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Exploring the current usage of and attitudes towards transanastomotic tube (TAT) feeding in infants born with duodenal atresia: a survey of practice in the UK

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ABSTRACT

Background Despite evidence demonstrating clinical and cost benefits of transanastomotic tubes (TATs), following repair of congenital duodenal obstruction they are used in a minority of infants in the UK. Most infants are fed using parenteral nutrition (PN) (sometimes in combination with a TAT). This variation is unexplained by clinical or demographic factors. We aimed to understand why this is and the barriers to practice change.

Methods UK-based clinicians (surgeons, neonatologists, dietitians and specialist nurses) completed an online mixed methods survey. Open-ended replies were summarised thematically. Data were analysed using descriptive and inferential statistics.

Results 109 clinicians (24 neonatologists, 7 nurses, 3 dietitians, 75 surgeons) from all 25 UK neonatal surgical units completed the survey. 88% (n=96/109) stated TAT use was decided solely by surgeons, driven primarily by considerations of providing appropriate nutrition and risks; 36% of surgeons felt TATs should always be used where possible. Decisions about central venous catheters (CVCs) were made by neonatologists (28%, n=31/109), surgeons (17%, n=18/109), jointly (48%, n=52/109) or 'other' (7%, n=8/109). Neonatologists and surgeons prioritised providing appropriate nutrition and risks when deciding whether to use CVCs/PN; surgeons rated a lack of supporting research and TATs' risks as key barriers to TAT usage. Costs and parents' preferences had limited influence on TAT and PN usage.

Conclusions Increased TAT usage requires surgeons to be persuaded of TATs' efficacy and safety, and neonatologist recognition that exclusive TAT feeding (ie, without CVCs/PN) can provide adequate nutrition. Further work is required to appreciate how best to achieve this.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Transanastomotic tubes (TATs) are used in a minority of infants following congenital duodenal obstruction (CDO) repair, despite having clinical and cost benefits.

WHAT THIS STUDY ADDS

⇒ We found limited usage of TATs following CDO repair primarily because some clinicians feel TATs are risky, do not provide adequate nutrition and perceive a lack of research demonstrating TATs' efficacy and safety.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This work contributes to the understudied area of surgeons' decision-making and is the first part of a larger study that will include co-designed interventions to increase TAT usage.

⇒ Barriers to increasing TAT usage have been identified that can be addressed in future research.

⇒ Increasing TAT feeding will be of interest to clinicians in financially constrained health systems such as the National Health Service, as well as those in resource-limited settings seeking to manage costs and decrease reliance on intravenous access.

BACKGROUND

Congenital duodenal obstruction (CDO), encompassing duodenal atresia and duodenal web, is a congenital anomaly causing intestinal obstruction and is estimated to occur in 1.22 per 10 000 live births in the UK.[1–3] Surgery is typically completed within days after birth to restore continuity of the gastrointestinal tract.[1] Following surgery, infants can be fed using parenteral nutrition (PN), enteral nutrition via a transanastomotic tube (TAT) or a combination of both.[1 4]

Two retrospective single-centre reviews carried out in the UK and Norway have shown that, compared with no TAT usage, TATs can confer nutritional, cost and safety benefits. In single centre reviews, infants receiving a TAT had reduced median time to feed initiation (3 vs 2 days and 2.5 vs 1 days, respectively) and days receiving PN (7 vs 0 days and 10 vs 8 days).[5 6] In addition, TAT-fed infants were

less likely to receive a central venous catheter (CVC), a common form of PN delivery associated with complications such as line infections or displacements.[5 6] Furthermore, the UK-based study concluded that TAT feeding reduced both the cost of PN and total nutrition, with a median cost saving of 44.8% or £622.26 per infant.[7] TATs can enable early provision of breast milk, associated with benefits such as favourable colonisation of the intestinal tract and a reduced risk of necrotising enterocolitis and mucosal atrophy.[5]

Two meta-analyses (based on retrospective cohort studies) found that TAT usage was associated with fewer days of PN (mean differences of 5.38 and 6.32 days, respectively) and reduced time to full enteral feeds (6.63 and 3.34 days).[1 8] The mean reduction in nutrition costs (quantified in a single meta-analysis) was £867.36 per patient.[1]

Despite these reported benefits of TATs, they are used in a minority of infants in the UK (42%) following CDO repair, whereas the majority (88%) receive PN (sometimes in combination with TATs).[2] This variation in postoperative feeding is unexplained by clinical or demographic factors.[2] A recurring conclusion of existing studies is that future research should study the barriers to increased TAT feeding.[1 5] We therefore conducted a survey of UK-based clinicians to explore: (1) how postoperative feeding practices are determined, and what clinicians' preferences are, (2) surgeons' and neonatologists' reasons for their current TAT and PN/CVC practices and (3) surgeons' and neonatologists' views on the barriers to (increased) TAT usage.

