Comparing the profile of child patients attending dental general anaesthesia and conscious sedation services

S. Hariharan,[1] M. T. Hosey[1] and E. Bernabé*[1]

In brief

Summarises the literature on previous comparisons between child patients receiving dental treatment under general anaesthesia and conscious sedation.

Highlights the existence of an overlap between the two patient groups.

Discusses the role of clinical practice protocols to support clinical decision-making.

Aims To compare the profile of paediatric patients receiving dental treatment under general anaesthesia (GA) or conscious sedation (CS). A second aim was to explore whether there is an overlap between the two patient groups. **Design** This service evaluation study was based on sociodemographic and clinical data extracted from clinical records of patients attending dental appointments for GA or CS services at King's College Hospital. Sociodemographic and clinical differences between GA and CS groups were explored using logistic regression models. **Results** Data from 113 children (58 GA and 55 CS) were analysed. There were differences between groups in terms of age and numbers of quadrants and teeth treated, but not in terms of sex, ethnicity or deprivation scores. In the adjusted model, older children and those having more teeth treated were more likely to be in the GA than in the CS group. An overlap between the GA and CS groups was found, with 50% of children aged four to nine years having two to four teeth treated in both groups. **Conclusion** Age and number of teeth treated were the main characteristics associated with receiving care under GA or CS. Some overlap between children receiving dental treatment under GA or CS existed despite demographic and clinical differences between both groups.

Introduction

Conscious sedation (CS) and general anaesthesia (GA) are the two mainstream pharmacological techniques, in addition to local anaesthesia, used for the management of paediatric dental patients in the United Kingdom.[1,2] The Standing Dental Advisory Committee for the Department of Health,[3] the General Dental Council,[4] the National Institute for Health and Care Excellence,[5] the Association of Paediatric Anaesthetists,[6] and the Royal College of Surgeons[7,8] are the main regulatory bodies in the UK which have issued detailed guidelines on the use of CS and GA for the provision of dental care and recommended their use only when behaviour management techniques and local anaesthesia do not allow treatment to be carried out, and in cases of severe tooth decay with consistent pain and discomfort.

Despite the above guidelines, the decision to treat children under CS or GA is routinely based on the clinician's discretion and expertise during initial consultations with children and their parents. Exploring the socioeconomic, demographic and clinical factors associated with the use of CS and GA could help us to understand the characteristics of these children, and in turn, establish clinical practice protocols to support clinical decision-making and treatment planning. Any potential overlap between the two patient groups would lend support to the need for criteria meant for the referral and provision of treatment under CS or GA, based on patients' profile and clinical history.

Most studies to date have described the characteristics of child patients receiving dental treatment under either CS[9–11] or GA.[12–16] A few studies have compared the profile of child patients in the two groups. A study of 76 nine to 15-year-olds referred for GA extractions showed no differences between CS (N = 26) and GA groups (N = 50) in terms of sex, age or pre-treatment dental anxiety scale scores.[17] In addition, the number of teeth extracted were not substantially different between the two groups of children (1.69 versus 2.20 permanent teeth and 0.92 versus 1.14 primary teeth).[17] A large study among five to 11-year-olds referred for emergency dental extractions showed that children offered GA were younger, had more decayed teeth, higher levels of anxiety and brushed their teeth less often than children offered CS. No differences between groups were found in terms of family structure and benefit status, parental employment or the age when parents left school. Child's age, dental anxiety, toothbrushing frequency and dentinal decay were the only factors that discriminated well between GA and CS status in multivariate models.[18] A national audit in Scotland comparing GA to CS and local anaesthesia for extractions in children showed that GA children were more dentally anxious than children of a similar age (that is, population norms) and received more extractions for caries than CS children. Multivariate analysis

[1]Division of Population and Patient Health, King's College London Dental Institute at Guy's, King's College and St. Thomas' Hospitals, London, United Kingdom.
*Correspondence to: Dr. Eduardo Bernabé,
Email: eduardo.bernabe@kcl.ac.uk

Refereed Paper. Accepted 30 January 2017
DOI: 10.1038/sj.bdj.2017.406

Official journal of the British Dental Association.

found that number of extractions was the major predictor of anaesthetic type. When the number of teeth was removed as a predictor, age became the most important factor.[19] The authors concluded that CS did not seem to be an alternative to GA for the majority of children referred for extractions due to caries.[19]

The primary aim of this service evaluation study was to compare the profile of patients receiving dental treatment under GA or CS at King's College Hospital Paediatric Dental Clinic. A second aim was to explore whether there is an overlap between the two patient groups.

