# Esophageal replacement by gastric tube: is three-stage surgery justified?

Jiledar Rawat[a], Anand Pandey[a], Sunita Singh[a], Sarita Singh[b] and Shiv N. Kureel[a]

***Background*** **Long gap esophageal atresia with or without tracheoesophageal fistula is a challenging problem. We present our experience with the three-stage surgery technique.**

***Materials and methods*** **All patients with long gap esophageal atresia were operated by gastric tube esophagostomy in the second stage and esophagostomy closure in the third stage. The patients were then evaluated for intraoperative and postoperative complications, need for a ventilator, and follow-up.**

***Results*** **There were a total of eight patients. There were no intraoperative complications. There was no anastomotic leak in any patient. One patient died in the postoperative period because of respiratory distress. Follow-up of the remaining patients was satisfactory.**

***Conclusion*** **Three-stage surgery may avoid respiratory complications because of the short operative time and less intervention. Anastomotic leak and stenosis in the long esophageal suture line may also be avoided. This may be a useful alternative under a resource-limited condition, with optimal outcome.** ***Ann Pediatr Surg*** **10:7–9 © 2014 Annals of Pediatric Surgery.**

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Departments of [a]Pediatric Surgery and [b]Anesthesia, King George's Medical University, Lucknow, Uttar Pradesh, India

Correspondence to Anand Pandey, MS, MCh, Department of Pediatric Surgery, King George's Medical University, Lucknow 226003, Uttar Pradesh, India
Tel: +91 522 2257825; e-mail: dranand27@rediffmail.com

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## Introduction

Long gap esophageal atresia is 'in the eyes of the beholder' as some authors defined it as a gap of more than 2 cm or two vertebral bodies between the upper and the lower pouch; some agree with a gap length of more than 3 cm. Most pediatric surgeons agree that a gap of more than 5 cm is generally accepted as a long gap as it is not amenable to primary repair [1]. Long gap esophageal atresia with or without tracheoesophageal fistula is a challenging problem. The dictum that 'The best esophagus in children is his/her esophagus' does not hold true for pure esophageal atresia (PEA) [2]. Among various surgical techniques for replacing esophagus [3], a gastric tube is a good alternative.

This is usually accomplished either in single or in two stages. We present our experience with the three-stage technique.

## Materials and methods

This was a retrospective study carried out from January 2006 to January 2010 in the Department of Pediatric Surgery at the Medical University. The study was approved by the Institutional Review Board. A retrospective review of eight cases of PEA, treated at birth by cervical esophagostomy and feeding gastrostomy, was carried out. The contrast study through gastrostomy was carried out to ensure adequate gastric capacity.

Echocardiography and ultrasonography abdomen were performed to look for the VACTERL anomaly. In the second-stage surgery, an isoperistaltic gastric tube, on the basis of the right gastroepiploic artery, was made (Fig. 1). Depending on the diameter of the upper esophageal pouch and the age of the patient, the tube was made of over 24–28 Fr red rubber tube. It had a length sufficient enough to reach 2–3 cm above the manubrium sterni. After creating a retrosternal tunnel, the gastric tube stoma was placed adjacent to the previously made cervical esophagostomy (Fig. 2). As the gastrostomy was placed at lesser curvature, it was left undisturbed. The feeding jejunostomy was also performed for future feeding purposes. In the immediate postoperative period, active suction was performed through a gastrostomy tube. The jejunostomy feeds were allowed on the third postoperative day. At the time of discharge, the patients were advised on sham feeding, jejunostomy feeding, and stoma care. The

**Fig. 1**

Isoperistaltic gastric tube based on the right gastroepiploic artery. Linear cutter stapler is used to create it.

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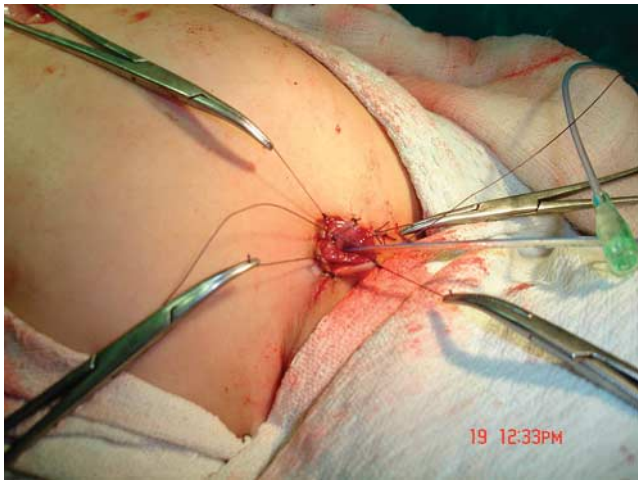
**Fig. 2**




Gastric tube ostomy in the cervical region in the second stage of surgery.

jejunostomy tube was removed after 3 weeks, followed by gastrostomy feeding. The third-stage surgery was performed after about 3 months. It was preceded by a contrast study through cervical neoesophagostomy to look for its patency and nonredundancy of the gastric tube. In the third stage, esophagogastric tube anastomosis was performed. In both stages of surgery, the mean operative time, mean blood loss, complications, requirement of intensive care or ventilatory support in postoperative period, and mean hospital stay were recorded. An oral esophagogram was performed after 4 weeks to look for adequacy of anastomosis. Once the children were receiving adequate oral intake, the gastrostomy tube was removed.