METHODS

Development of the survey instrument

The study authors (two mixed methods researchers, an academic neonatologist and an academic paediatric surgeon) designed a survey based on relevant literature, their clinical knowledge and the 'behavioural change wheel' framework to ensure the questions covered the three prerequisites for behavioural change. This framework[9] presupposes:

- Capability: psychological/physical capacity.
- Opportunity: physical and social factors (outside of individuals).
- Motivation: brain processes directing behaviour.

A pilot survey was sent to 10 clinicians to assess content, cognitive and usability standards, that is, whether the questions were measuring the correct constructs and respondents were able and willing to answer.[10 11] All 10 completed the survey independently and were invited to provide feedback: 5 provided written feedback, and 4 were asked questions informed by Graesser *et al*'s 'problems with questions' checklist[12] as well as 'probing-based' cognitive interviewing techniques[13] to elucidate difficulties they had encountered. The feedback was used to improve question clarity, conciseness and diversity. The final survey consisted of Likert-scale, single-choice, open-ended and 'select all that apply' style questions (online supplemental data 1).

All respondents answered questions exploring their preferred TAT usage and views on the barriers to (increasing) TAT usage, as well as their units current TAT usage. Surgeons and neonatologists (who predominantly determine postoperative feeding) answered additional questions exploring the reasons for their current TAT and PN usage and preferences. In the results, 'respondents' refers to all survey respondents from all the clinical backgrounds; where questions have only been answered by a specific group of clinicians (eg, surgeons or neonatologists), this is, specified.

Responses were collected from July 2023 to January 2024 using the online platform iSurvey and analysed anonymously.

Study population

UK-based clinicians with experience of caring for infants with duodenal atresia were eligible. Infants with this condition are predominantly cared for by resident (formerly known as trainee) and consultant paediatric surgeons, resident and consultant neonatologists, neonatal dietitians and neonatal specialist nurses. It was not possible to quantify the number of eligible respondents because CDO is a relatively rare condition treated in a limited number of centres, and data on how many clinicians care for infants with CDO do not exist. To achieve representative responses, we aimed to obtain at least one response from each of the 25 UK neonatal surgical units.

Patient and public involvement

Prior to developing the survey, we undertook patient and public involvement (PPI) consultation with parents of infants born with duodenal atresia. This took the form of several meetings over the course of the study attended by between three and five parents on each occasion. Overall, our objective in this was to ensure that our work produced findings that were important from a parental perspective. Through discussion we identified that parents believed TATs have clear benefits, particularly their ability to enable early (breast) milk feeding and the avoidance of CVCs and PN and their associated risks. They recommended studying the barriers to implementation of TAT usage rather than a prospective clinical research study such as a clinical trial, since they lacked equipoise regarding TAT based on the existing data and indicated they would therefore be reluctant to enrol in a trial.

Survey distribution

The survey was advertised via social media, the emailing lists of clinical organisations and learnt societies and personal contacts of the study authors to reach as many eligible clinicians as possible (convenience sampling). Respondents were encouraged to share the survey with other eligible clinicians (snowball sampling).

Data analysis

Data are largely presented using descriptive statistics. Missing data were excluded from the analyses. Where frequencies are reported, the denominator is the number of replies received. Not every clinician was eligible to answer every question, and the denominator may be smaller than the actual number of clinicians eligible to answer the question since most questions were voluntary. Open-text replies were summarised thematically; due to the large number of replies, only key illustrative themes are shown. Where average ratings between groups were compared, a Mann-Whitney U test was used with a statistical significance threshold of $p<0.05$ using SPSS V.29. Where respondents were asked to rate the importance of a factor using a Likert scale, they were also presented with multiple 'select all that apply' style statements relating to each factor outlining further details on how the factor influenced their TAT usage, ranked by multiplying the percentage of respondents agreeing with the statement with the average rating assigned to the statement's corresponding factor.

RESULTS

109 clinicians completed the survey:

- 75 paediatric surgeons (68.8% of respondents): 71 consultant paediatric surgeons (65.1%) and 4 (3.7%) resident paediatric surgeons.
- 24 consultant neonatologists (22.0%).
- 7 neonatal surgical specialist nurses (6.4%).
- 3 neonatal/paediatric dietitians (2.8%).

At least one response was received from all 25 UK neonatal surgical units that treat infants with CDO (online supplemental data 2). Responses from surgeons were received from 22/25 centres, and from neonatologists from 16/25 centres.

Most respondents (75%, n=82/109) reported working in units with no guidelines or protocols for nutritional management related to TATs and/or PN, compared with 8% (n=9/109) who did. 17% (n=18/109) were unsure if their unit had a guideline or protocol. Awareness of these guidelines was similar among neonatologists and surgeons: 5/75 (7%) of surgeons and 2/24 neonatologists (8%) reported working in a unit with such a protocol/guideline. 54/75 (72%) of surgeons responded 'no' to this question, whereas 16/75 (21%) were unsure; 20/24 neonatologists (83%) responded 'no,' 2/24 (8%) were unsure. However, some respondents were seemingly unaware of guidelines in their unit: respondents from five units reported having a guideline or protocol, but other respondents from the same five units reported that their unit did not have a guideline or protocol.

