Original Article

Transhiatal Isoperistaltic Colon Interposition without Cervical Oesophagostomy in Long-Gap Oesophageal Atresia

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Abstract

Background: Oesophageal colonic interposition in oesophageal atresia (OA) patients is almost exclusively done as a staged operation with an initial oesophagostomy and gastrostomy followed by the definitive surgery months later. This study presents a series of patients in whom a cervical oesophagostomy was not performed before the substitution surgery. **Patients and Methods:** Records of EA patients were evaluated for those who underwent colon interposition without cervical oesophagostomy. **Results:** There were five patients: three with pure EA and two with proximal tracheo-oesophageal fistula. A delayed primary repair could not be performed because of intra-abdominally located distal pouch. The mean age at the time of definitive operation was 5.54 (±2.7) months and the mean weight was 6.24 (±1.3) kg. A right or a left colonic segment was used for interposition keeping the proximal anastomosis within the thorax. The post-operative results were quite satisfactory within a median follow-up period of 33.2 months. **Conclusion:** Avoiding cervical oesophagostomy and its inherent complications and drawbacks is possible in a subset of patients with long-gap EA who underwent colonic substitution surgery. This approach may be seen as an extension of the consensus that the native oesophagus should be preserved whenever possible, because it uses the native oesophagus in its entirety.

Keywords: Colon interposition, oesophageal atresia, oesophageal substitution, oesophagostomy, long gap

Introduction

Commonly agreed consensus dictates every effort should be made in order to preserve the native oesophagus as it is the best conduit in oesophageal atresia (EA) patients.[1] Therefore, surgery for long-gap EA is considered a challenge for paediatric surgeons for decades. Approaches such as delayed primary anastomosis or several intraoperative elongation techniques have been designed to preserve the native oesophagus. However, oesophageal substitution with intra-abdominal gastrointestinal viscera is to be employed in a substantial number of long-gap EA patients.[2] Among these, colonic replacement of the oesophagus is a widely used technique and remains a good option.[2,3]

Traditionally, oesophageal substitution surgery is preceded by an initial cervical oesophagostomy in addition to a gastrostomy for feeding purposes. After a waiting period until about 1-year of age, the definitive surgery is undertaken.

This study describes a series of patients with long-gap EA who underwent colonic substitution surgery without an initial cervical oesophagostomy and thus deviated from the classical approach.

Patients and Methods

A retrospective review of for EA patients who underwent colonic interposition surgery without cervical oesophagostomy between the years 2010 and 2016 within a single pediatric surgery department was done. Demographic data, operative details, post-operative complications and follow-up data were recorded. An institutional clinical research ethical committee approval was obtained for the study (reference 2017/0141).

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Results

During the reviewed interval, 63 patients underwent EA surgery. Among these, five (8%) underwent colonic interposition without a preceding cervical oesophagostomy and comprised the study group [Table 1]. There were four males and one female. The gestational age varied between 32 and 39 weeks with a mean of 35 (±2.6) and the birth weight varied between 1420 and 3530 g with a mean of 2200 (±797.9). The initial radiological evaluation was consistent with pure EA in all, but a bronchoscopic examination revealed a proximal tracheo-oesophageal fistula (TEF) in two. Among the five babies, four were admitted to the ward on the first 2 days of their lives and a delayed primary anastomosis was planned. A Stamm gastrostomy was placed and an intermittent proximal pouch aspiration was begun in all. They remained as inpatients throughout the waiting period with assessment of the gap length every 3–5 weeks under fluoroscopic imaging. The Stamm gastrostomy placement was done in another centre for the fifth patient during the neonatal period. She had been followed up as an outpatient with continuous upper pouch suctioning at home. She had had several hospital admissions including intensive care units because of breakthrough aspiration pneumonia attacks during this period. She was severely malnourished when admitted to our ward with a weight of 3.050 g at the age of 8 months.