Methods

This service evaluation was registered with King's College Hospital NHS Trust before the commencement of the study. There was no need for ethical approval since this study was designed to evaluate existing hospital dental services provided as part of normal clinical treatments. However, the study adhered to the Caldicott principles for data collection and storage.[20,21]

Participants were recruited prospectively during the Summer of 2016 from the Paediatric Dental Clinic at King's College Hospital and included healthy children under 17 years of age who were given appointments to receive extractions due to dental caries under either CS or GA for the first time (repeats were excluded). The decision to provide dental care under CS or GA was made at an outpatient consultation with a consultant in paediatric dentistry. Only patients with an American Association of Anaesthesiologists (ASA) physical status classification system score of I (no systemic disease) or II (mild systemic disease) were eligible for inclusion. Children with special healthcare needs (that is, underlying medical conditions, learning disabilities, etc.) or receiving dental care for other reasons (such as orthodontics or dental trauma) were excluded from this evaluation.

Data were extracted from hospital records by a single researcher (SH) who was not involved in the provision of dental care and using a standardised extraction form. Data extracted included demographic variables (age, sex and ethnicity), socioeconomic position (postcodes) and clinical variables regarding the dental treatment to be performed during the appointment (reason for appointment, number of quadrants and teeth to be treated, and whether treatment would be provided under CS or GA). Ethnicity was assigned by parents into one of the main ethnic groups in the UK (White, Black, Asian, Mixed and Other). Children were later regrouped as White or non-White due to the few number of cases in some ethnic groups. Postcodes were used to obtain index of multiple deprivation (IMD) deciles using the Department of Communities and Local Government postcode lookup. Data on children's dental anxiety was not included in this service evaluation as it was not recorded in patients' notes.

Statistical analysis

All analyses were carried out using the Statistical Software for Social Sciences (SPSS) for Windows Version 22.0 (IBM Corp., Armonk, NY, USA). Chi-square test was used to compare CS and GA groups by sex and ethnicity whereas ttest was used to compare CS and GA groups in terms of age, IMD decile score, and number of quadrants and teeth treated. The association between each factor and treatment offered (CS/GA status: coded as 0 for CS and 1 for GA) was then evaluated in crude and adjusted models using binary logistic regression. Odds ratios (OR) were therefore reported. Finally, the overlap between GA and CS groups was explored in parallel histograms and in the stratified analysis for the variables that were significant in the regression analysis.

Results

Data from 113 children (55 in CS group and 58 in GA group) were analysed in this service evaluation. Table 1 presents the characteristics of both groups of patients. The ratio of boys to girls (9 to 11) was similar in the two groups. The main ethnic groups were Blacks and Whites (35% and 31%) in the CS group and Whites and Mixed (33% and 25%) in the GA group. However, there were no differences between groups according to ethnicity. The CS group was significantly older than the GA group (9.4 versus 6.3 years), but there were no differences in deprivation scores (3.6 for

Table 1 Comparison of demographic and clinical characteristics of children receiving dental care for dental caries under conscious sedation (CS) and general anaesthesia (GA)

Characteristics	CS		GA		P value*
Sex					**0.947**
Boys	25	45%	26	45%	
Girls	30	55%	32	55%	
Age in years					**<0.001**
Mean ± SD	9.4 ± 3.1		6.3 ± 1.7		
Range	4-15		2-10		
Ethnicity					**0.275**
Whites	19	35%	19	33%	
Blacks	17	31%	9	16%	
South Asians	5	9%	9	16%	
Mixed	9	16%	15	25%	
Others	5	9%	6	10%	
IMD decile score					**0.669**
Mean ± SD	3.6 ± 2.0		3.5 ± 1.8		
Range	1–9		1–9		
Number of quadrants treated					**<0.001**
Mean ± SD	2.1 ± 1.0		3.2 ± 0.9		
Range	1–4		1–4		
Number of teeth treated					**<0.001**
Mean ± SD	2.6 ± 1.8		5.8 ± 2.9		
Range	1–9		1-13		

SD: standard deviation. *Chi-square test was used to compare categorical variables and t-test to compare continuous variables

Official journal of the British Dental Association.