The decision to use a TAT was almost always surgeon-led:

- 88% (n=96/109) of respondents stated the decision to use a TAT was made exclusively by surgeons before or during surgery.
- 3% (n=3/109) stated there was joint decision-making between surgeons and neonatologists.
- 9% (n=10/109) answered 'other', for example, multidisciplinary team discussions.

Respondents' attitudes towards TATs are summarised in figure 1:

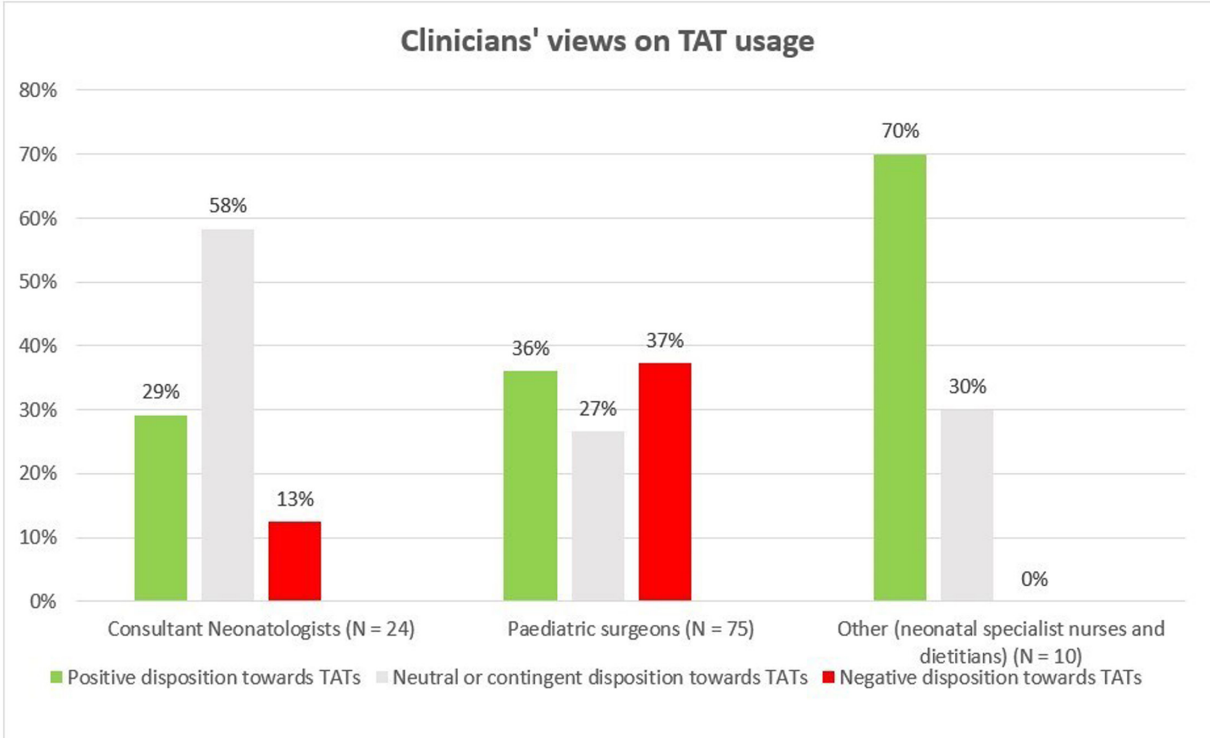

Figure 1 Overall views of different clinician groups regarding TAT usage. TAT, transanastomotic tube.

