

In total oesophageal reconstruction, try, try and try again

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Reconstruction of the oesophagus was not attempted until the late 19th century. Over the next 100 years, various reconstructive techniques proliferated, initially for malignant disease but subsequently for end-stage oesophageal failure from a variety of benign conditions. The earliest and simplest technique of applying a split-skin graft over a tubular stent was associated with poor graft survival and a risk of mortality from stent erosion into vital structures in the mediastinum.¹ Management has evolved since then. The use of the pedicled colon has become a popular choice for the thoracic portion.

Replacement of the cervical portion is commonly achieved by either free jejunal transfer or the free radial forearm flap. The literature is reviewed and a case report is presented in which three salvage options were exercised after partial failure of colonic transposition for total oesophageal reconstruction.

Case report

A 25-year-old man who had attempted suicide by ingesting battery acid was admitted to hospital in a moribund condition with severe mediastinitis. At thoracotomy on day 4 the entire necrosed oesophagus was debrided. A feeding jejunostomy was also created. After appropriate management of the patient's septic state he made an uneventful recovery.

At 4 months the general and thoracic surgeons performed a pull-through retrosternal colonic transposition to replace both the cervical and thoracic portions of the oesophagus. The ascending and part of the transverse colon was used, basing the blood supply on the middle colic artery. The transition to normal pharynx from the involved cervical oesophagus was difficult to ascertain since, despite mucosal healing, there was some degree of fibrosis at the site of the anastomosis. The cut edge of the colon tube most distant from the blood supply was pink, healthy and bled well. However, a short segment was scarred and completely stenosed.

One month later a free jejunal flap transfer was performed. The 16 cm of jejunum was anastomosed end-to-side to the laryngopharynx proximally and end-to-end to the normal

colon at the level of the sternal notch distally (Fig. 1). No attempt was made to excise the stenosed colonic segment because it was densely fibrotic and no lumen was present. The conduit was placed posterolateral to the larynx and trachea. The microvascular anastomosis was performed to

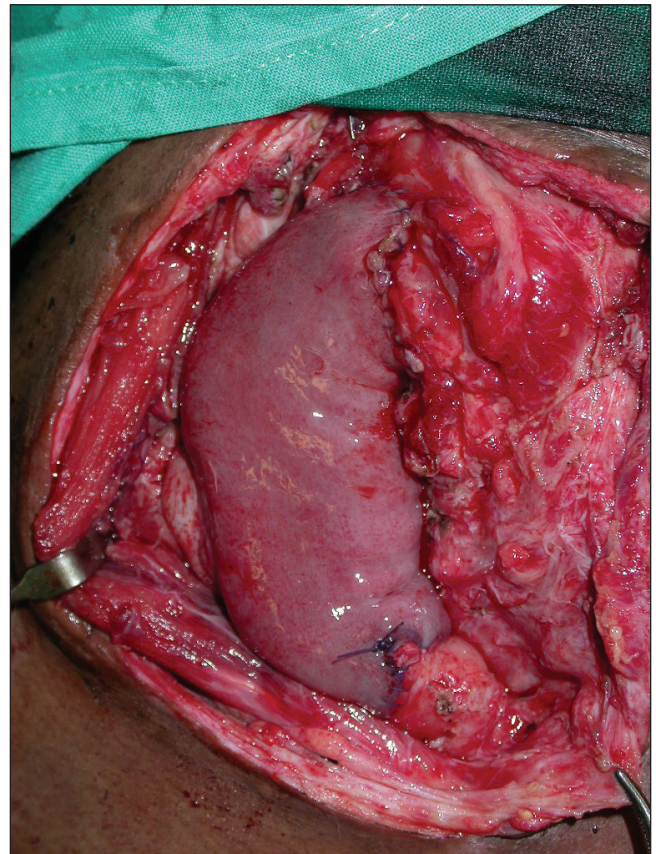


Fig. 1. Vascularised jejunal free flap *in situ* with an end-to-side anastomosis to the laryngopharynx above and an end-to-end anastomosis to the unstenosed portion of the previously transferred pedicled colon just above the sternal notch.

the external jugular vein and the transverse cervical artery. A small segment of the flap was left exposed for monitoring. On the morning of day 20 the flap was very congested. At exploration it could not be salvaged and was excised. The flap was immediately replaced with a skin graft wrapped around a stent to bridge the gap in the cervical oesophagus (Fig. 2). The stent was brought out through the mouth. The patient removed stent and skin graft on his return to the ward as he failed to tolerate it.