CS group and 3.5 for GA group). In terms of clinical characteristics, the mean number of quadrants and teeth treated were significantly lower in the CS group (2.1 and 2.6) than in the GA group (3.2 and 5.8).

Table 2 shows the association between patients' characteristics and the probability of being in the GA group (CS was the reference group). Three variables were significantly associated with the probability of belonging to the GA group in crude models, namely age (OR:0.56; 95% Confidence Interval: 0.460.73), number of quadrants treated (OR: 2.67; 95% CI: 1.784.03) and number of teeth treated (OR: 1.79, 95% CI: 1.422.26). In the adjusted model, only age and number of teeth treated remained significantly associated with the probability of being in the GA group. Younger children (OR: 0.58; 95% CI: 0.430.77) and those having more teeth treated (OR: 1.56; 95% CI: 1.102.20) were more likely to belong to the GA group than their corresponding counterparts.

Figure 1 shows the overlap in the number of teeth treated between the CS and GA groups. The largest overlap occurred for children having between two and four teeth requiring treatment. However, Figure 1 does not control for age, the other significant variable in the adjusted model. To that end, Table 3 shows the number and proportion of children having two to four teeth treated stratified by age. The major overlap was seen among children aged four to nine years, with 21 children in the CS group (63.6%) and 22 children in the GA group (41.5%) requiring treatment in two to four teeth. Overall, 43 children (50%) between the ages four and nine years had two to four teeth treated under either CS or GA.

Discussion

Child age and number of teeth treated were the main characteristics associated with receiving care under CS or GA. Children in the GA group were younger and had more teeth treated, regardless of their sociodemographic characteristics. Some overlap between the two groups was found. Half of children aged four to nine years received treatment for two to four teeth under either CS or GA.

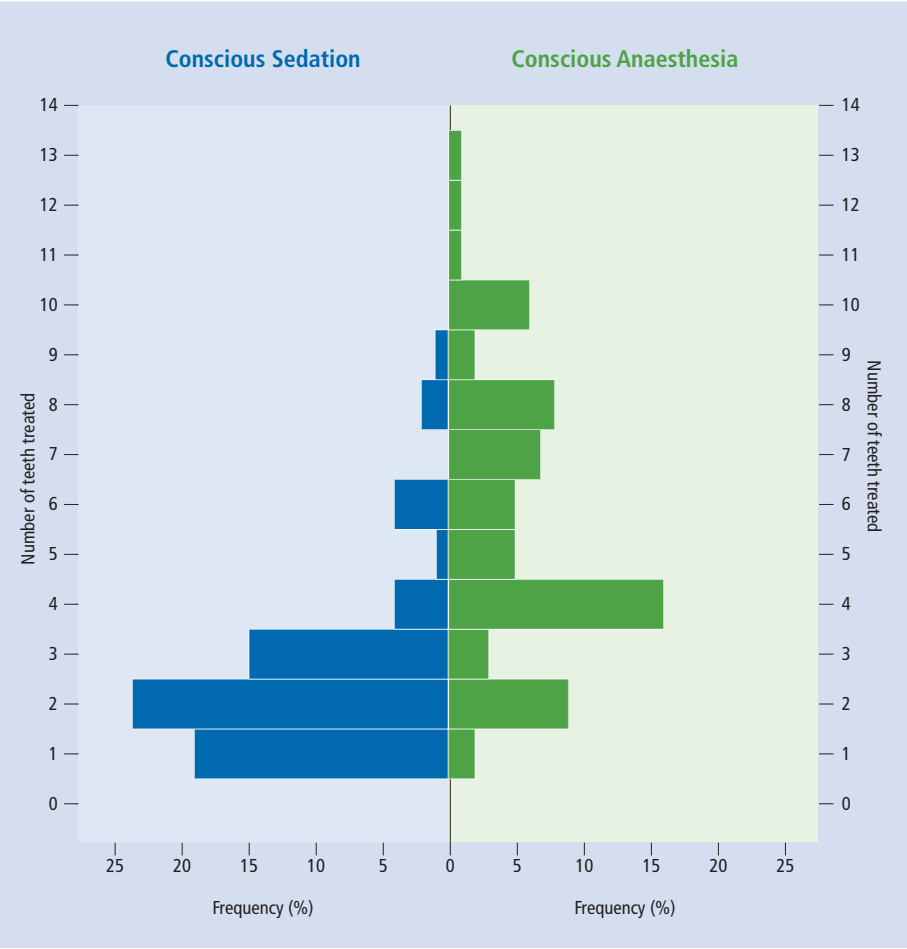
Some limitations of this study need to be borne in mind when interpreting the present findings. The generalisability of the findings beyond the study group is limited owing to the use of a local sample and the different demographic profile of London compared to the rest of the UK. Another limitation relates to the