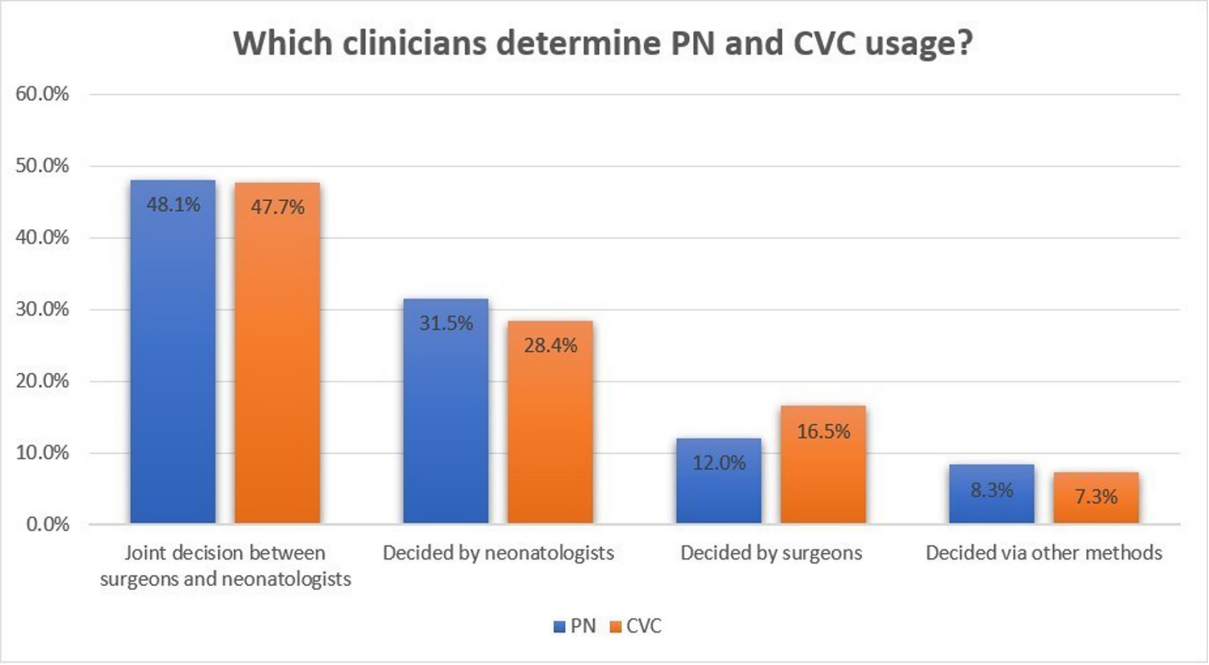

Figure 2 Key decision makers for PN and CVC use. CVC, central venous catheter; PN, parenteral nutrition.

- Those with a 'positive disposition' felt that TATs should be used in all infants with CDO (where clinically possible).
- Those with a 'negative disposition' felt TATs should not be placed.
- Those with a neutral or contingent disposition either had no preferences regarding TAT usage, or felt that TATs should or could be used in certain circumstances

Online supplemental data 3 shows how survey replies were mapped to these categories.

Surgeons were more likely than neonatologists to hold strong views in favour of or against TATs. 'Other' clinicians (nurses and dietitians) were the most 'pro-TAT' group, but this should be interpreted with caution due to the small number of respondents from this group (n=10).

The decision to use CVC and PN was most commonly a joint decision between surgeons and neonatologists (figure 2). When the decision was not made jointly, neonatologists were more likely to be the sole decision-makers rather than surgeons. Neonatologists were also more likely than surgeons to believe infants should receive a CVC/PN:

- 65% (n=15/23) of neonatologists believed all infants with CDO should receive a CVC/PN, regardless of TAT usage.
- 36% (n=27/75) of surgeons believed all infants should receive a CVC.

Regarding the timing of CVC placement, neonatologists were most likely to place a CVC prior to surgery:

- 67% (n=10/15) of neonatologists reported they placed a CVC prior to surgery.
- 7% (n=1/15) said they placed a CVC on the same day as surgery or during surgery.
- 13% (n=2/15) placed a CVC after surgical repair.
- 13% (n=2/15) answered 'other' including that placement was influenced by theatre availability.

Our survey explored the importance of a range of factors (table 1, column 1) influencing current practice. Both surgeons and neonatologists rated the effectiveness of providing appropriate nutrition as the most important factor influencing the decision to use or not use a TAT (table 1). Surgeons rated the risks associated with TAT feeding as the second most important factor, whereas for neonatologists it was 'Knowledge and expertise of TAT feeding within your clinical team'. The cost of TAT feeding was rated the least important factor by both surgeons and neonatologists. There were no statistically significant differences between the ratings either clinician group assigned to any of the seven factors.

In open-text replies (table 1), those with a positive disposition towards TAT use described factors such as more physiological feeding, a reduced need for PN and TATs' nutritional benefits as reasons for using TATs. Those with a negative disposition towards TATs believed PN provided superior or adequate nutrition, and believed TATs did not offer (sufficient) benefits compared with PN. The open-text replies were heterogeneous and sometimes contradictory: some believed TATs could be used safely, provided superior nutrition and enabled the avoidance of PN-specific risks, whereas others highlighted TAT-specific risks and felt they lacked nutritional benefits. Several respondents on either end of the 'TAT spectrum' felt that (some) PN was unavoidable, even with TATs.

The highest-ranked 'select all that apply' statements (summarised in the article, full statements/ranking in online supplemental data 4) in favour of using TATs related to their ability to provide breast milk, TATs being

Table 1 Factors underlying current practice related to TAT use with illustrative themes, ordered by rank of importance to surgeons

