Use of trans-anastomotic tubes in congenital duodenal obstruction

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Clinical Research Paper

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

The authors have no competing interests to declare.

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Abstract

Aim

Despite data to suggest benefit of trans- anastomotic tube (TAT) feeding in infants following repair of congenital duodenal obstruction (CDO), TAT usage is limited. We aimed to report a large series of infants with CDO treated with or without TAT in order to improve the evidence underlying this simple intervention.

Method

Single centre retrospective review of all infants CDO over a 20-year period (January 1999 – November 2020, inclusive). Important outcomes were compared between infants treated with or without TAT. Data are median [IQR].

Results

Ninety-six infants were included. A TAT was placed in 54 infants (56%). Median time to full enteral feed was significantly shorter in the TAT group (6 [5-8] days vs 10 [7.5-12], p <0.001). Time to first feed was shorter in the TAT group (2 [2-2.8] days vs 3 [2-5], p<0.001). Significantly fewer infants with a TAT placed received a central venous catheter (CVC, 15% *vs* 76%, p <0.001). Infants without a TAT received parenteral nutrition (PN) for longer (0 [0-0] *vs* 7 [0-11] days, p <0.001). There was no change in length of stay between TAT and no TAT group (16 [13-21.8] vs 15 [12-21.8] days, p=0.722). Eight infants (15%) in the TAT group required a CVC and PN. One infant in the TAT group developed a perforation that required surgical management and nine infants in the non-TAT group had complications related to the CVC (21%), including one infant that required general anaesthetic for tunnelled central line placement (2.3%).

Conclusion

In infants with CDO, TAT use was associated with earlier establishment of full enteral feeds, reduced need for CVC and PN and reduced complications. Further research should focus on the barriers to wider use of TAT by surgeons and neonatologists in infants with CDO.

Key words: duodenal atresia; congenital duodenal obstruction; transanastomotic tube; Parenteral nutrition

Level III evidence

Introduction

There is ongoing controversy over the use and benefit of trans-anastomotic tubes (TATs) after surgery for Congenital Duodenal Obstruction (CDO). Despite several small studies reporting benefit and reduced cost [1–3] with TAT, their use is not widespread [4]. It is possible that clinicians are not yet convinced by the existing data; of note there are no randomised control trials and only small numbers of infants treated with TAT in existing reports [2,3,5,6] Based on our previous work [2] and convinced by the benefits of avoidance of central venous catheters (CVC) and parenteral nutrition (PN) as well as reduced cost [1] we have continued to use TATs in infants following repair of CDO. We here report our outcomes, aiming to provide a larger population and therefore wider evidence base on which to guide future practice.

Methods

Method of study

A retrospective review of all infants admitted to a single tertiary neonatal surgery unit with CDO was undertaken over a 20-year period (January 1999 – November 2020, inclusive). Infants with CDO were identified from a prospectively kept neonatal database (Microsoft Access) which is used to record all neonatal surgical admissions. This report includes previously reported data for the period 1999-2008 [2].

Data collection

The following data were extracted from case notes and electronic patient records: gestational age at birth, weight at birth, co-morbidities, CDO diagnosis, operative details, placement of a TAT, time of commencement of enteral feed, time reached full enteral feed, placement of CVC, requirement for PN, length of stay, operative and post-operative morbidity, and mortality.

Key Outcomes

The primary outcome was time to achieve full enteral feeds, either into stomach or small bowel. Secondary outcomes were time to initiation of enteral feeds, CVC placement, PN requirement and duration, complications and length of stay. Outcomes were recorded up until the point of initial discharge home following CDO repair.

Unit Practice

CDO pathology was determined intra-operatively and was recorded as a duodenal web (type I), duodenal atresia (types II and III), or the presence of an annular pancreas. The operations performed included duodeno-duodenostomy (DD), duodeno-jejunostomy (DJ), and duodenoplasty with incision of web.

