Community Dental Health (2007) **24,** 55-58
Received 6 February 2004; Accepted 26 September 2004

An audit of paediatric dental treatments carried out under general anaesthesia in a sample of Spanish patients

E. Barberia[1], M. Arenas[1], B. Gómez[1] and D. Saavedra-Ontiveros[2]

[1]*Faculty of Odontology, Madrid Complutense University, Madrid, Spain;* [2]*Instituto de Salud Carlos III, Ministerio de Sanidad y Consumo, Madrid, Spain.*

Objective: To evaluate the success and failure rates of the clinical procedures carried out under general anaesthesia in disabled or medically comprised and healthy children ***Basic Research Design:*** Retrospective study included 47 patients who received dental treatment under general anaesthesia, grouped according to whether they were disabled or medically compromised (group A, n=16) or not (group B, n=31), and subgrouped according to whether they were under or over 6 years of age. ***Results:*** Mean duration of anaesthesia was 2 hours and 25 minutes, with a range of 1 to 4 hours. The percentage of children followed up was 87%. The procedures performed were: 105 preformed metal crowns, 142 restorations, 85 pulpotomies and 166 extractions. The success rate was 93% for preformed metal crowns, 96% for pulpotomies and 90% for restorations. ***Conclusions*:** General anaesthesia is necessary in some children, but should be complemented with a preventive programme, behavioural remodelling and a follow-up schedule to avoid having to repeat the use of general anaesthesia.

Key words: dental treatment under general anaesthesia; failure of dental treatment; general anaesthesia

Introduction

Comprehensive dental care is an important goal of paediatric dentistry; however, children frequently show high anxiety levels and a low level of co-operation, which forms a barrier to the provision of dental care (Pine *et al*., 2004) hence completion of necessary clinical procedures may not be possible (Vinckier *et al*., 2001). This can be a challenging health problem which should be taken into account in the design and budgets of governmental dental care programmes (Barbería and Maroto, 2005).

There are numerous options for controlling behaviour. Among them is the use of general anaesthesia, an option which provides optimal conditions for obtaining ideal outcomes (Acs *et al*., 2001). Nevertheless, it is rightly considered as the last resource due to the degree of risk, the low level of the parental acceptance and the high cost (Clinical Standards Advisory Group, 1995; Department of Health, 2000).

General anaesthesia is an induced state of unconsciousness, accompanied by a partial or complete loss of defensive reflexes. It is useful when the patient is not required to voluntarily respond to physical stimulation or verbal orders. The objectives in children are to eliminate cognitive, sensorial and motor activity in order to facilitate dental diagnosis and treatment.

The success of treatments under general anaesthesia is affected by the suitability of the clinical procedures involved and the materials used. However, since we are talking about children who are likely to be highly susceptible to caries, it has been suggested that success is also related to other factors such as parental co-operation and levels of dental caries (Vinckier *et al*., 2001).

Reports which assessed dental procedures carried out under general anaesthesia indicate that behavioural problems leading to an inability to cooperate as the main reasons for using it. However, it has been suggested that the age of the patient, the medical history and the complexity of the treatment required should also be considered (Al-Eheideb and Herman, 2003). According to the American Academy of Paediatric Dentistry, general anaesthesia is indicated in children with certain physical, mental or medically compromising conditions, un-cooperative children with extensive orofacial or dental trauma and in patients with dental needs who otherwise would not receive comprehensive dental care (AAPD, 2002). The management of early childhood caries (ECC), whether by extraction or restoration, often requires the use of general anaesthesia due to the child's apprehension (Barbería *et al*., 1983.; Barbería, 1985)

Clinical procedures carried out under general anaesthesia, as well as the techniques and materials used, have been evaluated by several authors. Al-Eheideb and Herman (2003) studied 54 children who received dental treatment under general anaesthesia between 1993 and 1995, who were followed up over a period of 6 to 27 months. The results showed that preformed metal crowns were more successful (95.5%) when compared with amalgam or composite restorations (50%). Eidelman *et al*. (2000) compared the restorations carried out in children with ECC under general anaesthesia and under conscious sedation. The results showed that 59% of the children treated under general anaesthesia required further dental treatment compared with 74% of those treated under conscious sedation. Most of the further treatments were for new carious lesions, 57% in the group treated under

Correspondence to: Profesor E Barberia, Dpto. Estomatología IV. Facultad de Odontología, Plaza de Ramón y Cajal s/n. 28040 Madrid. Spain. E-mail: barberia@odon.ucm.es

general anaesthesia and 60% in the group treated under conscious sedation.