Factor	Average rating: surgeons	Average rating: neonatologists	P value	Illustrative themes in open-ended replies: surgeons and neonatologists with a positive disposition towards TATs	Illustrative themes in open-ended replies: surgeons and neonatologists with a neutral or contingent disposition towards TATs	Illustrative themes in open-ended replies: surgeons and neonatologists with a negative disposition towards TATs
Effectiveness of providing appropriate nutrition	4.31	4.52	0.71	▶ TATs help avoid PN ▶ TAT-specific nutritional benefits (eg, more physiological feeding, provision of earlier enteral nutrition, ability to feed breast milk via a TAT)	▶ TATs expedite/improve gastric feeding ▶ Perception that TATs reduce PN ▶ Unawareness of TATs' nutritional benefits	▶ PN provides adequate nutrition ▶ TATs' lack of nutritional benefits
Risks associated with TAT feeding	3.73	3.45	0.36	▶ Reduced likelihood of PN-related risks ▶ TATs can be used safely/their risks can be managed ▶ Both TATs and PN have different risks ▶ Different risk profiles for certain infants impact TAT usage (eg, smaller infants at greater risk)	▶ Lack of detailed knowledge of TATs' risks ▶ Different but comparable risk profiles of TATs vs PN ▶ Different risk profiles for certain infants impact TAT usage (eg, smaller infants at greater risk) ▶ Both TATs and PN have different risks	▶ Anecdotal risks shared by colleagues ▶ Risk profiles do not warrant changing practice ▶ Do not use TATs due to TAT-specific risks (eg, NEC, displacements, perforations, delayed gastric emptying, delayed gastric feeding)
Knowledge and expertise of TAT feeding within your clinical team	3.49	3.78	0.32	▶ Well-established TAT practice/expertise in unit ▶ Experience with TATs during training	▶ Neonatal team does not use TATs but is willing to learn ▶ Lack of experience with TATs ▶ Some colleagues do not have the expertise needed for TATs	▶ Factor does not influence decision-making: clinicians know how to use TATs but choose not to for other reasons
Opinions of TAT feeding within your clinical team	3.18	3.65	0.12	▶ Support for TAT feeding among colleagues ▶ Mixed opinions on TATs among colleagues	▶ Lack of discussion on TAT usage ▶ Mixed opinions on TAT usage among colleagues	▶ Mixed opinions on TAT usage among colleagues ▶ Colleagues (especially surgeons) do not support TATs
The preferences of parents/carers	2.89	2.87	0.83	▶ Belief that parents and carers want TATs ('natural feeding', early milk feeds) ▶ Unawareness of parents' and carers' preferences ▶ Belief that parents and carers are unaware of feeding options	▶ Parents' and carers' preferences have limited/no influence ▶ Unawareness of parents' and carers' preferences ▶ Parents and carers rarely express preferences ▶ Belief that parents and carers prefer breast milk to PN	▶ Parents' and carers' preferences have no influence ▶ Unawareness of parents' and carers' preferences ▶ Belief that parents and carers do not have preferences/strong views on TATs
Other factors	2.77	3.17	0.60	▶ Belief that TATs are safe and relatively easy to use ▶ Desire to avoid/reduce PN ▶ Individualised approach ▶ Belief that (reduced) PN will still be required even with a TAT	▶ Belief that infants will still require CVC/PN even with a TAT ▶ Belief that TATs offer benefits but unaware of them	▶ Belief that TATs are not safer than PN ▶ Belief that PN has improved ▶ Difficulty using TATs ▶ Lack of PN complications means change is not warranted ▶ Belief that infants will still require CVC/PN even with a TAT
Cost of TAT feeding	1.72	1.32	0.11	▶ TATs' costs are not the main consideration ▶ TATs provide insignificant savings ▶ TATs are cheaper/more cost-effective	▶ TATs' costs are secondary to clinical considerations ▶ Factor does not influence decision-making ▶ Unawareness of TATs' costs	▶ Unawareness of TATs' costs ▶ TATs are cheaper, but still prefer PN ▶ Factor does not influence decision-making

CVC, central venous catheter; NEC, necrotising enterocolitis; PN, parenteral nutrition; TAT, transanastomotic tube.

more physiological than PN and TATs enabling quicker achievement of nutritional goals. The highest-ranked statements against using TATs were that TATs were riskier than PN due to perforation and obstruction risks, a lack of expertise around TATs, that CVC/PN were inevitable and that sole CVC/PN use was preferred.

Surgeons' and neonatologists' reasons for choosing to use or not use CVC/PN were informed by conflicting interpretations of CVCs'/PN's risks and effectiveness in providing adequate nutrition (table 2). Cost was the least influential factor.

Those with a positive view of TATs were more sceptical of CVC/PN and highlighted CVC/PN-specific risks such as cardiac tamponade. Those with a negative view of TATs were more likely to have equipoise about the efficacy and risks of enteral and parenteral nutrition, or express scepticism or concerns about TATs. The belief that (some) PN was unavoidable was reiterated.

The highest-ranked statements in favour of using CVCs/PN were that CVCs/PN were not riskier than TATs, that all infants needed PN/PN was necessary for required growth and that the cost of CVCs/PN was justified. The highest ranked statements against using CVCs/PN were that TATs offered sufficient nutrition, CVCs'/PN's risk of (bloodstream) infections and that CVCs/PN represented an extra procedure.

Surgeons rated risks related to TAT usage as the most important barrier to TAT usage; neonatologists cited a lack of research supporting TATs (table 3). Two of six factors had statistically significant differences in the average rating assigned: 'Risks related to TAT use' and 'Lack of support from colleagues', with surgeons assigning a higher average rating to the former (ranking it as the most important barrier) and neonatologists assigning a higher average rating to the latter (ranking it the second most important barrier). These differences may be because surgeons are usually the sole decision-makers about TAT placement, therefore, they may feel responsible for any complications arising, but are also less likely to require colleagues' support to change practice.

