6th, 1897, patient seen, quite well; no dyspnoea or dysphagia.

CASE VII.—Male, aged 54, admitted June 12th, 1896. Skin wound 4 inches long; crico-thyroid membrane divided for $\frac{1}{2}$ inch. Larynx closed with silk sutures; also skin, except at one angle, where a tube was put in. External wound suppurated and was slow in closing, but healing was almost complete when patient was discharged (July 13th). Afterwards he went to South Africa. Some time after his arrival there I heard that he was in good health.

CASE VIII.—Male, aged 60, admitted June 14th, 1896. Skin wound $2\frac{1}{2}$ inches long; wound in crico-thyroid membrane $\frac{1}{2}$ inch long, and situated $\frac{1}{2}$ inch below level of vocal cords. Patient was a very feeble man; he was

very collapsed when admitted, and no operative treatment could be undertaken for some hours. Wounds in larynx and skin closed with silk sutures; no drain and no tracheotomy tube. Acute pneumonia developed and proved fatal eight days later. There was a little emphysema of the neck for two days after admission, but beyond this the wound did well. *Post mortem*: acute croupous pneumonia of left lower lobe in stage of grey hepatisation; acute fibrinous pleurisy on left side; no septic broncho-pneumonia or pleural effusion; slight œdema of vocal cords; kidneys granular; liver fatty, and heart hypertrophied.

CASE IX.—Male, aged 36, admitted July 6th, 1896. Two wounds of air passage, one through crico-thyroid membrane, dividing one-third circumference of larynx, the other immediately below cricoid cartilage dividing trachea completely; patient melancholic. Tracheotomy tube introduced through fresh vertical slit in upper part of trachea, and wounds in trachea and larynx completely closed with silk sutures. Small drainage tube put in one angle of wound. Tracheotomy tube removed on third day; wound healed by first intention; no bad symptoms. Patient discharged fourteen days after admission, the throat being then quite well. He was admitted to Whittingham Asylum on July 30th; on December 18th I heard from the medical superintendent that his throat had given no further trouble.

CASE X.—Male, aged 60, admitted August 19th, 1896. Wound 1 inch long in thyro-hyoid membrane; skin wound 4 inches long. Larynx and skin sutured; small drainage tube in skin. Progress good with the exception of a little sloughing and suppuration at one angle of the wound. The man was discharged seventeen days after admission, the neck being then apparently almost healed. He was sent to the Union Hospital, Crumpsall. After his arrival there the suppuration increased, and some of the deep sutures had to be taken away. On November 30th, however, I heard that he was quite well; the wound was healed, and he had no difficulty in breathing and swallowing.

From an analysis of the above cases it will be seen that the position of the wound was as follows:

Above hyoid bone	...	...	...	...	...	1
Thyro-hyoid membrane	...	...	...	...	...	3
Crico-thyroid membrane	...	...	...	...	...	3
Through trachea	...	...	...	...	...	1
Through thyroid cartilage and crico-thyroid membrane (2 wounds)	...	...	...	...	...	1
Through trachea and crico-thyroid membrane (2 wounds)	...	...	...	...	...	1

In both cases where the trachea was injured, this tube was completely divided, the muscular fibres of the œsophagus being exposed.

Of the 10 cases, 2 died, 7 recovered, and 1 made an incomplete recovery. The first fatal case (Case I) was a man who had an extensive wound situated above the hyoid bone, and opening the pharynx. No sutures were applied; the patient sank gradually, and died from heart failure eight days after admission. With this exception all the wounds were sutured shortly after the accident. The other fatal case (Case VIII) was a very feeble man with a wound of the crico-thyroid membrane, who died on the eighth day from acute croupous pneumonia. The pneumonia was probably set up by the entrance of cold air into the lungs through the wound at the time of the accident, and was aggravated by the generally diseased condition of his organs. There was no sign of septic pneumonia, and hence the *post-mortem* appearances of this case rather justify than condemn the local treatment which was adopted. The case of incomplete recovery (Case V) was one in which the sutures holding together the ends of a divided trachea gave way, and thus permitted cicatricial contraction and subsequent stenosis. The remaining 7 cases made complete, and in most instances uninterrupted, recoveries; their average stay in hospital was eighteen days, and four of the number healed without the occurrence of suppuration.

The treatment adopted was not the same in all cases. Many improved operative details suggested themselves from time, and I therefore propose to give a short account of what I consider the best method of dealing with these wounds.

Whenever the condition of the patient permits he should be placed under the influence of an anæsthetic, the wound carefully cleaned, and the opening into the air passage closed by sutures. Not infrequently the patient is suffering greatly from shock when first seen, but if the primary hæmorrhage be arrested, he will usually rally sufficiently in the course of a few hours to bear the administration of an anæsthetic. If he have lost much blood, it may be advantageous to transfuse one or two pints of saline fluid into the veins.³

The best anæsthetic in these cases is undoubtedly chloroform. During the earlier stages of the operation its administration is often difficult, owing to the patient drawing in more or less air through the wound, but during the later stages, when the air passage has been closed, it can be given with much greater facility.