The decision to place a TAT was made by the operating surgeon but became the preferred option for the majority of cases since 2006. A 6-Fr silicone tube (Vygon, France) was placed via the nostril and fixed in place at the cheek. We aim to place the tip of the TAT tube 10-15cm beyond the anastomosis. Some very pre-term and growth restricted patients were felt by the operating surgeon to be too small to leave a TAT. A further tube was placed for gastric decompression (oral or nasal). In infants with a TAT, post-anastomotic feeding was initiated 24 – 48 hours post-operatively (at 5ml/hr continuously

for term infants) and increased as tolerated to a full feed volume of 150ml/kg/day. Pre-anastomotic feeds were initiated once nasogastric aspirates were low in volume. In infants without a TAT the decision to start pre-anastomotic feeds was made based on the clinical status of the infant and the volume of nasogastric tube output, with <10ml/kg/day considered acceptable.

CVC placement included usually a 2Fr or 3Fr peripherally inserted central catheter (PICC). The decision to place a CVC and initiate PN was made jointly by the surgical and neonatal intensive care teams and was made in accordance with our institutional neonatal nutrition guideline. In general terms when a TAT was placed our intention was to not routinely place a CVC. However, in our unit pre-term babies less than 32 weeks gestation routinely receive PN to supplement nutrition so as to avoid rapid feed increases resulting in risks such as feed intolerance or necrotising enterocolitis. Thus babies under 32 weeks gestation who had a TAT placed did routinely have a CVC placed for PN. In infants over 32 weeks gestation who had a TAT placed, a CVC was not routinely gained but was used in instances such as when the TAT was displaced in order to ensure nutritional requirements were met. PN was weaned as enteral feed volumes increased.

Analysis

Infants were grouped into either TAT or No TAT for analysis. Infants who initially received a TAT which subsequently became unusable were analysed in the TAT group. Data are presented as median (interquartile range) unless otherwise specified. Analysis was conducted in SPSS version 27 (IBM, USA). Data were compared using the Mann-Whitney U test, Fisher's exact test, or Chi-squared test as appropriate. A p-value of <0.05 was considered statistically significant.

Approvals

This study was locally registered as a Service Evaluation (local registration number SEV/0255).

Results

During the study period 96 infants with CDO were identified and had subsequent surgical repair. One additional infant who also had a tracheo-oesophageal fistula and tracheal cleft died without repair of CDO. Demographic data for both groups is presented in Table 1. A TAT was placed in 54 infants (56%) and no TAT in the remaining 42 (44%). Gender, median gestational age at birth, and median birth weight were similar between groups. The use of TAT tube became more commonplace after 2006.

Outcomes are presented in Table 2. The primary outcome of time to full enteral feed was significantly shorter in the TAT group compared to no-TAT (6 days vs 10, p<0.001). Infants in the TAT group also commenced enteral feed earlier, received less PN and had lower requirement for CVC than infants in the no TAT group. There was no difference in time to achieve full pre-anastomotic feeds nor length of stay between groups.

Eight infants (15%) in the TAT group required a CVC and TPN; 1 tube migrated proximally, 1 had sustained high NG aspirates and vomiting on less than full volume TAT feeds, 1 pulled out TAT on day 2, 1 had an anastomotic leak and jejunal perforation, 4 were premature at 27, 29 and 33 (x2 infants) weeks gestation. They required supplemental nutrition as is policy in our unit for any patient under 32 weeks gestation, and then in specific circumstances after that gestational age. Infants without a TAT received TPN for longer (0 days *vs* 7 days, p <0.001).

Complications related to treatment of CDO or TAT use occurred in 13 infants overall. Two of these were in infants treated with a TAT. One infant developed a pressure area on the nasal columella secondary to a bridle device used to secure the TAT requiring no further treatment (this was the only infant in this series in whom a bridle was used). A second infant developed free air on abdominal x-ray 4 days after CDO repair. At laparotomy an anastomotic leak and a separate jejunal perforation, five centimetres away from the anastomosis but proximal to the tip of the TAT tube which had not migrated, was encountered and both repaired. This infant had Trisomy 21 and was subsequently also diagnosed with Hirschsprung's disease.

In the no TAT group treatment related complications occurred in eleven infants, all related to CVC use. These included CVC related infection (n=6), line displacement (n=2), PN extravasation (n=2), localised swelling at a femoral line site (n=1). One of these required placements of a surgical CVC due to inability to re-site a PICC.