In open-ended replies, surgeons and neonatologists with a negative or neutral/contingent view on TATs highlighted the absence of research using specific methods such as case control and cohort studies, in addition to TAT-specific risks, as barriers. Some gaps in training and skills were outlined, especially related to nurses' lack of experience and training with TATs.

In the 'select all that apply' statements, the highest ranked barriers to (increased) TAT usage were concerns about perforations and a lack of existing research evidence supporting TATs (especially randomised controlled trials orRCTs).

DISCUSSION

This survey explored how feeding practices are determined in infants with CDO, the rationale for this and barriers to TAT usage. The decision to place a TAT is typically exclusively surgeon-led, most strongly influenced by assessments of whether TATs provide appropriate nutrition and TAT risks. While this may be anticipated since placing a TAT is a physical act performed by a surgeon during the operation it is notable that in most cases the surgeon appears to be making this decision unilaterally. Conversely, the decision to use PN is most frequently decided jointly by surgeons and neonatologists, and second most frequently by neonatologists in isolation; this is again primarily driven by considerations of providing appropriate nutrition and risks, but the approach to this decision appears more multidisciplinary. Approximately two-thirds of neonatologists believe PN should always be given to infants (regardless of TAT usage), whereas only approximately one-third of surgeons do. Furthermore, most neonatologists intend to place a CVC prior to corrective surgery. Key barriers to (increased) TAT usage cited by surgeons include a lack of research demonstrating TATs' safety and efficacy (including an RCT), and perceptions of TATs' risks. Overall, surgeons' current views on TATs form a roughly equal three-way split, with approximately one-third always intending to use TATs and a third never intending to.

The wide range of views about TAT use suggests there are challenges with the uptake based on existing research evidence. While surgeons cited TAT risks as the principal barrier to their increased use, existing data (meta-analysis of nearly 300 cases) demonstrate no significant difference in risk in infants managed with or without a TAT. The need for repeat laparotomy (the consequence of a TAT-related perforation) between infants with CDO managed with or without a TAT was similar.[1] This suggests that some surgeons' views contradict existing published data. Factors not prioritised by clinicians were cost and the views of parents. However, given the financial challenges facing many healthcare systems, including the UK NHS,[14] it is imperative for clinicians to consider cost-effectiveness. TAT-associated cost savings, as well as reduced dependence on intravenous access, will also be of interest to clinicians in healthcare settings in low- and middle-income countries where there are limited resources.[7 15]

Comparison to existing literature

In the context of the 'behavioural change wheel',[9] where capability, opportunity and motivation factors interact, capability had the lowest impact on TAT usage: surgeons typically know how to use TATs, although some clinicians felt their knowledge of feeding using TATs could improve. Respondents often had the opportunity to use TATs; however, a lack of appropriate or preferred (typically softer and more pliable) TATs was cited as a barrier in several open-text replies. The greatest factor impeding TAT usage was therefore 'motivation': some clinicians, crucially surgeons (since they are typically the key decision-makers regarding TAT placement), believed that TATs were too risky to use and/or did not believe

Table 2 Factors underlying current practice related to PN/CVC use with illustrative themes, ordered by rank of importance to neonatologists

Factor	Average rating: surgeons	Average rating: neonatologists	P value	Illustrative themes in open-ended replies: surgeons and neonatologists with a positive disposition towards TATs	Illustrative themes in open-ended replies: surgeons and neonatologists with a neutral or contingent disposition towards TATs	Illustrative themes in open-ended replies: surgeons and neonatologists with a negative disposition towards TATs
Effectiveness of providing effective nutrition	4.56	4.78	0.10	▶ Appropriate nutrition better provided with TATs ▶ Benefits of TAT feeding: achieves feeding objectives more quickly, more physiological and safe ▶ Belief that some infants require both TATs and PN ▶ Try to avoid PN/CVC if possible	▶ PN is used as a default ▶ Both PN and TATs enable adequate growth ▶ Individualised approach (eg, based on infant's size, gestation) ▶ Belief that infants may grow better if they receive PN	▶ Equipoise: both TATs and PN can provide effective nutrition ▶ Scepticism about sole TAT usage ▶ PN provides adequate nutrition ▶ Individualised approach (eg, based on infant's size, gestation)
Risks	4.26	4.09	0.55	▶ Avoidance of CVCs due to risks (death from TPN extravasation, tamponade, line misplacement, etc) ▶ Belief that TATs are safer but that PN is unavoidable ▶ Desire to avoid lines/PN	▶ Belief that CVC/PN carries more overall risks, but that risks from TATs are more detrimental ▶ Belief in PN-specific risks, but PN may be unavoidable ▶ Unawareness of balance of risks/benefits	▶ Belief in risk equipoise ▶ Belief that PN has minimal risks ▶ Concern about TAT-specific risks (perforations, luminal obstruction, anastomotic issues) ▶ Belief that PN has 'minimal risks'
Other factors	2.88	2.80	0.88	▶ Preference for TATs ▶ Belief that short-term PN is safe	▶ Individualised/infant-dependent approach ▶ Belief that some infants will need PN	▶ Belief that children do less well with TATs ▶ Ambivalence about merits of TATs vs PN, belief that similar outcomes are achieved ▶ Belief that TATs cannot be reliably inserted
Cost	2.06	2.00	0.77	▶ Prioritisation of other factors over costs ▶ TAT feeding is cheaper than PN	▶ Prioritisation of other factors over costs ▶ Cost of TAT or PN is justified, even if it is more expensive	▶ Cost benefit favours PN ▶ Unawareness of cost ▶ Cost of (more expensive) PN is justified ▶ Limited impact of cost factors