Having cleaned the wound with antiseptic lotion, and

arrested all hæmorrhage, the surgeon must decide whether he will completely close the air passage or will put in a tracheotomy tube. On this point it is impossible to lay down a definite rule; in many instances it is undoubtedly quite safe to close the wound in the air passage, and I adopted this procedure in 5 cases, 4 of which were successful. There is, however, some risk of subsequent œdema of the vocal cords, a certain amount of which was present in the fatal case already referred to, although in this patient death was due to an independent cause. If the wound be extensive, almost or quite dividing the larynx or trachea, it is better to employ a tube, and the same rule should be followed if the larynx be opened in the immediate vicinity of the vocal cords. Further, in wounds of the thyro-hyoid membrane, if the epiglottis be extensively injured, it is wise to perform laryngotomy or high tracheotomy before closing the laryngeal wound entirely by sutures.

Should it be deemed advisable to employ a tracheotomy tube, I am very strongly of opinion that it should not be introduced through the suicidal wound in the air passage, but that a fresh vertical cut should be made at a lower level for its insertion. After suturing there is considerable strain on the wound, owing to the movements of the larynx and trachea, which cannot be kept absolutely at rest, and the risk of yielding of the sutures is greatly increased if they be weakened by a portion of the wound being left open in front for the insertion of the tube, and if they be subsequently disturbed by the changing of the tube for purposes of cleaning. In two of the earlier cases the tracheotomy tube was introduced through the suicidal wound; in one (Case III) the tube was removed on the fourth day, but, although the sutures did not give way, an opening into the larynx was left which did not heal for nearly a month; in the other (Case V) the trachea was completely divided, the ends being retracted for nearly an inch; they were approximated by sutures, and a tracheotomy tube was put into the anterior part of the wound; the tube was removed on the fifth day, but a few days later all the sutures gave way, cicatricial contraction gradually took place, and the man recovered with permanent stenosis of the trachea. I regret very much the incomplete recovery of this patient, for I have little doubt that if a fresh opening had been made for the tube, he would have recovered completely, and would not have been condemned to wear a tracheotomy tube for the rest of his life. In two cases (Nos. IV and IX) a tube was considered advisable, and a fresh vertical cut made for its insertion; in both the tracheotomy wound healed rapidly after the removal of the tube, illustrating the fact that vertical cuts into the larynx or trachea as a rule unite much more readily than transverse cuts. It is usually unnecessary to make a fresh incision through the skin, in order to open the trachea for the insertion of the tracheotomy tube. If the œsophagus or pharynx be injured, the opening must be closed completely by fine sutures introduced by means of a curved needle.

Attention should now be turned to the suturing of the wound in the air passage, a procedure requiring great care and patience. Full-curved needles held in a needle-holder will be most useful, and it will be found best to introduce all the sutures before tying any. The sutures should be prevented from penetrating the mucous membrane, but they should be made to include a considerable portion of the fibrous and cartilaginous parts of the tube. Having introduced as many sutures as are necessary to close the opening completely they must be tied, the posterior parts of the wound being first brought together. As to the number of sutures, in cases where the trachea is completely divided from eight to ten will be necessary; other cases will require a smaller number according to the size of the wound. The material I have chiefly used for sutures in these cases is silk, recently sterilised by boiling; it is strong and reliable, and is only open to the objection that if suppuration takes place, it may give rise to subsequent trouble (Case X). This disadvantage, however, is far outweighed by the disadvantages of catgut, which is unreliable when there is so much tension.

Having closed the air passage, the other parts of the wound must be treated in accordance with ordinary principles. The sterno-mastoid and the infra-hyoid muscles are usually more or less injured, and it is necessary to approximate the retracted end by sutures. Owing to the platysma muscle being

divided transversely there is usually great inversion of the skin, which must be corrected before the edges of the wound can be brought into good apposition. Frequently there are several secondary cuts—I have seen as many as fifty—from the presence of which the edges of the main wound are often jagged and require trimming before they can be sutured satisfactorily. It will usually be necessary to insert a small drainage tube at one or both angles of the wound. Throughout the operation it is essential to adopt all antiseptic precautions, for it is only by care in this respect that the systematic suturing of wounds of the throat has been rendered safe. If all precautions be taken it will be found that a very large proportion of the wounds will heal by primary union.

SUBSEQUENT TREATMENT.

