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- Intravenous sedation with propofol is another treatment modality to offer dentally anxious young people and may avoid the need for a general anaesthetic.
- Conservative and surgical treatment was successfully completed for the majority of patients.
- Patient and parent feedback have been used to develop the service.

Introduction:

Management of children with dental anxiety remains a challenge for dental professionals. The UK child dental health survey in 2013 found that over half of adolescents reported moderate dental anxiety and 10-14% extreme dental anxiety.¹ Children who are dentally anxious tend to have poorer oral health (higher caries experience and more missing teeth due to extraction) and are symptomatic or irregular users of dental services.^{2,3,4} Behavioural management techniques have been shown to be successful, including more recent studies which have employed cognitive behavioural therapy.⁵ However; these techniques are not suitable for all children and in some cases pharmacological techniques are required to allow the child to complete their dental treatment. It is important for general dental practitioners to be aware of the services available in their area when assessing children and young people with dental anxiety. These patients often present late and are symptomatic, therefore it is important they are referred to the appropriate service to manage their needs.

Inhalation sedation is the mainstay for children experiencing dental anxiety who require treatment. However; inhalation sedation may not provide the degree of anxiolysis required, leading some of these children to undergo general anaesthesia for management of their dental condition. Intravenous sedation (IVS) with midazolam has been shown to be successful in managing dental anxiety in adults and young people. Midazolam has a rapid onset and its duration of action is around 30 minutes. Sedation levels during this period cannot be routinely adjusted without using a reversal agent. Propofol is administered by an anaesthetist via a target-controlled infusion. It has a rapid onset with a distribution half-life of 2-4 minutes and a rapid recovery with an elimination half-life of 1-3 hours. The rapid onset and offset of propofol mean the sedation level can be more easily tailored to the treatment required than midazolam. For example, higher levels of sedation for local

anaesthesia or dental extractions after which the level of sedation can be reduced. Furthermore, longer treatment procedures can be completed with propofol in comparison to midazolam as propofol's duration of action is dependent on administration as an infusion.

Propofol has some amnesic effects, but this is less profound in comparison to midazolam⁶. The amnesic effect can be beneficial to anxious patients if an unpleasant surgical procedure is planned. On the other hand, it is thought that remembering a positive experience can help transition these patients to receiving routine dental treatment without pharmacological management in the future. In addition, there have been isolated reports that midazolam can have a paradoxical reaction in children.⁷ With propofol, the margin of safety between sedation and anaesthesia is narrower compared with benzodiazepines. IVS with propofol therefore needs to be carried out in a hospital setting by an anaesthetist which is more costly in comparison to midazolam which can be administered by an appropriately trained dental surgeon in a dental surgery. Furthermore, a period of fasting is required for propofol. A cannula is used to administer propofol which some patients with a needle phobia may be unable to tolerate. It can cause pain on injection so local anaesthetic is regularly used.

The Department of Paediatric Dentistry at the Charles Clifford Dental Hospital introduced an IVS service to bridge the gap between inhalation sedation and GA services for children with dental anxiety in 2016. The consultant-led service takes place in the Theatre Suite at Sheffield Children's Hospital. A consultant anaesthetist supported by an Operating Department Practitioner is responsible for administering the sedative agents and monitoring of the patient throughout the procedure. Dental treatment is provided by a Specialist in Paediatric Dentistry with a dental nurse and support worker. Following completion of the procedure, the patient is transferred to the peri-anaesthetic care unit (PACU) and discharged once they have recovered sufficiently.

This is an evaluation of the new IVS with propofol service, from the pilot period, October to November 2016, and first year permanently running the service, August 2017 to June 2018. Both quantitative and qualitative data were obtained during this time period. Some

modifications were made to the service following the pilot which are discussed below. This paper aims to report our experience running the service. Our objectives were to assess:

1. The characteristics of children referred to the service
2. Type and quantity of dental treatment completed
3. Surgery and recovery time
4. Assessment of dental anxiety of children using the service
5. Child and parent satisfaction with the service

Methods:

This service evaluation was registered with the SCH Clinical Audit and Effectiveness Committee. Data were collected prospectively from a convenience sample taken from the pilot period, October to November 2016, and in the first year of the service, August 2017 to June 2018.