O'Sullivan and Curzon (1991) reviewed treatments performed in 80 children, between 1984 and 1987, with a two year minimum follow-up. Eighty per cent needed further ambulatory treatment. The failure rate was 3% for preformed metal crowns, 29% for restorations and 2% for pulpotomies. Tate *et al* (2002) reviewed 504 clinical records of patients who received dental treatment under general anaesthesia between 1990 and 1992, with a follow-up period of at least six months. The greatest success rate was observed in preformed metal crowns and the greatest failure rate was found in composite restorations and composite strip crowns for anterior teeth.

The aim of the present study was to evaluate the success and failure rates of clinical procedures carried out under general anaesthesia for medically compromised or disabled children as well as healthy children.

Materials and Method

Clinical records of 47 patients who received dental treatment under general anaesthesia between 1994 and 2003 were included. These patients were treated in a paediatric dental clinic at the Madrid Complutense University as part of the Dental Programme for Paediatric Patients.

The choice of general anaesthesia was based on the medical history and dental status of the patient. The inclusion criteria were: disabled patients (presence of a medical, mental or physical condition), children under three years of age and un-cooperative children of any age, who presented with a high level of dental treatment need and whose extreme youth precluded them from accepting extensive dental treatment in the normal manner, who resided a long distance from a dentist or when the parents decided on general anaesthesia instead of some proposed type of restrictive behavioural management. The exclusion criteria applied to patients with a high anaesthetic risk or parents who rejected the costly treatment under general anaesthesia. Informed consent was obtained for both dental treatment and general anaesthesia. In every case all dental treatment was completed in a single session. All anaesthetic procedures, whatever their duration, were carried out in a hospital theatre by a professional anaesthetist and all the clinical procedures were carried out by the same paediatric dentist (BE). The treatment criteria for all patients were based on the patient's dental problem, according to the international standards (AAPD, 2002). The treatment aimed to be as conservative as possible.

To assess the dental procedures, two study groups were formed as follows:

- A) disabled or medically compromised patients
- B) other patients

Both groups were divided by age: children under and over 6. This 6 year cut-off age was chosen to differentiate between children with deciduous dentition and those with mixed dentition.

All patients considered for general anaesthesia were classified as having a high risk of relapse and were therefore included in a programme of home maintenance. A preventive programme was initiated with all the children using fluoride varnish (5%NaF) at each six monthly visit and, in the home, month long cycles of mouthrinse or topical applications (depending on patient age and maturity) with clorhexidine 0.12% one week and NaF 0.05% the rest of the month. Patients brushed with fluoride toothpaste.

The follow-up review appointment included clinical and radiological evaluations. These were done every six months by the same professional (BE) and by a dental colleague. The restorations, pulp treatments in primary teeth and preformed metal crowns cemented on primary molars were evaluated as successes or failures at the time of review as follows:

Preformed metal crowns: dislodgement, de-cemented or perforated crowns.

Pulp treatment in primary teeth: abscess or radiographic evidence of inter-radicular pathology.

Restorations: Recurrent caries or missing, fractured or poorly-adapted restorations.

Kappa coefficient, performed in order to determine the inter-examiner variation, was 0.72.

Data were entered and analyzed using a SPSS 11.0 for Windows program. The chi-square test for nonparametric variables and Student's t test for parametric variables were undertaken. An alpha level of 0.05 was used.

Results

Characteristics of the sample

A sample of 47 patients received treatment under general anaesthesia. Of these 23 were female, 24 were male; 16 were disabled or medically compromised (group A) and 31 were not (group B).

The youngest patient was 2 years and 0 months old and the oldest was 11 years and 7 months. The mean age was 5 years and 10 months. At the time of treatment, 28 children were below six years of age and 19 were above six. All the children had very poor oral hygiene and had a very cariogenic diet.

The decision to use general anaesthesia for treatment in the group of healthy children, group B, was made by the parents, contrary to the opinion of the dentist in about a third of the sample under six whereas in the group aged over six, it was administered at parental request in 80% of cases. In the rest of the cases the opinion of the dentist prevailed.

The anaesthesia lasted from 1 to 4 hours. In 36% of cases, 1-2 hours were necessary; of these, 19% were in children under six years of age and 17 % in the group of older children. In 64%, the anaesthetic procedure took 3-4 hours. In this latter group, 41% were under six and 23% over six. The mean length of anaesthesia time for the whole sample was 2 hours and 25 minutes. In the younger group, the frequency of procedures lasting 3-4 hours was significantly higher than the frequency of 1-2 hour procedures.

A total of 105 preformed metal crowns were cemented, 77 in children under six years of age (17 in A and 60 in B) and 28 in those over six years of age (10 in A and 18 in B). Eighty-five pulpotomies were performed with formocresol on primary teeth, of which 62 were in patients under six years of age (11 in A and 51 in B) and 23 in children in the older age group (7 in A and 16 in B). Of a total of 166 extractions, 105 were

in the younger group (30 in A and 75 in B) and 61 in the older group (32 in A and 29 in B). Table 1 shows the mean and standard deviation for each procedure per group and for the total sample. Comparing each dental treatment in children above and under six, in each group and in the total sample, a significantly greater mean was found only in the restorations done in disabled or medically compromised patients under six.