If a tracheotomy tube have been used, it is well to place the patient in a steam tent for twenty-four or forty-eight hours. Provided that no bad symptoms arise, the tube may be removed with safety on the second, third, or at the latest the fourth day. In some cases I have retained the tube for a longer period, but I now regard this as unnecessary, and as calculated to prolong the period of recovery. The dressing on the wound will require frequent changing, especially if a tracheotomy tube have been used. The skin sutures, unless they are causing irritation, should be left *in situ* for ten or twelve days; if removed earlier there is risk of the scar giving way. Throughout the treatment it is essential to keep the parts at rest as much as possible, but I see no necessity for adopting the old method of bringing down the chin to the sternum; all that is necessary is to keep the patient recumbent with the head raised on an ordinary pillow, and to steady it by a band across the forehead and a sandbag on each side. One of the most important questions in the after-treatment is feeding. I am convinced that it is unnecessary in most cases to feed by a tube or by the rectum, and that the patient may with safety be allowed to swallow fluid food. In cases, however, where the epiglottis is injured, where the larynx or trachea is completely divided, or where the pharynx or œsophagus is opened, it is better to adopt rectal alimentation for two or three days.

The use of sutures is also advisable in all cases of suicidal wounds of the throat not involving the air passage, provided that the general condition of the patient is sufficiently good. Of the 25 cases of this description which came under my notice 21 were treated by primary suture, 19 of which healed by first intention; 1 was packed with iodoform gauze and allowed to granulate, and 3 died, all within a few hours of admission. The fatal cases were (1) a man, aged 43, who was in the last stage of phthisis, who was moribund when admitted, and died an hour and a half afterwards; (2) a man, aged 35, who had lost a great deal of blood, and who died four hours after admission; and (3) a man who had attempted suicide during the delirium of pneumonia, and who died fourteen hours after his arrival at hospital.

SUMMARY.

1. Suicidal wounds of the throat should be treated by primary suture in all cases where the general condition of the patient permits.
2. Antiseptic precautions are most important.
3. If necessary, chloroform should be administered, and is perfectly safe.
4. Divided muscles should be sutured, and in bringing together the edges of the skin the inversion caused by the platysma muscle should be corrected.
5. The wound in the air passage should be completely closed.
6. In many cases it is quite safe to dispense with the use of a tracheotomy tube. If a tube be deemed necessary it should not be introduced through the suicidal wound in the air passage, but through a fresh vertical cut at a lower level.
7. Silk is the best material for suturing the larynx or trachea.
8. During the after-treatment it is unnecessary, except in certain special cases, to feed by a tube or by the rectum.
9. If the above methods of treatment be adopted, not only will a very large proportion of even dangerous and extensive wounds of the air passages recover, but the period of recovery will be greatly shortened, the patient will not be exposed to

the same risks of secondary inflammatory complications, and he will be much less liable to the occurrence of permanent stenosis of the trachea or the formation of an aërial fistula.

I have to thank the honorary surgeons of the Manchester Royal Infirmary for their kind permission to publish these cases.

REFERENCES.

¹ *Lancet*, 1892, vol. ii, p. 1427. ² *Ibid.*, p. 1532. ³ A case of wound of the common carotid artery and internal jugular veins in which recovery followed ligation of the injured vessels and transfusion of saline fluid has been recorded by W. T. Thomas, *BRITISH MEDICAL JOURNAL*, 1895, vol. ii, p. 1420.

TWO CASES OF ACUTE INTESTINAL OBSTRUCTION DUE TO ADHESIONS, IN ONE OF WHICH ENTERECTOMY AND ANASTOMOSIS BY MAUNSELL'S METHOD WERE PERFORMED.

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THESE two cases resemble each other only, in so far that the obstruction in each case was the result of previous peritoneal inflammation, due in the first case to an operation for ovarian disease, and in the second to perimetritis after parturition. In the first case the patient came to the hospital at once, and the operation was performed within a few hours of the onset of the symptoms, so the gut was naturally not damaged; while in the second case the symptoms had existed for nearly eleven days before admission, and so the constricted part of the gut was so damaged as to necessitate enterectomy. Although both cases made perfect recoveries, the greater severity of the operation required in the second case shows how much the risk to life is increased when abdominal exploration is not performed at an early period in cases of acute intestinal obstruction.

CASE I.—E. S., aged 28, was admitted into the West London Hospital on June 27th, 1895. She was suffering from acute abdominal pain and vomiting, and stated that five months previously she had undergone double ovariectomy at another hospital. During convalescence there had been a faecal discharge from the wound, which, however, had stopped for about six weeks, the wound being now soundly healed. She still, however, had some abdominal pain from time to time. Two hours before admission she was seized with acute pain referred to the umbilical region, and she vomited several times. On admission the patient was doubled up with pain, and the abdomen was slightly distended and extremely tender. The patient vomited two or three times after she was put to bed. The pulse was rapid and feeble, and the patient was restless and perspiring.