Table 2 Socio-demographic and clinical factors associated with receiving dental care under general anaesthesia

Characteristics	Crude association			Adjusted associations		
	ORa	[95%CI]	P value	OR*	[95%CI]	P value
Sex						
Boys	1	[Reference]			[Reference]	
Girls	1.03	[0.49-2.15]	0.947	1.42	[0.34-3.96]	0.618
Age	0.58	[0.46-0.73]	<0.001	0.58	[0.43-0.77]	<0.001
Ethnicity						
White	1	[Reference]		1	[Reference]	
Black	0.53	[0.19-1.48]	0.225	1.06	[0.23-4.94]	0.937
South Asian	1.8	[0.51-6.38]	0.362	1.84	[0.28-12.13]	0.527
Mixed	1.67	[0.59-4.73]	0.337	1.27	[0.30-5.43]	0.745
Other	1.2	[0.31-4.61]	0.791	0.66	[0.11-4.14]	0.659
IMD decile	0.96	[0.79-1.16]	0.666	1.01	[0.76-1.35]	0.949
Number of quadrants treated	2.67	[1.78-4.03]	<0.001	1.44	[0.69-3.01]	0.333
Number of teeth treated	1.79	[1.42-2.26]	<0.001	1.56	[1.10-2.20]	0.012

*Binary logistic regression was used and odds ratios (OR)

Fig. 1 Distribution of the number of teeth treated under conscious sedation and general anaesthesia



Official journal of the British Dental Association.

Table 3 Number of children requiring dental care for 2 to 4 teeth according to pharmacological management technique and age

Age	CS		GA		Total	
	N	%	N	%	N	%
3 years			3	60%	3	60%
4 years	3	75%	3	60%	6	67%
5 years	1	50%	4	33%	5	36%
6 years	4	57%	4	29%	8	38%
7 years	3	38%	6	46%	9	39%
8 years	8	89%	2	50%	10	67%
9 years	2	67%	3	60%	5	67%
10 years	1	50%			2	100%
11 years	2	67%			5	100%
12 years	3	50%			6	100%
13 years	2	40%			6	100%
14 years	2	50%			4	100%
15 years	1	50%			1	50%
Total	**32**	**61%**	**25**	**42%**	**63**	**39%**

relatively small sample size. However, a post-hoc power calculation showed that the number of participants was large enough to identify a small effect size (0.20). Patients' ethnicity was classified as White or non-White for analysis due to the few cases in some ethnic groups. This approach may have masked potential differences between Asians, Blacks, Mixed and Others (when combined into the non-White group) but also within White British and White others. In addition, the study did not include other relevant variables such as dental anxiety, which could be an important determinant to decide the type of treatment provided for dental extractions.[18,22] Service evaluation studies are often limited by the accuracy and comprehensiveness of case records.

This study showed that factors such as age and number of teeth treated differed between treatment groups, which is contradictory to the results from previous studies,[17,23] but in line with those from the study with the largest sample.[18] Indeed, the non-significant differences in deprivation scores found in our study resembled those reported by Carson and Freeman[18] using alternative socioeconomic measures such as parental employment, benefit entitlement and age when parents finished school. There does not seem to be a predilection in the provision of CS or GA for patients of a given sex, as reported in all previous studies.[17,18,23] We also did not find predilections by ethnicity. A recent study exploring the characteristics of children who underwent extractions under GA in Wolverhampton showed that children of Mixed ethnicity (defined as neither White nor South Asian in that study) required more extractions than other ethnic groups.[15] However, this may simply be a reflection of ethnic differences in the prevalence and severity of dental caries[24] rather than the preference of clinicians to offer one technique over another for the provision of complex dental care.