CVC, central venous catheter; PN, parenteral nutrition; TAT, transanastomotic tube.

Table 3 Barriers to TAT use among surgeons and neonatologists with illustrative themes

Factor	Surgeons	Neonatologists	P value	Surgeons and neonatologists with a positive disposition towards TATs	Surgeons and neonatologists with a neutral or contingent disposition towards TATs	Surgeons and neonatologists with a negative disposition towards TATs
Lack of research supporting TAT use	3.26	3.79	0.139	▶ Belief that research/evidence is a prerequisite to practice change ▶ Unawareness of current research/evidence ▶ Belief that current evidence/research on TATs can be manipulated to support preferences ▶ Existing research/evidence is adequate but insufficiently well-known/convincing	▶ Unawareness of current research/evidence ▶ Lack of specific research/evidence (eg, case control studies, observational studies of standardised management) ▶ Existing research/evidence is equivocal ▶ Existing research/evidence is insufficient ▶ Existing research/evidence demonstrates only marginal benefits of TATs	▶ Lack of specific research/evidence (eg, local evidence, registry/cohort studies, national data on safety profile about adverse events of TAT vs PN) ▶ Existing research/evidence is insufficient
Risks related to TAT use	3.46	2.75	0.018	▶ Risk of perforation when using TATs ▶ Other clinicians' concerns about nutritional risks ▶ Risk that TATs alone may not provide adequate nutrition	▶ Risk of perforation ▶ Difficulty inserting TATs ▶ Lack of evidence/research about risks	▶ Difficulty inserting TATs ▶ Risk/benefit profile does not support changing practice ▶ Risk of perforation when using TATs ▶ Risk of obstruction when using TATs ▶ Technical difficulties passing TATs ▶ Risk of necrotising enterocolitis ▶ Unawareness of risk/benefit profile ▶ Scepticism of risks/benefits mentioned in existing research/evidence
Lack of support from colleagues	2.70	3.68	0.006	▶ Colleagues' resistance to change ▶ Colleagues' fear of complications ▶ Colleagues' lack of knowledge and interest ▶ Fragmented care leads status quo to continue ▶ Neonatologists decide to use PN before giving TATs a chance ▶ Colleagues may have difficulty inserting TATs	▶ Colleagues' resistance to change ▶ Colleagues do not believe TATs are clinically important ▶ Lack of discussion with colleagues ▶ Surgeons' views drive practice ▶ Varied practice among colleagues ▶ Lack of colleagues' ability to influence practice	▶ Lack of strong reasons for colleagues to change practice ▶ Local experience shows TATs offer insufficient benefits ▶ Colleagues do not advocate for TATs
Lack of experience of and training on TAT use	2.83	3.50	0.086	▶ Lack of experience/training ▶ Lack of communication between clinicians Resistance to change	▶ Nurses lack experience/training ▶ Lack of training on NICU ▶ Lack of experience/training	▶ Difficulty training residents without any personal experience of TATs ▶ Nurses lack experience/training ▶ Surgical teams lack experience/training ▶ Lack of buy-in from nurses ▶ Lack of experience/training

Continued

Table 3 Continued

Factor	Surgeons	Neonatologists	P value	Surgeons and neonatologists with a positive disposition towards TATs	Surgeons and neonatologists with a neutral or contingent disposition towards TATs	Surgeons and neonatologists with a negative disposition towards TATs
Opinions of parents and carers	2.48	2.53	0.939	▶ Parents' and carers' preferences do not influence practice ▶ Belief that parents and carers support TATs ▶ Unawareness of parents' and carers' preferences ▶ These opinions are not applicable due to the belief that parents and carers cannot make informed choices about TATs	▶ Unawareness of parents' and carers' preferences ▶ Belief that parents and carers prefer enteral feeding where possible ▶ Parents' and carers' preferences do not influence practice	▶ Belief that parents and carers do not have strong preferences about TATs ▶ Parents' and carers' preferences do not influence practice ▶ Unawareness of parents' and carers' preferences
Other barriers	2.50	2.75	0.864	▶ Lack of (appropriate/ preferred) TATs ▶ Difficulty using TATs ▶ Postoperative risks of TATs ▶ Risk of perforation when using TATs ▶ Risk of delayed gastric feeding with TATs ▶ Risk of necrosis when using TATs ▶ Risk of obstruction when using TATs	▶ Lack of (appropriate/preferred) TATs ▶ Mixed practice among senior colleagues ▶ Belief that TATs may require more effort ▶ Risk of perforation when using TATs	▶ Belief that TATs cannot be reliably inserted ▶ Belief that infants have 'done well' without TATs ▶ Belief that local benefit shows a lack of benefits when using TATs ▶ Lack of (appropriate/ preferred) TATs ▶ Risk of perforation when using TATs ▶ Belief that TATs lack benefits compared with PN

NICU, neonatal intensive care unit; PN, parenteral nutrition; TAT, transanastomotic tube.

that they provided adequate nutrition in isolation, hence little benefit to their use as PN would be required anyway.

