

# Is routine use of transanastomotic tube justified in the repair of esophageal atresia?

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**Background:** Transanastomotic feeding tube (TAFT) is commonly used for post-operative enteral nutrition after esophageal atresia (EA)/tracheoesophageal fistula (TEF) repairs. The purpose of this study is to analyze the therapeutic implications of avoiding a TAFT and its impact on the outcomes post-operatively.

**Methods:** The medical data of 33 inpatients with EA/TEF type C repair from 2009 to 2014 were retrospectively reviewed. Patients were divided into two groups for comparison based on the usage of TAFT during the repair: TAFT- (without) and TAFT+ (with) groups, without randomization. Both groups were compared statistically for post-operative complications and outcomes.

**Results:** Eighteen neonates were males and 15 females, with an average birth weight of  $2.43 \pm 0.43$  kg and a mean gestational age of 36.15 weeks. Nineteen (57.5%) in the TAFT- group and 14 (42.4%) were in the TAFT+ group. The post-operative complications, need for dilatations, duration of total parenteral nutrition (TPN) and length of hospital stay were similar in both groups. The incidence of pneumonitis was significantly higher in the TAFT+ group.

**Conclusions:** By avoiding a TAFT, there is no increase in complication rates nor does it entail a prolonged period of TPN. Besides, not using a TAFT may have the advantage of reducing incidence of aspiration and consequent pneumonitis.

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**Key words:** esophageal atresia;  
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## Introduction

Esophageal atresia (EA)/tracheoesophageal fistula (TEF) is a rare malformation with a prevalence of 2.43 per 10 000 births.<sup>[1]</sup> The survival rate is close to 100% in isolated defects and about 90% when associated with abnormalities.<sup>[2,3]</sup> Most infants with EA/TEF require surgical repair in the first few days of life. The repair involves division and ligation of the TEF and primary esophageal anastomosis.<sup>[4]</sup> To avoid prolonged total parenteral nutrition (TPN) and the need for a gastrostomy in this group of neonates, transanastomotic feeding tubes (TAFT) have been used by many centres.<sup>[5,6]</sup> Conversely, this practice is not followed by some surgeons.<sup>[6-8]</sup> The goal of our study is to analyse the therapeutic implications of avoiding a TAFT and its impact on the outcomes of this malformation post-operatively.

## Methods

The medical data of all infants who were admitted at our institution with EA/TEF type C (proximal pouch and distal fistula) from 2009 and 2014 were retrospectively reviewed. Ethical clearance was obtained from the institutional ethics committee. Forty-six consecutive patients were identified but 13 were excluded from this population owing to serious cardiac anomalies (3), staged repairs for long gap EA/TEF (2), lack of complete data (4) and mortality in the first two months (2). The cause for the mortality (both were out born) was unmitigated sepsis due to aspiration pneumonitis prior to arrival at our institution for the definitive repair. One baby each was excluded for post-operative necrotizing enterocolitis and a missed upper pouch fistula. Further data were reviewed for the remaining 33 infants and their demographics, associated anomalies, operative findings, post-operative complications, duration of TPN, resumption of oral feeding, length of stay, and follow-up contrast studies were examined. Patients were divided into two groups for comparison based on the usage of TAFT during the repair: TAFT- (without) and TAFT+ (with). There was no randomization at any stage. Two of our surgeons

routinely used a TAFT while others did not. But for this step, there were no differences in surgical technique and postoperative care between the two groups. We performed primary repair in the first week for all these infants as soon as they were physiologically stable. All the repairs were performed via thoracotomy and the approach was extrapleural. We did not perform a preoperative bronchoscopy routinely to confirm the diagnosis or to exclude a proximal fistula. All patients underwent a trachea-esophageal fistula ligation and a single layer end-to-end esophageal anastomosis using vicryl (polyglactin) sutures. We routinely placed a chest tube regardless of the usage of TAFT during our EA/TEF repairs. Gastrostomy was not performed in any of these patients. Patients in the TAFT- group were kept nil by mouth until stable post-operatively and off the ventilator (usually 5-7 days postoperatively). Once off the ventilators the babies were nursed in prone propped positions. Patients were maintained on partial TPN until this time. In general, we start feeds as early as possible to reduce dependence on full TPN. It is not routine for us to perform contrast esophagogram prior to the institution of feeds. Patients in the TAFT+ group were kept nil per oral until hemodynamically stable. Feeding through the TAFT was started usually after 2-3 days and then slowly progressed as tolerated. Oral feeding was attempted when there is no evidence of egress of the TAFT feeds through the chest drain 5-7 days postoperatively.