## Results

A total of eight patients with PEA, in whom esophagostomy and gastrostomy was performed at birth, were admitted to our department. The male to female ratio was 3 : 1. The mean weight at the time of surgery was $9.52 \pm 0.56$ (range 8.2–10.8) kg. The mean age at surgery was $8.5 \pm 1.25$ (range 6–12) months. None of these patients had any other component of VACTERL association. The mean time of surgery in the second stage was $90 \pm 4.0$ (range 80–100) min and that in third stage was $35 \pm 5.77$ (range 30–40) min. In the postoperative period, one patient developed respiratory distress, 24 h after the third stage of surgery, and was kept on a ventilator. Unfortunately, he died on the third postoperative day. The probable cause of respiratory distress was bronchospasm. The mean duration of hospital stay was $7.75 \pm 0.47$ (range7–9) days in the second stage and $4.66 \pm 0.33$ (range 4–5) days in the third stage. In the follow-up, none of our patients had any complication.

## Discussion

The first successful use of a gastric tube was in two patients of esophageal stricture [3]. Besides PEA, esophageal replacement may also be needed in cases of anastomotic dehiscence where primary repair of esophageal atresia is performed [4]. Although many procedures have been described for its management, each one has its advantage and disadvantage [3].

Delayed primary end-to-end anastomosis repair with upper pouch suction or feeding gastrostomy with suction of the upper esophageal pouch before definitive surgery is not practical in our setting because many babies are referred from remote areas. Their parents are not enough educated to perform the suction properly; hence, there is an increased risk of pneumonia. Besides this, prolonged wait for surgery can result in more psychological trauma to the parents [1]. Circular or spiral myotomies of the upper pouch during anastomosis increase the risk of pseudodiverticula formation and has a deleterious effect on anastomosis healing [5]. Foker's esophageal elongation has an additional risk of lost sutures during the elongation process [1]. The extrathoracic elongation process (Kimura's process) leads to a risk of early esophageal stump tear, perforation, pseudodiverticula formation, increased esophageal dysmotility, and long-term increased risk of esophageal stricture [6].

Currently, esophageal replacement is the most widely accepted procedure, where the choice of conduit has shifted from the colon and jejunum to gastric transposition or gastric tube esophagoplasty [1,7,8]. The gastric tube is preferred over the colon or jejunum because of its acid resistance, ability to retain a tubular shape without dilation, and less chance of vascular insult. Besides, the thick wall of the esophagus resist infection, which may be present due to previous leak in thorax [2,3,7–9].

In developing countries, there is a relative deficiency of health resources and economical resources. Even in experienced hands, the outcome is affected by the preoperative and postoperative management. Because of the limited resources, we are performing esophageal replacement in three stages. In the first stage, cervical esophagostomy with feeding gastrostomy was performed. Cervical esophagostomy prevents aspiration pneumonia, whereas gastrostomy feeding allows increasing gastric capacity [3,8,10].

The retrosternal route prevents the risk of mediastinitis and the dissection is minimal [2,3]. Besides this, we have observed that this is the shortest route for the isoperistaltic gastric tube. Moreover, this route prevents angulation of the tube. The esophagogram of neoesophagus helps to ensure its patency and no redundancy, thereby ruling out any vascular insult to it. In the third stage, cervical esophagogastric anastomosis requires minimal dissection, which further saves the vascular supply of both ends. The gastrostomy serves to protect the anastomosis from reflux of gastric juice. Early jejunal feeding decreases the complications of parenteral fluids, with early postoperative recovery and discharge.

The advantage of three-stage repair is the short operative time at each stage, minimal or no need for a pediatric ICU, decreased complications of fluid therapy, and decreased risk of acid reflux. Before proceeding to the third stage, we ensured that the conduit is healthy. Although it did not occur in any of our patients, if there had been an anastomosis leak, it would have been dealt

by the gastrostomy and there would have been no leakage in the chest.

It can be argued that the two-stage surgery shortens the total operative time; however, it will affect the long suture line and the cervical anastomosis simultaneously, which is not the case with the three-stage procedure, where long suture is prevented from being functional by creating a cervical ostomy.

There are certain limitations to this study. This is a retrospective study. The total number of patients and the follow-up is short. Because of limited resources, we were unable to wait and watch in a belief that native esophagus will grow for primary anastomosis. Hence, we cannot preserve native esophagus in its totality in patients of PEA. Also, there was no comparison with patients who underwent a two-stage repair.

Thus, our observations can be considered more subjective than objective. However, on the basis of our follow-up and the status of the patients, we believe that the three-stage procedure is applicable in situations where ICU facilities are limited. During the follow-up, no patient developed complications such as stricture, gastroesophageal reflux, peptic ulcer, perforation, empyema, Barrett's syndrome, etc, as described in the literature [1–3].

## Conclusion

Three-stage surgery may avoid respiratory complications because of short operative time and less intervention. Anastomotic leak and stenosis in a long esophageal suture line may also be avoided. This may be a useful alternative under a resource-limited condition, with optimal outcome.

## Acknowledgements

### Conflicts of interest

There are no conflicts of interest.

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