After consultation it was decided to perform a laparotomy immediately, and this was done within two hours of the patient's admission.

The abdomen was opened in the line of the old cicatrix, and a loop each of the ileum and of the sigmoid was found densely adherent to the abdominal wall. One of the appendices epiploicæ of the sigmoid loop was adherent to the abdominal wall a short distance away, and so formed a band under which a portion of the ileum, just above the adherent portion, had been caught and was strangulated. This band was divided between two ligatures, and the loops of ileum and sigmoid were freed from their dense adhesions to the abdominal wall, after which they both retracted some distance from the wound. The strangulated portion of the ileum was congested, and showed a deep sulcus where the constriction had existed, but was not damaged. The omentum was carefully arranged beneath the incision so as to obviate any chance of adhesions between the bowel and the new scar, and the wound closed.

The patient made an uninterrupted recovery, and left the hospital perfectly well at the expiration of three weeks after the operation.

CASE II.—J. C., a healthy woman, aged 42, was admitted into the West London Hospital on April 7th, 1896. She had been confined of twins eight weeks previously, and on the third day after delivery she developed some form of perimetritic inflammation which she described as "milk fever."

Although she recovered from this trouble, she continued to have from time to time attacks of pain in the pelvis, and on March 28th she had an attack of severe abdominal pain accompanied by distension and followed by vomiting. From that date the vomiting, abdominal pain, and distension had increased every day, and had been treated by croton oil, sulphate of magnesia, and other purgatives without effect. During the forty-eight hours previous to admission the vomit had become faecal.

On admission, the patient looked very anxious, and her face was pale, pinched, and drawn. The pulse was 140 per minute, very small, rapid, and running. The tongue was brown and rather dry, and the breath had a distinctly faecal odour. The abdomen was greatly and uniformly distended, and was tympanitic all over, but there was not much pain; coils of intestine could be seen moving beneath the abdominal wall. As no hernial protrusion could be discovered, obstruction by a band was diagnosed. An operation was performed three hours after admission, chloroform was given, and the abdomen was opened by a median incision $3\frac{1}{2}$ inches long below the umbilicus. The cæcum was first examined and was found to be contracted, so the small intestine, which was much distended, was brought out of the wound, coil by coil, and examined. After 6 or 8 feet had been examined and replaced, a band was found which slightly constricted the bowel; this was divided between ligatures, but as the gut beyond the bowel was distended the search was continued, and a tight band was found on the left side of the pelvis which was adherent to and strongly nipped the gut. This band was also divided between ligatures, and it was then discovered that the intestine itself was also adherent to the brim of the pelvis. After separating these adhesions, the damaged bowel was examined, and as it was deeply congested, and its peritoneal coat was dull and abraded for about 3 inches, it was decided to resect the damaged part. Sponges were packed in the wound, and the loop of bowel brought outside the abdominal cavity; it was clamped above and below between safety pins and sponges, and nearly 4 inches with a piece of mesentery were removed. The two ends were then united by Maunsell's method, the longitudinal incision being closed with a continuous suture, and the mesentery being united with three interrupted sutures. On examining the anastomosis, the mucous membrane was found to be protruding at one or two points, so a row of Lembert's sutures was inserted all round the joint. The abdomen was sponged out, and the wound closed with silkworm gut sutures.

The patient rallied well after the operation, and only vomited very slightly. On the following day, brandy, milk, and barley water were given by the mouth, and as no flatus escaped on passing a rectal tube, an enema was ordered but without any result, as the rectum was blocked with stony faeces. About midday on the second day after the operation, the bowels acted four or five times copiously without any further enema, and all the abdominal distension disappeared. The patient, however, became considerably collapsed, but rallied after champagne and hypodermic injections of strychnine. At 9 P.M. she became much worse, and appeared almost moribund; her pulse was small and flickering, and the skin was cold; she also vomited slightly. My house-surgeon, Mr. Pardoe, immediately injected 4 pints of normal saline solution into the median basilic vein; almost directly after this the pulse became firm and full, and there was no more vomiting. The further progress of the case was quite uneventful. The patient took nourishment freely by the mouth and made a steady progress; her convalescence, however, was retarded by a bed sore, which had existed before her admission to the hospital. She got up on April 24th, but had to remain in hospital till May 22nd to allow of the complete cicatrization of her bed sore. During the first fortnight she occasionally had slight attacks of abdominal pain and slight distension, which, however, were relieved by enemata; a hard lump, too, could be felt in the left iliac region at the site of the anastomosis, but this could not be felt when she left the hospital. When last seen, four months after the operation, she was in excellent health, and did not have any trouble with her bowels.

REMARKS.

Although several cases of acute intestinal obstruction after ovariectomy have been recorded, such cases are always of