Complications unrelated to CDO or TAT use occurred in 7 cases (7.2%): digital ischaemia secondary to arterial line (n=1), wound infection (n=3, 2= no TAT group, 1= TAT group), superficial wound dehiscence (n=1 TAT group), blood-stained gastric aspirates (n=2). These complications were not considered to be relevant for the purposes of this analysis as they were not directly related to the presence or absence of a TAT or CVC. There was no mortality in either group until the point of discharge.

Discussion

In this retrospective study of the management of infants born with CDO, we have demonstrated that the use of a TAT is associated with several advantages. Specifically, TAT usage is associated with a shorter time to full enteral feed and reduced need for CVC and PN, with associated reduction in CVC related sepsis. To our knowledge this study has the largest number of infants in the literature to date comparing outcomes of TAT with no-TAT. These data further contribute to the evidence in support of TAT use in infants with CDO.

There are a number of limitations to our study. Firstly, as a retrospective cohort study the use of a TAT was left to surgeon discretion rather than being formally randomised. Whilst there is the potential for the observed differences in outcomes between groups to be due to factors other than TAT use, both groups of infants were similar with regard to demographic and clinical features which we would anticipate to influence primary and secondary outcomes. Given our study was unblinded it is possible that the advancement of gastric feed was different in each group. Throughout this study period our practice has not changed, and we have been advocates of progressing gastric feeds early in all infants with CDO, regardless of TAT use. Finally, it is possible that some infants treated with a TAT did not actually need one. Whilst there are reports of infants with CDO achieving full oral feeds quickly (and therefore not requiring PN nor a TAT), we believe this is a minority and infants are unlikely to meet current guidance for nutritional intake without either PN or early enteral feeds.

These data re-affirm our previous report of the benefits of TAT use in this population [2]. In addition to these clinical benefits a recent report from another UK centre demonstrates there are significant cost savings to be made with TAT use [1]. Despite this a TAT is only used by a minority of surgeons (43% in a recent nationwide study) and even when a TAT is used the majority of cases also received a CVC and PN [4]. It is not clear why placement of a TAT has not been more widely adopted by paediatric surgeons, particularly as all recent evidence suggests a consistent benefit of early enteral feeding, avoidance of PN and associated CVC complications. Perhaps reluctance to use a TAT is due to historic publications. Mooney et al's 1987 report of a 72% survival rate in patients with CDO also concluded TAT use prolonged time to oral feeding, and therefore hospital stay [7]. However, this was a small

cohort with no comparative analysis published and unclear patient selection criteria. Similarly, Upadhyay et al's 1992 report of 21 infants found a longer length of stay in infants managed with a TAT [8]. More recent data from outside the UK also points towards the benefit of a TAT; an Indian study by Sarin et al, of 18 infants treated with duodenotomy and excision of duodenal web reported earlier establishment of normal oral feeding pattern in 8 infants who received a TAT compared to 10 who did not [6]. No comparative analysis was performed due to small sample size. Arnbjornsson et al (2002) published their results from Sweden of 18 infants comparing the use of TAT and no TAT finding that the presence of TAT reduced time to introduction of feeds by 3 days, and time to full pre-anastomotic feeding by more than 5 days which was statistically significant [3].

The focus on time to achieve full feeds in the majority of comparative studies in our opinion overlooks an important additional aspect of TAT use which is the potential to avoid CVC and associated complications, most notably CVC related sepsis. Bishay et al reported sepsis in 41% of infants receiving PN with a CVC compared to 14% in those who did not receive PN [9] The overall incidence of CVC related complications in this series was 26% and in a recent national cohort study was 21% [4]. Whilst typically a treatable complication, the potential for an episode of sepsis in a small baby to cause significant morbidity and even mortality should not be overlooked. Other benefits of TAT placement include the early provision of the optimal nutritional substrate for the neonate (i.e., breast milk) along with the associated benefits; favourable colonisation of the intestinal tract, and reduction of risk of necrotising enterocolitis, or mucosal atrophy [10]. In addition to clinical benefits, the avoidance of PN also confers a very significant financial benefit as described by Harwood et al [1].