All patients in this series (survived the first two months) underwent a first esophageal upper gastrointestinal contrast study, as a matter of protocol, between the third and fourth months to evaluate the degree of strictures and need for dilatation. Further contrast studies were done at 6 and 12 months after surgery. The need for dilatation was determined on the basis of symptoms and the severity of stricture on the contrast study. The degree of stricture was assessed according to the stricture index (SI), which was calculated as  $SI = 1 - (SD/OD)$ , where SD is the stricture diameter and OD is the diameter of the lower segment of esophagus.<sup>[9]</sup> Severe gastroesophageal reflux (GER) was defined as reflux causing major symptoms or complications, or that required fundoplication. All patients were weighed periodically and failure to thrive was defined as weight for age that falls below the 5th percentile on multiple occasions. Tracheomalacia was diagnosed by clinical symptoms and confirmed by bronchoscopy. Pneumonitis was diagnosed if there was tachypnea or fever or focal chest signs in the presence of consolidate on a plain X-ray of the chest. Follow-up data were collected from our inpatient and outpatient records. The outcome measures analysed included incidence and severity of post-operative strictures,

anastomotic leaks, severe GER, pneumonitis, failure to thrive and need for dilatations. Statistical analysis (SPSS version 16.0) was performed using the Fisher's Exact test and Chi-square test in consultation with our statistician. A *P* value of less than 0.05 was considered statistically significant.

## Results

Of the 46 neonates with EA/TEF type C who had undergone a single stage surgical repair at our hospital, 33 were included into this study. The age at presentation was 2 days (range 0-7 days). Eighteen neonates were males and 15 females. Three of the 33 neonates were out born and presented to our center in the first week of life. The average birth weight was  $2.43 \pm 0.43$  kg (range: 1.3 kg-3.2 kg) with a mean gestational age of 36.15 weeks. Thirty-one patients had at least one scan done antenatally and 65% ( $n=20$ ) demonstrated polyhydramnios. The demographic characteristics and associated anomalies of the patients in each group are presented in Table 1. Nineteen (57.5%) patients were in the TAFT- group and 14 (42.4%) patients were in the TAFT+ group. All patients in this series underwent a single stage procedure for EA/TEF repair. The mean interval time to surgery was 21.5 and 23 hours in TAFT+ and TAFT- groups, respectively. The mean operative time was comparable in both groups (212 minutes vs. 201 minutes). Five patients in the TAFT+ and one in TAFT- group required post-operative ventilation. The mean hospital stay was 16.42 and 16.05 days for the TAFT+ and TAFT- groups, respectively. Days to initiation of oral feeds were 4.3 days (full feeds: 8.2 days) in TAFT- and 6.4 days (full feeds: 11 days) in TAFT+. The mean follow-up time was  $49 \pm 18.05$  months (range: 13-73 months).

The mean gestational age and birth weight were not significantly different between the TAFT+ and TAFT- groups. There were no differences in the frequency of major associated anomalies between the two groups.

**Table 1.** Patients' characteristics and associated anomalies

Variables	TAFT- ( $n=19$ )	TAFT+ ( $n=14$ )	<i>P</i> value*
Gestational age (wk), mean $\pm$ SD	36.52 $\pm$ 2.20	35.64 $\pm$ 2.60	0.093
Birth weight (kg), mean $\pm$ SD	2.50 $\pm$ 0.32	2.30 $\pm$ 0.23	1.320
Associated anomalies			
Vertebral	3	2	1.000
Anorectal	3	4	1.000
Cardiovascular	5	4	1.000
Renal	2	1	1.000
Limbs	1	2	1.000

\*: *P*<0.05 is considered to be statistically significant. TAFT: transanastomotic feeding tubes; SD: standard deviation.

**Table 2.** Post-operative complications and outcomes, *n* (%)

Variables	TAFT+ ( <i>n</i> =14)	TAFT- ( <i>n</i> =19)	<i>P</i> value*
Anastomotic leak	2 (14.2)	2 (10.9)	1.000
Stenosis	4 (28.5)	3 (15.8)	0.422
Tracheomalacia	4 (28.5)	1 (5.2)	0.138
Sepsis	2 (14.2)	3 (15.8)	1.000
Wound infection	1 (7.1)	2 (10.9)	1.000
Severe GER	2 (14.2)	3 (15.8)	1.000
Pneumonitis	7 (50.0)	2 (10.5)	0.019
Need for dilatation	5 (35.7)	6 (31.5)	1.000
Failure to thrive	2 (14.2)	3 (15.7)	1.000

\*:  $P < 0.05$  is considered to be statistically significant. GER: gastroesophageal reflux; TAFT: transanastomotic feeding tubes.