IVS pathway

An IVS team was formed as described previously. A Standard Operating Procedure was created. The criteria for the IVS service were as follows:

- Aged 12 years and above
- ASA I or II
- To require pharmacological management to complete dental treatment
- Must be able to tolerate cannula without sedation or pre-medication

The service was piloted in October to November 2016. Eligible children were clinically and radiographically assessed at the Charles Clifford Dental Hospital. The options for carrying out the treatment were discussed which included: local anaesthetic alone, nitrous oxide/oxygen inhalation sedation, IVS with propofol and general anaesthetic. Once the child opted to have the treatment under IVS, an information leaflet was provided, written consent obtained and they were placed on the waiting list at Sheffield Children's Hospital (SCH).

On arrival to SCH, children were pre-assessed by a support worker who applied topical anaesthetic cream to the hands. Following this, further assessment was undertaken by both the anaesthetist and dentist. They were then escorted to a theatre where a cannula was inserted into the dorsal surface of their hand and propofol and remifentanil administered using a target-controlled infusion. Remifentanil was given to all children as it has a sparing effect on the amount of propofol required and is also a powerful analgesic. It can cause respiratory depression, however not at the low levels given for this procedure. One parent or relative were allowed to remain in the treatment room throughout if the child wished. After completion of the dental treatment the child was escorted on a trolley to the PACU and later discharged as per Trust policy by qualified recovery staff when fully recovered.

Following positive child and parent feedback of the pilot service, the service was permanently implemented from July 2017. Following the pilot, an information leaflet specifically for young people undergoing this procedure was created in line with feedback obtained from families. The Standard Operating Procedure was modified, to include a lowering of the age range to include emotionally mature 10- and 11-year-olds, staggering admission times and to allow those who were classified as ASA grade of III to be assessed by a Consultant Anaesthetist on a case by case basis.

Questionnaires

Children were asked to complete the Children's Experiences of Dental Anxiety Measure, at their first and subsequent visits. The Children's Experiences of Dental Anxiety Measure (CEDAM), was developed with children to assess different components of dental anxiety.⁸ The CEDAM is based on a cognitive behavioural assessment model of anxiety and is a 14-item self-report measure which assesses the unhelpful thoughts, behaviours, physical symptoms, and feelings experienced by children who have higher levels of dental anxiety.⁸ The measure was developed with children and aimed to provide a useful clinical assessment tool which can identify the internal components of dental anxiety experienced by children, as well as the factors that may be maintaining the child's anxiety. Internal consistency (Cronbach's alpha = 0.88) and excellent test-retest reliability (0.98) of the measure has been previously demonstrated.⁷ Each item has the option of three possible responses specific to

the question and is scored on a three-point ordinal scale (e.g., When I next visit the dentist I think... I will have a lot of control over what happens in the appointment (score = 1); I will have a bit of control over what happens in the appointment (score = 2); or I will not have any control over what happens in the appointment (score = 3)). Raw ordinal scores for each item are then totalled and converted into an interval score, allowing accurate calculation of change scores. The possible range of total scores is 14–42 (higher scores indicate a higher level of dental anxiety).

Furthermore, patient demographics, treatment completed, surgery and recovery time were recorded. Child and parent feedback forms were completed in the recovery area after their first visit. These forms were issued until data saturation was achieved.

Data analysis

Quantitative data were entered onto a Microsoft Excel spreadsheet and analysed using SPSS (IBM, New York, United States). Their postcodes were used to calculate the patients' Index of Multiple Deprivation (IMD). Thematic content analysis of the qualitative data was performed and themes identified relating to the satisfaction with the service emerged. The questionnaires were analysed independently by two researchers (AW and FG). Initially notes were made on the general themes and these were then discussed to further refine the themes. Statements made by participants were highlighted and categorised into different themes.