We acknowledge one significant complication of an anastomotic leak in an infant in whom a TAT was placed. At laparotomy a second perforation slightly distal to the anastomosis was also encountered but this was 5cm proximal to the tip of the TAT which had not exteriorised outside the bowel and remained intraluminal. This infant had undiagnosed Hirschsprung disease and developed on obstructive clinical picture in the days following duodenal atresia repair prior to perforation. Whilst we cannot completely explain the surgical findings we postulate that the obstruction may have resulted in back pressure on the anastomosis. Previous reports document anastomotic leak as a recognised complication of repair of congenital obstruction with or without Hirschsprung disease and with or without use of TAT [4,9]. We recommend care to ensure no trauma to the intestine during TAT placement.

Based on these data and the potential for cost savings [1] we recommend the use of a TAT in infants with CDO and avoidance of CVC and PN, since in the majority of cases these are not required. We acknowledge that in preterm infants who may be anticipated to require PN to achieve adequate nutritional intake in a timely fashion or who require slower introduction of enteral feed due to risk of NEC then the balance of benefit is less in favour of a TAT and it would seem appropriate to use PN in this group. We remain intrigued at the lack of widespread uptake of this practice since we believe there are real benefits to patients.

Conclusion:

In conclusion, placing a TAT at the time of surgery in order to avoid CVC and PN will benefit the majority of infants by reducing time to full enteral feeds, and associated morbidity of CVC and PN. Further research should focus on the barriers to wider use of TAT by surgeons and neonatologists in infants with CDO.

References

[1] Harwood R, Horwood F, Tafilaj V, et al. Transanastomotic tubes reduce the cost of nutritional support in neonates with congenital duodenal obstruction. Pediatr Surg Int. 2019;35:457–61. doi: 10.1007/s00383-018-4411-5.

[2] Hall NJ, Drewett M, Wheeler RA, et al. Trans-anastomotic tubes reduce the need for central venous access and parenteral nutrition in infants with congenital duodenal obstruction. Pediatr Surg Int. 2011;27:851–5. doi: 10.1007/s00383-011-2896-2.

[3] Arnbjörnsson E, Professor´ AP, Larsson M, Finkel Y, Karpe B. Transanastomotic Feeding Tube After an Operation for Duodenal Atresia. Eur J Pediatr Surg. 2002;12:159-162. doi: 10.1055/s-2002-32727.

[4] Bethell GS, Long AM, Knight M, Hall NJ. Congenital duodenal obstruction in the UK: A population-based study. Arch Dis Child: Fetal Neonatal Ed. 2020;105:F178–83. doi: 10.1136/archdischild-2019-317085.

[5] Girvan DP, Stephens CA. Congenital intrinsic duodenal obstruction: A twenty-year review of its surgical management and consequences. J Pediatr Surg. 1974;9:833-9. doi: 10.1016/s0022-3468(74)80217-4

[6] Sarin Y, Sharma A, Sinha S, et al. Duodenal webs: an experience with 18 patients. J Neonatal Surg. 2012;1:20.

[7] Mooney D, Lewis E, Connors RH, et al. Newborn Duodenal Atresia: An Improving Outlook. Am J Surg. 1987;153:347-9. doi: 10.1016/0002-9610(87)90574-5.

[8] Upadhyay V, Sakalkale R, Parashar K, et al. Duodenal Atresia: A Comparison of Three Modes of Treatment. Eur J Pediatr Surg. 1996;6:75-7. doi: 10.1055/s-2008-1066475.

[9] Bishay M, Lakshminarayanan B, Arnaud A, et al. The role of parenteral nutrition following surgery for duodenal atresia or stenosis. Pediatr Surg Int. 2013;29:191–5. doi: 10.1007/s00383-012-3200-9.

[10] Nolan LS, Parks OB, Good M. A Review of the Immunomodulating Components of Maternal Breast Milk and Protection Against Necrotizing Enterocolitis. Nutrients. 2019;12:14. doi: 10.3390/nu12010014.