We then attempted to reconstruct the cervical oesophagus with a free tubed radial forearm flap raised with a 12 cm pedicle. The microvascular anastomosis was performed to the contralateral facial artery and the superior thyroid vein. Postoperatively minor wound breakdown occurred, resulting in a fistula. At 2 months surgical closure of the fistula was obtained (Fig. 3). Finally, 10 months after the initial incident, an upper gastro-intestinal tract scope and swallow fluoroscopy demonstrated a good conduit from the pharynx to the stomach (Fig. 4). No anastomotic narrowing was noted. The jejunostomy was closed and the patient commenced swallowing of both solids and liquids immediately. No rehabilitation was instituted. At follow-up after 1 year the patient's swallowing was equivalent to the premorbid state.

Discussion

The literature favours a multi-staged reconstruction of the total oesophagus with the pedicled colon for the thoracic portion, while the cervical portion is replaced with a free jejunal or radial forearm flap in a second procedure.² A third procedure then connects the stomas of each bowel in the

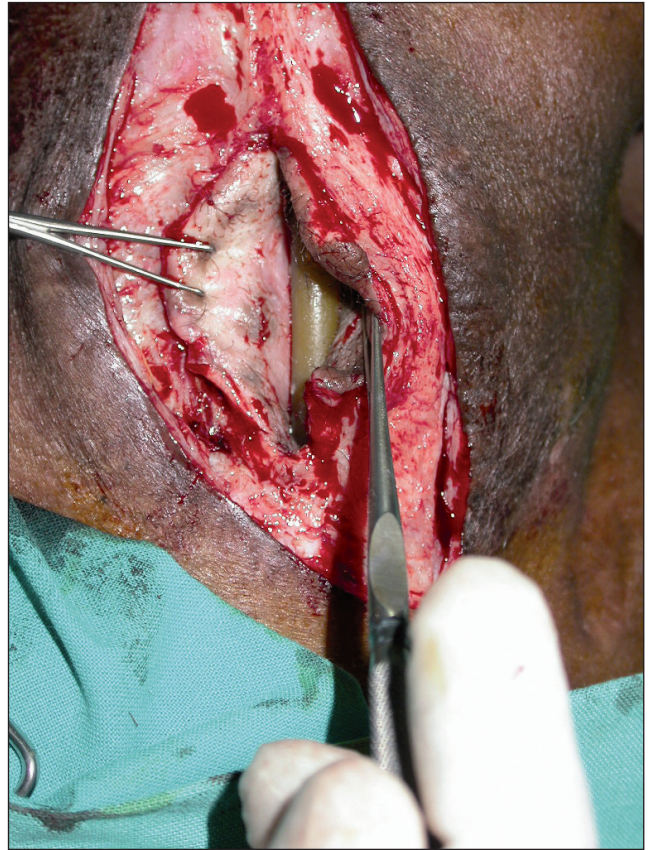


Fig. 3. The reconstructed cervical oesophagus with the free radial forearm flap is seen during fistula repair.



Fig. 2. Partial-thickness skin graft wrapped around a stent that is intubated from the pharynx above to the colon end below.



Fig. 4. Barium swallow demonstrating good patency of the neocervical oesophagus.

neck. The procedure, which can be done as a single-stage reconstruction, is a gastric pull-through with less likelihood of ischaemic problems than the one-stage colonic transposition. A single-stage colon transposition is a controversial, more complicated alternative procedure with a higher risk of ischaemia because the stomach is not available to restore gastro-intestinal continuity.