Results:

Demographics

In total 47 children were included in the service evaluation, our findings are summarised in Table 1. Of those, 55.3% (n=26) were female and 44.7% (n=21) were male. Over a third (36%; n=17) of children resided in areas classified as most deprived areas in England (IMD quintile 5). There were two patients (4.3%) who had either a current or history of a child protection plan, according to hospital record systems. The mean age of children attending the service was 13 years of age (range=10-16 years).

Treatment

Treatment was successfully completed for 91.5% (n=43) children. Three children refused sedation and one was unable to complete treatment following IVS. One patient refused to enter the treatment room so cannulation was not possible. As this patient was due to receive orthodontic extractions they were discharged back to their orthodontist and general dental practitioner. Two patients failed to have a cannula placed and were reviewed at the Dental Hospital to reassess treatment options. One patient was successfully sedated however unable to tolerate local anaesthesia and subsequently referred for comprehensive dental care under general anaesthetic.

Children attended for 1.5 (mean) appointments (range 1-5). Treatment provided included fissure sealants, restorations, extractions, surgical extractions and minor oral surgery. The number of teeth that required treatment ranged from 1 to 17 with a median of three teeth. The average number of teeth that were treated at each visit was 2.6. The average surgery and discharge time were 32.9 (8-105 minutes) and 33.1 (5-84 minutes) respectively.

Anxiety

At visit one, 93.6% (n=44) children completed a CEDAM questionnaire. One young person refused to complete it, another felt the questions were aggravating her anxiety and one patient with autism was unable to comprehend the questions. The scores ranged between 14 and 30, with a mean score of 20.8. Three participants scored the lowest possible score (14). The items endorsed by most children at their first visit were: "when I next visit the dentist I think I will feel shaky" (65.9%; n=29), "when I next visit the dentist I think I will be worried that it will be painful (79.6%; n=35) and "when I next visit the dentist I will get worried if the dentist tells me I need to have something done (84.1%; n=37). Of the 36.2% (n=17) patients who attended for two or more visits, 13 completed a second CEDAM. The mean score at the 2nd visit was 19.54 (range 14-26). Three participants had a reduction in their CEDAM scores while the remaining 10 CEDAM score increased at the second visit. The most frequently reported items at the 2nd visit were: "when I next visit the dentist I think I will feel shaky" (76.9%; 10); "when I next visit the dentist I think I will be worried that it will be painful (69.2%; n=9) and "when I next visit the dentist I will get a worried if the dentist

tells me I need to have something done (69.2%; n=9) and “when I next visit the dentist I will feel stressed (69.2%, n=9).

Qualitative data

Thematic content analysis of the feedback forms was carried out and themes relating to the satisfaction with the service emerged. Significant statements were highlighted and categorised into different themes: communication, environment, timing of appointments, service satisfaction and advice to other patients. Each of these areas will now be explored in greater detail with supporting quotes from the participants.

Communication

There were suggestions to improve written and verbal communication. The below response is in relation to a very anxious patient who did not want her Mother to be present for cannulation or treatment. The cannula was placed without any problem, however the Mother was not subsequently informed of this and she continued to worry until the patient was transferred to the recovery area.

*“Be informed during procedure, ***** was anxious when going in and I wasn’t told anything till she was done” (Parent response)*

Initially, some generic theatre information leaflets were sent to families and it was felt that this was not relevant.

“Some of the information was about general anaesthetic not sedation so maybe some of the leaflets could be updated” (Parent response)

Environment

These suggestions related to both the room where pre-operative assessment was performed and the theatre environment.

One parent commented that the room in which the pre-operative assessment was tailored to younger children.

"Needs to have more of an area for teens as rather babyish" (Parent response)

Conversely, the young people were happy with the treatment room.

"I really liked the room, it was calm and a nice atmosphere to be in" (Young person response)

Both the young people and the parents felt that playing music during the procedure was beneficial.

"I really liked the music in the background, it was relaxing" (Young person response)

"Love the fact your child can choose their own music" (Parent response)

Timing

There were suggestions to change the appointments to the morning. Firstly, to reduce the time for anxiety to build up and secondly, to reduce the impact of fasting.