In group A, all of the crowns were successful; 5.6% of the pulpotomies and 10.6% of the restorations failed (Table 2). In group B, 6.7% of the preformed metal crowns, 3.6% of the pulpotomies and 9.9% of the restorations were unsuccessful. No significant differences were found between groups in the success rate of any of the clinical procedures.

Follow-up assessment was carried out after a minimum period of six months and over an average of four years using telephone reminders and recall cards. The percentage of patients who came for the follow-up was 94% for group A and 84% for group B; for the whole sample it was 87%.

Discussion

This study assessed the clinical histories of 47 child patients who received treatment under general anaesthesia. Other studies have recently been published (Al-Eheideb and Herman, 2003; Tate *et al*., 2002) in which a retrospective assessment is made of the success of clinical dental procedures performed under general anaesthesia with a six month follow-up. However, the majority of these studies were carried out with hospitalized patients and the professional was a graduate student or someone with limited experience (Al-Eheideb and Herman, 2003; Tate *et al*., 2002)

The length of the anaesthesia sessions in our study was longer than that mentioned by other authors (O´Sullivan and Curzon, 1991). Vinckier *et al* (2001) estimated an average duration of 1 hour and 20 minutes in patients referred by private dentists treated by expert professionals and with a conservative approach to treatment. In our case, the longer duration may be due to the greater degree of oral deterioration in the sample.

Of all the patients, 87% came for their check-ups, revealing no differences based on age or duration of the anaesthesia, although group A was more regular than group B in complying with the check-up schedule. Other authors show great variety in the percentages of children who come to follow-up. O'Sullivan and Curzon (1991) indicate that approximately three-quarters of their patients came back whereas Acs *et al* (2001) and Tate *et al* (2002) gave values of approximately 50%. These differences may be due to the fact that parents paid all the treatment costs in the study described here.

The need for treatment was very high, as was to be expected due to the type of sample studied. Vinckier *et al* (2001) obtained slightly different values to ours in children aged from 2 to 6 years with a lower mean number of extractions and pulpotomies but a higher rate of restorations. This was not due to the existence of fewer lesions but that the existing caries were less advanced. Our results were similar to those of O'Sullivan and Curzon (1991) who studied a similar sample.

When comparing treatment success, we can see that the results of restorations in our case were much better than those reported by Al-Eheideb and Herman (2003) and similar to Eidelman *et al* (2000) (Table 3). Failures in pulpotomies were similar to those reported by other authors (Al-Eheideb and Herman, 2003; O´Sullivan and Curzon, 1991) and, in the case of preformed metal crowns, the number of failures was slightly higher than those of Al-Eheideb and Herman (2003) and lower than Tate *et al* (2002). These differences may be due to various factors. On the one hand, the experience of the operator was in our case considerable, while in other studies, treatment was performed by graduate students. On the other hand, therapeutic criteria may differ. For example, it has been observed that some authors do not refer to placing preformed metal crowns (Vinckier *et al*., 2001) after pulpotomies.

A cause for concern is that in 80% of patients over six years of age in Group B, general anaesthesia was performed at parental request to avoid the need to use behavioural control techniques.

In summary, general anaesthesia can be used to support dental treatment in some child dental patients making possible the use of techniques necessary to restore their dental health. Parents should be suitably motivated to respect the follow-up programme and to apply preventive treatments at home, doing the treatment personally if their children lack the necessary skills. The goal is to avoid new lesions and to teach the child to accept ambulatory dental treatment.

Table 1. Mean and standard deviation of preformed metal crowns, pulpotomies, restorations and extractions in each of the groups studied

	Group A			*Group B*			*Total*		
	Age			*Age*			*Age*		
	< 6 years	*> 6 years*	*Total*	*< 6 years*	*>6 years*	*Total*	*< 6 years*	*> 6 years*	*Total*
	Mean (SD)			*Mean (SD)*			*Mean (SD)*		
Preformed Metal Crowns	2.4 (0.4)	1.1 (0.3)	1.6 (0.4)	2.8 (0.4)	1 (0.4)	2.5 (0.4)	2.7 (0.4)	1.4 (0.3)	2.2 (0.4)
Pulpotomies	1.5 (0.4)	0.7 (0.3)	1.1 (0.3)	2.4 (0.4)	1 (0.4)	2.1 (0.4)	2.2 (0.4)	1.2 (0.3)	1.8 (0.4)
Restorations	3.1 (3.2)*	1.8 (1.8)	2.3 (2)	3.9 (2.7)	2 (2.5)	3.3 (2.7)	3.6 (2.8)	2 (2.1)	3.0 (2.6)
Extractions	4.2 (3.2)	3.5 (2.1)	3.8 (3.4)	3.5 (3.2)	2.9 (2.6)	3.3 (3.0)	3.7 (3.0)	3.2 (3.3)	3.5 (3.1)

* $p < 0.05$

A: disabled or medically handicapped patients

B: the rest of the patients

Table 2. Relationship of the relative success rate in each of the different groups of the different treatments carried out.