In order to assess the timing for a delayed primary repair, serial assessment of gap measurement was done in each patient. For this purpose, a metallic stent or a flexible endoscope was inserted through the gastrostomy into the distal pouch pushing upwards [Figure 1]. Simultaneously, either a radiopaque catheter or a metallic stent was inserted through the mouth into the upper pouch and pushed. Under fluoroscopic imaging, the gap between the two ends was assessed. The measured gap was ≥ 4 vertebrae in all patients in the series. Nevertheless, a definitive surgery was planned in all with the expectation to achieve a primary anastomosis at a mean age of 4.43 (±1.17) months and a weight of 6.3 (±1.48) kg in the first four patients [Table 2]. In the last, severely malnourished patient at admission, the surgery was undertaken after her stabilisation at the age of 10 months.

No pre-operative bowel preparation was done. A right posterolateral thoracotomy incision was done. The proximal pouch was dissected free. During this dissection, the proximal TEF was inadvertently opened at the level of the thoracic inlet in one of the patients with proximal fistula but could be repaired successfully. An exploration revealed no distal oesophageal pouch within the thorax in any of the five patients. A midline abdominal incision was done, and oesophageal hiatus was explored for the distal pouch. It was found to be a tiny remnant below the diaphragm in each case. A left colonic segment based on the left vascular pedicle was prepared in three patients and a right colonic segment without the caecum based on the middle colic vascular pedicle in two. The colonic segments were passed between the stomach and the pancreas and brought up into the thorax through the oesophageal hiatus in an isoperistaltic manner. After opening the proximal oesophageal lumen, an end-to-end single-layer anastomosis using separated 5/0 polydioxanone stitches was done between the oesophagus and the colon [Figure 2]. The proximal anastomosis was within the thorax in all, although somewhat at a higher level in the two with proximal TEFs. The distal cologastric anastomosis was done behind the stomach using absorbable double-layered sutures in four and onto the tiny oesophageal stump in one. A Heineke–Mikulicz pyloroplasty was done in all. Elective mechanical ventilation was employed for all during the early post-operative course.

Table 1: Demographic data and associated anomalies

Case	Gender	Gestational Week	Birth Weight (grams)	Primary Diagnosis	Associated Anomalies					
					Vertebral	Anorectal	Cardiac	Renal	Extremity	Spinal
1	Male	39	3530	Pure EA	No	No	Yes	No	No	No
2	Male	35	1920	Pure EA	Yes	No	No	Yes	Yes	No
3	Male	34	2230	pTEF-dEA	No	No	Yes	No	Yes	No
4	Male	35	1920	pTEF-dEA	Yes	No	No	No	Yes	Yes
5	Female	32	1420	pure EA	No	No	No	No	No	No

OA: Oesophageal atresia; TOF: Tracheo-oesophageal fistula

Table 2: Operative and Follow-up Data

Case	Age at Interposition (months)	Weight at Interposition (grams)	Colonic Segment Used	Postoperative Discharge (days)	Follow-up Period (months)	Gastrostomy Tube	Feeding
1	5.15	8.0	Left	32	75.8	Removed	Fully oral
2	5.57	6.8	Right	49*	39.7	Removed	Fully oral
3	2.99	4.5	Right	23	29.2	Removed	Fully oral
4	4.00	5.9	Left	78**	16.4	Removed	Fully oral
5	10.00	6.0	Left	38	10.2	Present	Partially oral

*Underwent right nephroureterectomy; **underwent proximal fistula repair at a separate surgery

Candidal sepsis complicated the course in one of them, but he fully recovered. He was one of the patients with proximal TEF and underwent cervical TEF repair 36 days after the colonic interposition surgery. One patient underwent a planned right nephroureterectomy for a non-functioning kidney with massive reflux on the 42nd post-operative day.