Clearly, total reconstruction with the pedicled colon flap in this case was controversial. There are several reasons for partial or total failure of this flap. Isolating the blood supply on the middle colic vessel makes the two vascular right colic and ileocolic territories dependent on it, rendering the blood supply in the most distant ileocolic territory tenuous. This is further compounded by not having enough colon length to prevent tension or stretch at the anastomotic site. Terminal necrosis of the most distal part of the interposed flap is potentially a serious complication, but total necrosis of the flap can occur owing to twisting or thrombosis of the main arterial or venous inflow or more commonly the venous outflow, which can occur acutely or several days later.³ Other factors that can contribute to ischaemia are: (i) damage of the vascular pedicle during preparation; (ii) the pull-push manoeuvres of the flap through the mediastinum; and (iii) a narrow orifice to the tunnel together with swelling of the flap and surrounding tissue during the perioperative period.

Whatever the mechanism, after about 3 weeks our patient had a short, completely stenosed segment, and further reconstruction was needed. The jejunum was used as the flap of first choice for reconstruction of the cervical portion. The facts that it is a natural conduit and has propulsive peristalsis support its use as a flap.² However, its disadvantages are that it is technically demanding to harvest and the necessity for bowel and intra-abdominal surgery carries a potential risk. The critical warm ischaemic time is 3 hours, and it is very sensitive to ischaemia, secreting copious mucus proportional to the length of ischaemia.⁴ We were not able to determine a cause for the unusual flap loss at day 20, but it is highly probable that prolonged compression on the vascular pedicle and/or kinking of the jejunum resulting from the position of the patient's neck while he was asleep was a contributory factor. Our subsequent attempt to reconstruct the defect with a skin graft tube was nothing other than an act of desperation. It is a method that is best condemned.¹ The best solution for the loss of one free flap is often another free flap.

The radial forearm flap, our second choice flap, worked perfectly once the minor complication of the fistula was surgically managed. In one of the largest studies, 70 free jejunal flaps were compared with 39 free radial forearm flaps.⁵ The authors reported that significantly more fistulas and strictures developed in the radial forearm than in the jejunum. Donor site morbidity was lower in the radial forearm group, however, and there was no case of total flap necrosis. They nevertheless concluded that the jejunum should be the first choice for a flap owing to the significantly greater number of fistulas and strictures in the radial forearm group (fistulas 3/70 v. 15/39, $p < 0.0001$, and strictures 6/64 v. 13/33, $p = 0.0008$).

Reconstruction with a tubed free forearm flap can provide a thin pliable fasciocutaneous conduit, and with time the skin lining takes on the appearance and quality of mucosa. The use of the jejunum, which provides mucosal lining, may be advantageous, but it is possible that the role of peristalsis in a short segment of neo-oesophagus is overrated.⁵

Another study recommended the radial forearm flap as first choice. It offers the combined advantages of rapid harvest with minimal morbidity, a long flap pedicle, extraordinary reliability and the possibility of customisation to fit nearly any defect.⁶ These authors did acknowledge an increased fistula rate, but most resolved with a brief period of conservative treatment.

Gastric pull-through is an attractive one-stage operation option for the general surgeon. The specific problems are loss of gastric capacity, ulceration, bile reflux and direct dumping of food into the jejunum affecting the quality of patient's life. The major drawbacks of the combined colonic transposition and free-flap reconstruction of the entire oesophagus are that it is multistaged and time-intensive. As demonstrated in our case, use of the colon alone to achieve a single-stage operation places the distant blood supply at risk of ischaemia. One option may be to supercharge the distant end of the colon flap to the vessels in the neck by means of a micro-anastomosis. Although this use of the colon has not been described in the literature, the supercharged pedicled jejunum has been used for total oesophageal replacement.

Conclusion

Oesophageal reconstruction is a challenge, but functional restoration is obtainable. The technique chosen must be familiar to the operating team and all necessary steps must be taken to preserve an adequate blood supply. It is important to abide by the rules of the proven multistaged reconstruction to avoid complications. Free-flap failure is always a risk, but in the event of loss it should be replaced with another that does not compromise on the quality of the reconstruction. A one-stage supercharged colon pull-through operation deserves further study to determine its reliability.

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