A second finding was the extent of overlap between the CS and GA groups. After accounting for the only two significant variables in this study group (age and number of teeth treated), half of four to nine year olds in our study had two to four teeth treated under CS or GA. This finding implies that there is a specific age group of children in which both treatment options are used to provide the same level of care. It also identifies GA cases where treatment under CS could have been considered as an option to GA and where clear clinical protocols and care pathways would be beneficial to practitioners and patients. As this study did not account for children's dental anxiety, it is possible that patients in the GA (of similar age and dental care needs) had higher levels of dental anxiety, explaining the overlap found here. However, two previous studies[17,18] and a national audit[19] found no differences in dental anxiety scores between CS and GA child patients requiring dental extractions,[17,23] while a third study found significant differences between the groups.[18] Interestingly, the negative studies measured dental anxiety with instruments completed by children[17,18,23] whereas the remaining study used parents as proxies to assess their child dental anxiety.[18] An alternative explanation for the overlap could be the child's psychological profile. Studies have suggested that a high number of children who are scheduled for tooth extraction under GA following an assessment by paediatric dentists have clinically evident and significant emotional and psychological problems.[25–27] This area needed further exploration.

Dental caries in children is certainly a public health problem and in most cases multiple teeth are affected which means wider extractions are carried out under CS and GA, which leads to considerable use of healthcare resources in the UK, potentially burdening the National Health Service. The overlap of services could pose a significant problem since children who receive care under a risky procedure like GA, which is associated with significant morbidity and mortality, can be very well treated under CS which is relatively safe.[28–30] There must be further research, using strong research designs, to identify the characteristics of paediatric dental patients requiring pharmacological approaches for dental care and generate the evidence needed for the development of referral care pathways and appropriate clinical protocols to assist treatment planning decisions.

Conclusion

This service evaluation study shows that age and number of teeth treated were the main characteristics associated with receiving care under conscious sedation or general anaesthesia. Interestingly, some overlap between children receiving dental treatment under conscious sedation or general anaesthesia existed despite demographic and clinical differences between both groups.

1. Welbury R, Duggal M S, Hosey M T. *Paediatric Dentistry*. Oxford: Oxford University Press, 2012.
2. Shepherd A R, Ali H. A care pathway for children unable to accept dental care within the general dental services involving the use of inhalation sedation and general anaesthesia. *Prim Dent J* 2015; **4:** 29–34.
3. SDAC. Conscious sedation in the provision of dental care. London: Department of Health, 2003.
4. GDC. Standards for Dental Professionals. London: General Dental Council, 2005.
5. NICE. Sedation in children and young people – Sedation for diagnostic and therapeutic procedures in children and young people. NICE clinical guidelines 112. London: National Institute for Health and Care Excellence, 2010.

Official journal of the British Dental Association.