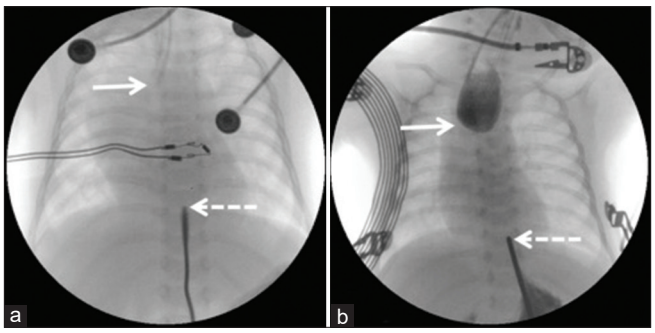

Figure 1: Images obtained during serial gap measurements in patient 1 on two separate occasions. (a) A spiral endotracheal tube (arrow) through the mouth and a ureter dilatation bougie (broken arrow) is inserted through the gastrostomy and both are pushed. (b) The upper pouch is delineated by contrast medium (arrow) and a Hegar bougie (broken arrow) is inserted through the gastrostomy pushing upwards

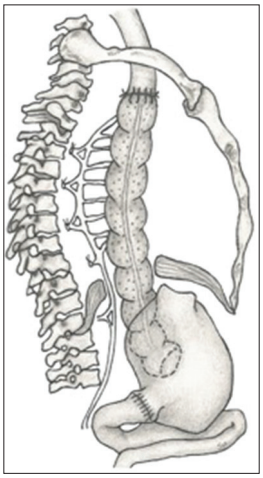

Figure 2: Schematic representation of the completed operation. The colonic segment is brought upwards through the oesophageal hiatus and lies in the posterior mediastinum in a straight position. The upper anastomosis is within the thorax. The cologastric anastomosis is located behind the stomach and a pyloroplasty is added

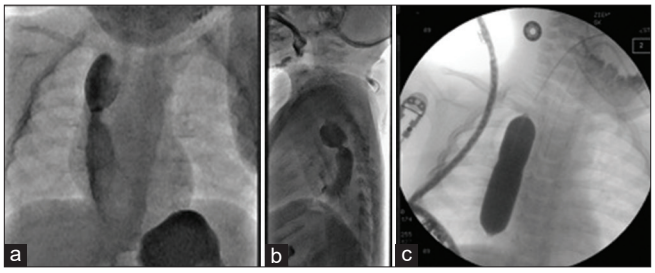

Figure 3: (a and b) Anteroposterior and lateral views of anastomotic stenosis as demonstrated on barium swallow in patient 2. (c) Oesophageal endoscopic balloon dilatation done under fluoroscopic control

All patients were discharged from the hospital after initiating oral feedings but with their gastrostomy tubes in place. They are being regularly followed up in outpatient clinics. A contrast swallow study and a flexible endoscopic examination were done in all 6-8 months after the operation and showed functional conduits. An age-appropriate diet is fully tolerated in four patients. The gastrostomy tubes are removed in all patients but one. This last patient is the one in whom the anastomosis was done onto the distal oesophageal stump; she has some degree of gastro-colonic reflux which is manageable with conservative measures for the time being. She takes approximately half of the daily caloric requirements by the mouth.

An oesophagocolonic anastomotic stricture was detected in one patient who presented with food impaction before a contrast study was done [Figure 3]. He underwent anastomotic balloon dilatation three times and is currently asymptomatic. There were no major complications observed during the long-term follow-up which ranges from 14.2 months to 6.7 years with a median of 33.2 months.