A widely accepted explanation of the cognitive processes characterising human decision-making is 'dual-process theory'.[16] Building on previous empirical research, it argues that human cognition is determined by two processes, referred to as 'system' 1 and 2 (as popularised by Kahneman)[17 18] or 'type' 1 and 2 processing: people make decisions based on interactions between 'system 1' (intuitive, experiential and tacit) and 'system 2' (analytical, rational, deliberate) thinking.[16 19–21] This aligns with findings that surgeons use numerous decision-making processes, ranging from subconscious, intuitive approaches based on pattern recognition, to more analytical, deductive approaches.[22] Surgeons may disagree with published data and rely instead on experience or heuristics to make decisions.[23] They may have cognitive biases such as anchoring bias and inaccurate risk-benefit estimations.[24] Surgeons' assessments of the benefits and risks of operative versus non-operative management can vary when presented with identical clinical vignettes.[25] This parallels our survey findings, notably that clinicians' interpretations of the existing evidence, and risks related to TATs, were heterogeneous and were used to justify the full spectrum of TAT usage.

Strength and limitations

A strength of this survey was the collection of complementary qualitative and quantitative data, which can increase validity and allow for clarification across methods.[26] By surveying all UK neonatal surgical units, a national picture of clinicians' reasons and thought processes underpinning their current nutritional management of infants with CDO was captured. These findings reveal previously unexplored explanations for the previously unexplained heterogeneity in postoperative feeding practices of infants with CDO documented in population-based research.[2 4]

Online surveys have inherent limitations, such as potential under-coverage, self-selection and supply of false information and a lack of uniformly accepted guidelines for developing surveys.[27 28] Convenience and snowball sampling were used to ensure as wide a distribution as possible, however, this also means there is no method of determining a denominator to estimate a response rate. Most replies (75/109 or 68.8%) came from surgeons: although this enabled an in-depth understanding of their views as the main decision-makers about TATs, responses from comparatively fewer replies from other clinicians meant these views could not be explored as comprehensively. Despite our efforts we had only a few dietitians and nurses respond to our survey. Interestingly, they were generally highly supportive of TAT use, but we note they are unlikely to be the key decision-makers.

This survey primarily focused on the decision-making with regard to TATs and PN, and did not cover the use of nasogastric or oral feeding in this population. This was a deliberate choice in light of the fact most clinicians would not be comfortable feeding across an anastomosis soon after surgery, and also given that the gastric distension that accompanies CDO that means feeds are poorly tolerated early in life. We felt this was reasonable, but it does mean we may not have described this third (and likely small) potential area of practice if it exists.

Implications for future work

This study identified that surgeons and neonatologists have conflicting and wide-ranging views on TATs' risks and efficacy, which they reported as the key reasons to use or not use them. This highlights a need to understand what specific types of evidence clinicians believe are necessary to change practice, as well as to understand the origins of clinicians' perceptions of TATs' risks. One possibility would be to perform an RCT comparing outcomes for infants managed with a TAT and deliberate avoidance of PN/CVC, to those managed without a TAT. However, such a trial would be challenging, and based on discussions with clinicians, and lack of support from our PPI group may not be feasible. Prior to considering an RCT we would require a clear indication that if a trial were to demonstrate superiority of one approach over the other then clinicians would actually change practice. Another aspect, reported as a barrier to TAT usage by surgeons and neonatologists with both positive and negative dispositions towards TATs was a lack of experience and training. A practice guide to facilitate TAT use and a training programme for units lacking experience of TAT use may be useful interventions.

We now intend to explore these aspects further in qualitative interviews and focus groups with a sample of our survey respondents. We will use survey findings to inform topic guides so that these perceived barriers can be explored in greater detail. We will also explore whether alternative methodologies to an RCT would provide sufficient evidence to influence practice. Given the anticipated challenges of an RCT and lack of support from our PPI group it is important to understand how TAT usage could be increased by other means. For example, better dissemination of existing evidence, larger observational studies, sharing of anecdotal evidence and best practice among clinicians, especially surgeons.

CONCLUSIONS

Increasing TAT use will require surgeons to be persuaded of TATs' safety and efficacy. Achieving a concomitant decrease in PN requires neonatologist recognition that exclusive TAT feeding can provide adequate nutrition, thereby avoiding PN. Further research is required to understand how best to generate the evidence required to influence these clinicians and support the implementation of TAT use in these babies.

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