	Group A			*Group B*			*Total*		
	Age			*Age*			*Age*		
	< 6 years	*> 6 years*	*Total*	*< 6 years*	*>6 years*	*Total*	*< 6 years*	*> 6 years*	*Total*
	%			*%*			*%*		
Preformed Metal Crowns	100	100	100	93.3	83.3	91	94.8	89.2	93.3
Pulpotomies	100	85.7	94.4	96	100	97	96.9	95.6	96.4
Restorations	85.7	94.1	89.4	90.2	90.9	90.3	89.4	92.3	90.1

p= NS not significant in all the comparisons made
A: disabled or medically handicapped patients
B: the rest of the patients

Table 3. Review of the provision of dental treatments under general anaesthesia.

Author(s) And Years	*Country*	*Period of study*	*Number of patients*	*Mean Age-range (years)*	*Type of treatment (mean No. procedures per patient)*				*Repeat GA´S (% of patients)*
					REST	*EXT*	*PP*	*PMC*	
Al-Eheideb & Herman (2003)	USA	1993-95	54	4.6	6.2	-	0.6	2	-
Eidelman *et al.* (2000)	Israel	1995-97	34	2.8	2.4	-	-	2.2	0
O´Sulllivan & Curzon (1991)	UK	1984-89	80	4.6	2.7	4	1.7	2.6	8.7
Tate *et al.* (2002)	USA	1990-98	241	4.2	4.2	3	0.9	3.5	-
Vinckier *et al.* (2001)	Belgium	-	98	4.8	7.2* 0.1**	1.8	1.5	-	-
Our study	Spain	1994-03	47	5.1	3	3.5	1.8	2.2	6.3

Rest: restorations, Ext: Extractions, PP: pulpotomies, PMC: preformed metal crowns
* primary teeth
** permanent teeth

References

Acs, G., Pretzer, S., Foley, M. and Ng, M.W. (2001): Perceived outcomes and parental satisfaction following dental rehabilitation under general anaesthesia. *Pediatric Dentistry* **23** (5), 419- 422.

Al-Eheideb, A.A. and Herman, N.G. (2003): Outcomes of dental procedures performed on children under general anaesthesia. *The Journal of Clinical Pediatric Dentistry* **27**(2),181-184.

American Academy of Pediatric Dentistry. (2002): Guideline on the elective use of conscious sedation, deep sedation and general anaesthesia in pediatric dental patients. *Pediatric Dentistry* **24** (7), 74-80.

Barbería, E. (1985): Posibilidades conservadoras en dentición temporal y permanente joven. *Anales Españoles de Pediatría* **22**, 128-131.

Barbería, E., López, M.A., Cerón, J.A., Alexandrov, N., Verd, J.J. and García, J.M. (1983): Estudio Epidemiológico en una población infantil. *Boletín de Información Dental* **43**, 43-46.

Barbería, E. and Maroto, M. (2005): ¿Es necesario cambiar la atención odontológica del niño? *Gaceta Dental* **162**, 88-104.

Clinical Standards Advisory Group. (1995): *Dental general anaesthesia*. London HMSO.

Department of Health. (2000): *A conscious decision: a review of the use of general anaesthesia and conscious sedation in primary dental care*. London Department of Health.

Eidelman, E., Faibis, S. and Peretz, B. (2000): A comparison of restorations for children with early childhood caries treated under general anaesthesia or conscious sedation. *Pediatric Dentistry* **22**, 33-37.

O´Sullivan, E.A. and Curzon, M.E.J. (1991): The efficacy of comprehensive dental care of children under general anaesthesia. *British Dental Journal* **17**, 56-58.

Pine, C.M., Adair, P.M., Burnside, G., Nicoll, A.D., Gillet, A., Borges-Yanez, S.A. *et al*. (2004): Barriers to the treatment of childhood caries perceived by dentist working in different countries. *Community Dent Health* **21 (1Suppl)**: 112-120.

Tate, A.R., Ng, M.W., Needlman, H.L. and Acs, G. (2002): Failure rates of restorative procedures following dental rehabilitation under general anaesthesia. *Pediatric Dentistry* **24**, 69-71.

Vinckier, F., Gizani, S. and Dominique, D. (2001): Comprehensive dental care for children with rampant caries under general anaesthesia. *International Journal of Paediatric Dentistry* **11**, 25-32.