"Maybe have morning appointments, as nerves start tricking in longer they have to wait"
(Parent response)

"I would have preferred a morning slot when it is 6 hour starve" (Parent response)

Service satisfaction

There was very high satisfaction with the service from both young people and parents, with particular emphasis on the staff.

"Staff are amazing" (Young person response)

"Excellent service, very caring staff" (Parent response)

There was acknowledgement that all members of the team were appreciated from pre-assessment, treatment and through to recovery.

“Keep it up and say thank you to all the doctors, dentists and nurses who helped me”

(Young person response)

Advice for others

The young people also provided reassuring advice to other patients who are considering having treatment under IVS, for incorporation into our patient information sheets.

“Relax and don’t worry” (Young person response)

“They shouldn’t panic cause it was actually fun” (Young person response)

They were particularly reassuring about the absence of pain that they were anticipating.

“It won’t be painful” (Young person response)

“I didn’t remember having the injection in my mouth and this was the thing I was worried about” (Young person response)

Discussion:

This paper discusses our findings from setting up an IVS service and provides an insight into the demographics of the service users, their dental anxiety and their suggestions for improvement.

Almost half the children lived in the most deprived quintiles in England. This is perhaps unsurprising, as the majority required treatment for dental caries. Previous studies have shown that dental caries is unequally distributed with higher levels found in those living in deprived areas and those from ethnic minority groups.^{9,10,11}

Treatment success was high with only four children (91.5%) failing to complete treatment. There were three patients who could not tolerate cannulation. Needle phobia can prevent young people from receiving necessary immunisations as well as medical or dental treatment. An intervention to reduce needle fear may be an area to explore further in the future.

Three studies of similar aged children receiving dental treatment under propofol IVS had similar success rates with 94.1% (32/34)¹², 90% (36/40)¹³ and 82% (37/45).¹⁴ A dedicated pre-assessment clinic may reduce the likelihood of failure. This has now been introduced and a further service evaluation will be carried out to assess whether this has been successful in ensuring children feel better prepared for the procedure. During this appointment they will receive acclimatisation to the dental environment, preventive advice and treatment including fluoride varnish and fissure sealants. By completing the fissure sealants in the chair this maximises the operating time under IVS and provides acclimatisation. During this appointment, consent can be obtained, the importance of attending and following fasting instructions can be reinforced. It is hoped that this visit will also help to reduce the cancellation or was not brought rates. A systematic review found that nurse-led pre-operative assessments reduced the cancellation rate of elective surgical in-patient procedures.¹⁵ However the evidence was weak due to small sample sizes. The use of a decision aid in combination with this may further ensure that children and their families can make informed choices about the treatment modality that they choose.¹⁶

The Scottish Dental Clinical Effectiveness Programme's guidance on Conscious Sedation in Dentistry states that the referring practitioner has a responsibility to clinically assess the patient and discuss the different anxiety management options.¹⁷ It is preferable that the appropriate technique for the patient is chosen initially rather than attempting other techniques that are likely to be unsuccessful. Therefore it is important for general dental practitioners to be aware of the services available in their area when assessing children and young people with dental anxiety so that they are referred appropriately. Paediatric Dentistry propofol IVS services are not widely available around the UK. Some other specialist units offer Paediatric Dentistry IVS with midazolam. Currently in our service, patients cannot be directly referred to the IVS service. They are initially assessed on a Consultant-led new

patient clinic where the different techniques for management of their dental anxiety are discussed and the appropriate option chosen. Following referral, it is important for the general dental practitioner to continue to see the patient regularly for review, acclimatisation, to provide preventive advice and treatment in order to reduce the likelihood of the patient requiring future dental treatment.

The majority of patients completed treatment over one or two appointments, with two patients requiring four or more appointments. The number and type of treatments performed were similar to those reported by Hosey¹¹ and Bailey.¹⁴

The aim of the service was to reduce the number of children requiring dental GA by providing a treatment modality which would allow them to complete their treatment without GA. An additional benefit to this, is that it potentially reduces the cost compared with a GA. Indeed, no child required admission and recovery time was on average 33 minutes. Both of these aspects reduce the number of staff required and costs compared to completing dental treatment under general anaesthetic.