6. Adewale L, Morton N, Blayney M. Guidelines for the management of children referred for dental extractions under general anaesthesia. London: Association of Paediatric Anaesthetists of Great Britain and Ireland; 2011.
7. RCS. Guideline for the use of general anaesthesia (GA) in paediatric dentistry. London: Royal College of Surgeons of England; 2008.
8. RCS. Standards for Conscious Sedation in the Provision of Dental Care – Report of the Intercollegiate Advisory Committee for Sedation in Dentistry. London: Royal College of Surgeon, 2015.
9. Naudi A B, Campbell C, Holt J, Hosey M T. An inhalation sedation patient profile at a specialist paediatric dentistry unit: a retrospective survey. *Eur Arch Paediatr Dent* 2006; **7:** 106–109.
10. Alexopoulos E, Hope A, Clark S L, McHugh S, Hosey M T. A report on dental anxiety levels in children undergoing nitrous oxide inhalation sedation and propofol target controlled infusion intravenous sedation. *Eur Arch Paediatr Dent* 2007; **8:** 82–86.
11. Ashley P F, Parry J, Parekh S, Al-Chihabi M, Ryan D. Sedation for dental treatment of children in the primary care sector (UK). *Br Dent J* 2010; **208:** E21; discussion 522–523.
12. Hosey M T, Bryce J, Harris P, McHugh S, Campbell C. The behaviour, social status and number of teeth extracted in children under general anaesthesia: a referral centre revisited. *Br Dent J* 2006; **200:** 331–334, discussion 327.
13. Moles D R, Ashley P. Hospital admissions for dental care in children: England 1997–2006. *Br Dent J* 2009; **206:** E14; discussion 378–379.
14. Goodwin M, Sanders C, Pretty I A. A study of the provision of hospital based dental general anaesthetic services for children in the northwest of England: part 1a comparison of service delivery between six hospitals. *BMC Oral Health* 2015; **15:** 50.
15. Raja A, Daly A, Harper R, Senghore N, White D, Ravaghi V. Characteristics of children undergoing dental extractions under general anaesthesia in Wolverhampton: 2007–2012. *Br Dent J* 2016; **220:** 407–411.
16. Friend T, Allen P. Prospective study on dental extractions carried out for paediatric patients under general anaesthetic in a district general hospital. *SAAD Dig* 2016; **32:** 58–61.
17. Arch L M, Humphris G M, Lee G T. Children choosing between general anaesthesia or inhalation sedation for dental extractions: the effect on dental anxiety. *Int J Paediatr Dent* 2001; **11:** 41–48.
18. Carson P, Freeman R. Dental caries, age and anxiety: factors influencing sedation choice for children attending for emergency dental care. *Community Dent Oral Epidemiol* 2001; **29:** 30–36.
19. Macpherson L M, Pine C M, Tochel C, Burnside G, Hosey M T, Adair P. Factors influencing referral of children for dental extractions under general and local anaesthesia. *Community Dent Health* 2005; **22:** 282–288.
20. The Caldicott Committee. Report on the review of patient identifiable information. London: Department of Health, 1997.
21. Walker P. Protecting and using patient information. A manual for Caldicott Guardians. Leeds: NHS Executive; 1999.
22. Taskinen H, Kankaala T, Rajavaara P, Pesonen P, Laitala M L, Anttonen V. Self-reported causes for referral to dental treatment under general anaesthesia (DGA): a cross-sectional survey. *Eur Arch Paediatr Dent* 2014; **15:** 105–112.
23. Shepherd A R, Hill F J. Orthodontic extractions: a comparative study of inhalation sedation and general anaesthesia. *Br Dent J* 2000; **188:** 329–331.
24. Marcenes W, Muirhead V E, Murray S, Redshaw P, Bennett U, Wright D. Ethnic disparities in the oral health of threeto fouryearold children in East London. *Br Dent J* 2013; **215:** E4.
25. Millar K, Asbury A J, Bowman A W, Hosey M T, Musiello T, Welbury R R. The effects of brief sevoflurane-nitrous oxide anaesthesia upon children's postoperative cognition and behaviour. *Anaesthesia* 2006; **61:** 541–547.
26. Hosey M T, Asbury A J, Bowman A W *et al.* The effect of transmucosal 0.2 mg/kg midazolam premedication on dental anxiety, anaesthetic induction and psychological morbidity in children undergoing general anaesthesia for tooth extraction. *Br Dent J* 2009; **207:** E2; discussion 32–33.
27. Hosey M T, Macpherson L M, Adair P, Tochel C, Burnside G, Pine C. Dental anxiety, distress at induction and postoperative morbidity in children undergoing tooth extraction using general anaesthesia. *Br Dent J* 2006; **200:** 39–43; discussion 27; quiz 50.
28. Folayan M O, Faponle A, Lamikanra A. Seminars on controversial issues. A review of the pharmacological approach to the management of dental anxiety in children. *Int J Paediatr Dent* 2002; **12:** 347–354.
29. Lyratzopoulos G, Blain K M. Inhalation sedation with nitrous oxide as an alternative to dental general anaesthesia for children. *J Public Health Med* 2003; **25:** 303–312.
30. Wilson S. Pharmacological management of the paediatric dental patient. *Paediatr Dent* 2004; **26:** 131–136.

Official journal of the British Dental Association.