The post-operative data are compiled in Table 2. Postoperative complications such as anastomotic leak (2/14 vs. 2/19;  $P=1.000$ ) and stenosis (4/14 vs. 3/19;  $P=0.422$ ) were similar between the TAFT+ and TAFT- groups. The other complications such as severe GER, tracheomalacia, sepsis, wound infection, need for dilatation and failure to thrive were not significantly different between the two groups. The incidence of pneumonitis, on the other hand, was significantly higher in the TAFT+ group (relative risk: 4.75, 95% confidence interval: 1.16-19.49). Only those patients who developed pneumonitis post-operatively were included in the study (vide above).

## Discussion

Complications directly related to esophageal anastomosis remain frequent during the first year of life, despite recent surgical progress. The surgical procedure (esophageal anastomotic tension) and post-operative nutrition are considered independent predictors of complications.<sup>[10]</sup> One of the main challenges for surgeons caring for these patients is the provision of enteral nutrition after repair. As an option, TAFTs have been in vogue for a long time in many centers with a goal to provide the option of early enteral feeding while reducing the dependence on TPN.<sup>[8]</sup> Yet some researchers favour TAFT primarily for the very premature infants who are likely to require gavage feeding<sup>[7]</sup> or if ventilation is anticipated.<sup>[6]</sup>

The main reason for the use of TAFT appears to be the option of early enteral feeding while reducing the duration of TPN. Consequently, earlier attempts at enteral feeding, a shorter duration of parenteral nutrition, and shorter times to full enteral feeding, as well as a shorter interval to full oral feeding have been claimed to reduce the complications associated with the use of long term TPN such as cholestasis and catheter related complications.<sup>[6,11]</sup> Additionally, patients

with TAFT tended to be discharged from the hospital earlier. While there have been studies advocating TAFT routinely, many surgeons also believe there is limited evidence to support the use of TAFTs and larger prospective studies will be required to conclusively demonstrate these benefits and to ensure that this technique does not increase anastomotic leaks.<sup>[12]</sup> The other potential complications of TAFT include strictures and recurrent TEF.<sup>[13]</sup> It is perhaps for this reason, in a recent international survey, about 10% of the surgeons did not leave a TAFT after repair.<sup>[14]</sup>

The purpose of this study was to assess any differences in postoperative complication and outcomes, between groups of matched infants with and without the use of TAFT.

There is no ideal surgical procedure for this anomaly. Due to the logistic reasons and our center's inexperience with minimally invasive techniques with EA/TEF repairs, all of our repairs were done through right posterolateral thoracotomy and extrapleural approach, with a chest drain post-operatively. When there was potential for tension at the anastomosis, we performed a posteriorly based Gough flap repair, designed from the upper pouch.<sup>[15]</sup> However, the personal experiences of the individual surgeons have favoured the use of TAFTs differently. Since the aim of the study was to check the utility of TAFT specifically and we had to keep the bias to a minimum, we have included only those patients with type C EA/TEF who had one stage repairs and survived into the third month, without other major anomalies.

Our study demonstrated no significant increase in complications including anastomotic leak, stenosis, sepsis, tracheomalacia and severe GER as a result of TAFT placement. In addition, the need for dilatation and failure to thrive were also not significantly different in the two groups. We did not experience any additional difficulties in the TAFT- group, with regard to the dilatations. Those with GER were controlled with adequate medications and none of them required fundoplication. In contrast, the incidence of pneumonitis was significantly higher in the TAFT+ group, albeit higher than in other series. We believe that it was due to the TAFT (usually a No.6 or No.8 feeding tube) hampering the free flow of the saliva from above that results in more frequent aspiration episodes. Giving credence to this thought is that the incidence of pneumonitis was the highest in the first two weeks after surgery (when the TAFT was in situ) and thereafter the incidence was comparable in both groups. It is also possible that the TAFT triggers the GER and hence higher chance of aspiration. This happens especially in centers like ours where 1:1 nursing for these babies is not available round the clock due to the sheer numbers,



for the repeated pharyngeal suctioning post-operatively, in the setting of neonatal intensive care unit. The mean days to the initiation of oral feeds and also the full feeds in our series has demonstrated that fairly similar enteral nutrition is possible with or without the TAFT, keeping the dependence on partial TPN to a minimum. Early introduction of oral feeds in the TAFT- group is not associated with an increased complication rate. It is our experience that routine contrast esophagogram is unjustified prior to the initiation of feeds. Moreover, the mean hospital days were also comparable in both groups.