Discussion

It is generally agreed that EA patients without distal fistula are likely to have a long gap between the two oesophageal ends.[4] The treatment of long-gap EA has always been challenging for paediatric surgeons not only because it is a technical challenge but also the gap length may have an impact on the outcome. Although delayed primary repair is the first-line surgical option in many centres including ours, it may not be possible in every patient. The classical surgical approach is staging the operation for long-gap EA patients whose oesophagi are not amenable for a primary repair.[5,6] For this purpose, a cervical oesophagostomy coupled with a gastrostomy (if not performed at an earlier age) is created. After a waiting period till about the age of 1 year, an oesophageal substitution surgery is undertaken. This concept seems to derive from the fact that oesophageal substitution surgery harbors risks of major complications such as graft necrosis and death; therefore, the older the child, the higher the chance of resisting such complications because of a better developed vascular supply and nutritional status.[5]

On the other hand, although a few, there are reports presenting considerably good results by doing 'neonatal' oesophageal substitution surgery.[7-10] Either colon or stomach as a pull-up procedure or as a tube was used as the substituting luminal organ in those studies. Most patients in those reports were operated on without creating cervical oesophagostomy or gastrostomy. However, as there is a general agreement that the native oesophagus should be conserved whenever possible, a delayed primary anastomosis is considered the prime treatment by most pediatric surgeons. The natural growth of the oesophagus is maximal during the first 8–12 weeks of life which is the widely accepted waiting period for this approach.[1] Therefore, at least some of those patients who underwent substitution surgeries as neonates are likely to

have missed the chance of using their native oesophagi. In the presented series, a delayed primary anastomosis was aimed at each patient. After a reasonable waiting period, all underwent operation again with aiming, at least hoping, a primary repair. Operative findings were consistent with an intra-abdominal distal oesophageal segment excluding the possibility of a primary anastomosis. Then, instead of creating a cervical oesophagostomy and delaying the operation a couple of months further, the definitive surgery was performed during the same operative session.

Although not widely mentioned in the literature, an intra-abdominally located nubbin-like distal oesophageal segment should probably be considered a special subset of long-gap EA patients. In one series comprising 16 pure EA cases, 8 had exclusively intra-abdominal distal oesophageal segments.[6] Therefore, after a waiting period of 4–10 weeks, a cervical oesophagostomy was created in all for a future substitution surgery.

Performing the oesophagogastric anastomosis without a previous oesophagostomy enables the conservation of the entire native oesophagus with its inherent peristaltic ability. In a way, this can be considered as a similar approach with the policy of conservation of the native oesophagus whenever possible. Cervical oesophagostomy is not only an additional surgical procedure but also may yield complications such as infection, bleeding, stenosis and peristomal maceration. More importantly, avoiding cervical oesophagostomy and performing the upper anastomosis below the thoracic inlet have the potential advantage of preventing the compression of the graft and thus lessening the possibility of ischemia. On the other hand, it should be realised that a leaking upper anastomosis could be more detrimental with this approach in comparison to an anastomosis located in the cervical region. However, the use of the posterior mediastinal route for EA patients, which was described by Freeman and Cass in 1982, is the shortest and the most direct route and permits a decreased incidence of anastomotic leakage as well as redundancy.[11,12] In addition to the route used, placing the colon in an isoperistaltic manner has the long-term advantages of better emptying and being less prone to gastro-oesophageal reflux.[12,13] Actually, transhiatal isoperistaltic colonic replacement is the routine surgical method employed in our clinic for every oesophageal substitution surgery regardless of the primary indication or presence of a cervical oesophagostomy.

At the time of this writing, we came across a similarly approached small series of patients which was published in 1988.[14] The authors operated on three patients, one with pure EA and two with proximal TEFs, at ages 3, 5 and 6 months. They waited with the expectation of a primary repair and finally used basically the same technique described in this report with the exception of distal anastomoses that were performed on the oesophageal stumps in all three.

Conclusion

A cervical oesophagostomy was avoided in this small series of patients with long-gap EA who underwent transhiatal isoperistaltic colonic substitution surgery. The short- and long-term results are satisfactory without any major complications regarding the technique. This approach uses the native oesophagus in its entirety and is in agreement with the consensus that the native oesophagus should be preserved whenever possible.

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Conflicts of interest

There are no conflicts of interest.

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