CEDAM scores ranged from 14 to 30, a mean score of 20.8. The mean score is similar to that reported both in the CEDAM evaluation study and in that reported by Bux and co-workers.^{8,18} The evaluation study compared clinical and non-clinical samples with the clinical sample including those who self-identified as being worried about the dentist. The mean score for the clinical sample was 21.97 with a range of 14-42.⁸ Similarly, Bux and colleagues provided guided self-help cognitive behavioural therapy to a group of anxious children aged 8 to 16 years old in a general dental practice and reported a mean baseline CEDAM score of 20.3 with a range from 16 to 25.8.¹⁸ It might have been expected that participants in the current study would have higher CEDAM scores as they required pharmacological management to complete their treatment. However, in contrast to the other studies the CEDAM was not administered at the first appointment, instead completed prior to their first IVS appointment. It is conceivable that this may have altered their CEDAM scores as they were now familiar with some of the dental staff and having been referred for this treatment modality felt that their concerns had been acknowledged.

The scores for some patients who completed a second CEDAM questionnaire decreased, while others increased. Although they successfully received treatment between questionnaires there was no intervention to help reduce their anxiety. Therefore, a reduction in their CEDAM score was not anticipated. A study of children attending a IVS service in Liverpool demonstrated some reduction in anxiety following treatment under sedation using the Modified Dental Anxiety Scale.¹⁹ However, this data was only available for ten of the children in the study, so it is not possible to draw any firm conclusions. It would be interesting to conduct some qualitative research with children having IVS to understand what aspects of their dental anxiety change during the treatment course. In addition, further studies are required to analyse the minimal important difference when using CEDAM.

Feedback was generally positive. The feedback was reviewed regularly and improvements made where possible. Any negative comments were discussed immediately. Team discussions took place to address the comment about poor verbal communication. It was agreed that if the patient did not want their parent present, then the support worker would inform the parent once the cannula was placed successfully. Furthermore, the IVS patient information booklet is currently being updated with photos of the patient journey and comments from the patient feedback.

Both the patients and parents enjoyed that music, chosen by the young person, was played during the treatment if they wished. The effect of music intervention on anxiety reduction in dentistry and medicine has been explored.^{20,21} A Cochrane review in 2013 concluded that listening to music may have a beneficial effect on preoperative anxiety.²²

It is understandable that morning appointments were requested by the families. These dentally anxious young people may spend the morning worrying which could in turn affect their ability to cooperate for treatment. As the fasting time, six hours before their appointment time, is during the day, there is more opportunity for the patients to accidentally break the fast and subsequently have their appointment cancelled. Reducing the fasting time was discussed with the anaesthetic team, but this was rejected due to safety concerns.

Unfortunately, due to other lists running in the procedure room and staff availability, the IVS has remained an afternoon session.

The service on whole has been hugely successful and the feedback has been really positive. Staff continuity is important for anxious patients but this can cause some difficulties if our regular nurse, dentist or anaesthetist is different. The caring nature of the staff involved was recognised and appreciated by both the patient and parent.

The young people provided reassuring advice to patients who were having treatment under IVS in the future, with many commenting on the absence of pain. These comments are significant as the second highest scoring CEDAM question is about anxiety that they will experience pain when they next visit the dentist and persisted in those who completed CEDAM a 2nd time.

The feedback and discussions we have had about the service with children and their families are invaluable and have ensured that we have improved our care in ways which the families who use the service value. We continue to learn lessons as the IVS service continues its development and endeavour to include service users regularly to continue to enhance the care we provide.

Conclusion: In conclusion, the majority of patients successfully received dental treatment under intravenous sedation with propofol. CEDAM scores for this group of patients were comparable to similar studies. Further research using this tool will be valuable to gain a better understanding of young people's anxiety and how best to manage it. Feedback from the patients and parents was generally positive and all suggestions for improvement were considered. Changes, where possible, have been made to the service to improve patient experience and maximise productivity.

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