The lone circumstance where a TAFT has a significant advantage is, when there is an unfortunate anastomotic leak. The options then remain conservative measures (such as chest tube drainage, TPN support, mechanical ventilation and use of broad spectrum antibiotics) or surgical repair. When anastomotic leaks do happen, the choice between the two can be difficult. It has been shown that this complication can be managed successfully by conservative treatment alone.<sup>[16]</sup> If there was a TAFT *in situ*, it can be used for parenteral feeding with lesser dependence on TPN support, for a reasonably long period of time is anticipated for the spontaneous closure of leaks. In this series, patients with leaks ( $n=4$ ) fortunately settled with conservative measures alone. Two of them already had a TAFT that was used for feeding till the leak sealed by itself. The other two babies (TAFT-) recovered after short periods of TPN (without mechanical ventilation) when kept nil orally with periodic throat suctioning. All of them received long term antibiotics.

To summarize, the practice of using a TAFT in EA/TEF repairs was the norm to potentially reduce the dependence on TPN, without increasing the risks of anastomotic leaks, stenosis, tracheomalacia, severe GER or strictures. Our experience has shown that, TAFT is although not disadvantageous, and avoiding a TAFT will not increase complication rates or entail a prolonged period of TPN. Besides, not using a TAFT may have the advantage of reducing incidence of aspiration and consequent pneumonitis, thus benefitting babies in high volume centers without meticulous post-operative nursing care. However, the results should be viewed with caution as the sample size was small and randomization was not done. A prospective study with comparable populations is necessary to address this issue further.

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**Competing interest:** None declared.

**Contributors:** Narayanan SK and Somnath P proposed the study and wrote the first draft. Vazhiyodan AP analyzed the data. All authors contributed to the design and interpretation of the study and to further drafts. Mohanan A and Somnath P are the guarantors.

## References

- 1 Pedersen RN, Calzolari E, Husby S, Garne E, EUROCAT Working group. Oesophageal atresia: prevalence, prenatal diagnosis and associated anomalies in 23 European regions. *Arch Dis Child* 2012;97:227-232.
- 2 Saing H, Mya GH, Cheng W. The involvement of two or more systems and the severity of associated anomalies significantly influence mortality in esophageal atresia. *J Pediatr Surg* 1998;33: 1596-1598.
- 3 Lilja HE, Wester T. Outcome in neonates with esophageal atresia treated over the last 20 years. *Pediatr Surg Int* 2008;24:531-536.
- 4 Kovesi T, Rubin S. Long-term complications of congenital esophageal atresia and/or tracheoesophageal fistula. *Chest* 2004; 126:915-925.
- 5 Spitz L. Esophageal atresia: past, present, and future. *J Pediatr Surg* 1996;31:19-25.
- 6 Patel SB, Ade-Ajayi N, Kiely EM. Oesophageal atresia: a simplified approach to early management. *Pediatr Surg Int* 2002; 18:87-89.
- 7 Beasley S. Congenital malformations. In: Parikh DH, Crabbe DCG, Auldish AW, Rothenberg S, eds. *Pediatric thoracic surgery*. London: Springer, 2009: 292.
- 8 Lal D, Miyano G, Juang D, Sharp NE, St Peter SD. Current patterns of practice and technique in the repair of esophageal atresia and tracheoesophageal fistula: an IPEG survey. *J Laparoendosc Adv Surg Tech A* 2013;23:635-638.
- 9 Said M, Mekki M, Golli M, Memmi F, Hafsa C, Braham R, et al. Balloon dilatation of anastomotic strictures secondary to surgical repair of oesophageal atresia. *Br J Radiol* 2003;76:26-31.
- 10 Schneider A, Blanc S, Bonnard A, Khen-Dunlop N, Auber F, Breton A, et al. Results from the French National Esophageal Atresia register: one-year outcome. *Orphanet J Rare Dis* 2014; 9:206.
- 11 Suri S, Eradi B, Chowdhary SK, Narasimhan KL, Rao KL. Early postoperative feeding and outcome in neonates. *Nutrition* 2002; 18:380-382.
- 12 Pinheiro PF, Simões e Silva AC, Pereira RM. Current knowledge on esophageal atresia. *World J Gastroenterol* 2012;18:3662-3672.
- 13 Moriarty KP, Jacir NN, Harris BH, Latchaw LA, Robertson FM, Crombleholme TM. Transanastomotic feeding tubes in repair of esophageal atresia. *J Pediatr Surg* 1996;31:53-54; discussion 54-55.
- 14 Zani A, Eaton S, Hoellwarth ME, Puri P, Tovar J, Fasching G, et al. International survey on the management of esophageal atresia. *Eur J Pediatr Surg* 2014;24:3-8.
- 15 Gough MH. Esophageal atresia-use of an anterior flap in the difficult anastomosis. *J Pediatr Surg* 1980;15:310-311.
- 16 Zhao R, Li K, Shen C, Zheng S. The outcome of conservative treatment for anastomotic leakage after surgical repair of esophageal atresia. *J Pediatr Surg* 2011;46:2274-2278.

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