Clinical considerations in the provision of restorative dental treatment for children under general anaesthesia: a review

K.T. LAW, N.M. KING

Abstract. Aim Dental treatment under general anaesthesia is one of the options for young or uncooperative children, and disabled patients. However, special considerations are necessary before proceeding with this form of anaesthesia. This article reviews the indications, complications and safety factors, the anatomic and physiological considerations, drug interactions, current treatment outcomes and the reasons for repeated anaesthesia for the provision of dental treatment under general anaesthesia for children.

Keywords: Review, Dental, Paediatric, General anaesthesia.

Introduction
Dentistry can be a fearful experience for young children, so it is not surprising that they are amongst the most difficult patients to manage. The anxiety and fearfulness is frequently due to a lack of prior positive experiences and to the influence of parental attitudes towards dentistry. Coping skills are underdeveloped, or even non-existent in young children, and there is no incentive to co-operate. Hence, young children cannot appreciate that cooperation during treatment may enhance the quality of it, whilst reducing the chance of accidental trauma.

The goal of child management techniques in dentistry is to accomplish the necessary treatment whilst neither reducing the level of future cooperation nor the comfort of the patient. The majority of children can be adequately treated with simple behaviour modification techniques such as “tell, show and do” [Addelston, 1959]. However, for young or uncooperative children it may be difficult to administer pain control without jeopardising the long-term cooperation of the child.

According to most authors the main reason for providing general anaesthetics for children is the management of dental caries, or its sequel [Smallridge et al., 1990; Holt et al., 1991; O’Sullivan and Curzon, 1991; Vermeulen et al., 1991]. In England, more than 230,000 general anaesthetics were administered between 1994 and 1995 for the extraction of teeth in patients under the age of 18 years [Bridgman et al., 1999]. This seems to support the notion that despite the decline in caries experience in young people, over the last 20 years, there remains a group of children, and even young adults, who still require a substantial amount of dental treatment under general anaesthesia (GA) [Nunn et al., 1995]. Some treatments are elective, while the majority is required by necessity.

Therefore, it is proposed to review the published literature on the indications and safety of GA for children and to consider the effectiveness of the restorative dental treatment that has been provided for paediatric patients.

Indications for treatment to children under general anaesthesia
There are a number of generally agreed specific indications for the use of GA to treat children, which have been collated from the following publications [Legault et al., 1972; Vermeulen et al., 1991; Nunn et al., 1995; Jamjoom et al., 2001]. Those children may present with:
- management problems or extremely uncooperative behaviour;
- disabling sensory, physical or mental conditions;
- orofacial and/or dental trauma;
- ineffective local analgesia due to an acute infection and anatomic variations;
- craniofacial anomalies that require extensive dental treatment;
- phobic gaggers;
- minor oral surgical procedures on a child who cannot cope with the operation under local analgesia

[Legault et al., 1972; Vermeulen et al., 1991; Nunn et al., 1995; Jamjoom et al., 2001]. Based on information contained in the published literature, the frequencies of the reasons for paediatric patients who needed dental treatment under GA are displayed in Table 1.

### Considerations for the provision of dental treatment for children under general anaesthesia

General anaesthesia for children differs in a number of ways from the adult scenario, so an awareness and understanding of the anatomical and physiological

### Table 1 - Summary of the frequencies, expressed in percentages, of the reasons given for the provision of general anaesthesia in studies published between 1967 and 2001.

<table>
<thead>
<tr>
<th>Authors/date</th>
<th>Country</th>
<th>Study period</th>
<th>Sample size</th>
<th>Age range (years)</th>
<th>Med</th>
<th>Behav</th>
<th>MR</th>
<th>Tx/caries</th>
<th>Surg</th>
<th>Others</th>
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<tr>
<td>Allen et al., 1967</td>
<td>USA</td>
<td>-</td>
<td>-</td>
<td>2-8</td>
<td>38</td>
<td>-</td>
<td>12</td>
<td>50</td>
<td>-</td>
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<td>Rule et al., 1967</td>
<td>UK</td>
<td>1959-1965</td>
<td>225</td>
<td>1.8-15</td>
<td>6</td>
<td>70</td>
<td>16</td>
<td>-</td>
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<td>Legault et al., 1972</td>
<td>Canada</td>
<td>4 years</td>
<td>300</td>
<td>1-15</td>
<td>6.3</td>
<td>31.1</td>
<td>-</td>
<td>52.9</td>
<td>-</td>
<td>9.7°</td>
</tr>
<tr>
<td>Keniry, 1974</td>
<td>UK</td>
<td>6 months</td>
<td>1307</td>
<td>1-16</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>93°</td>
</tr>
<tr>
<td>Smith et al., 1978</td>
<td>USA</td>
<td>1972-1976</td>
<td>318</td>
<td>mean: 6.59</td>
<td>18</td>
<td>50</td>
<td>32</td>
<td>-</td>
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<tr>
<td>Persliden et al., 1980</td>
<td>Sweden</td>
<td>1976-1979</td>
<td>352</td>
<td>0-16</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>-</td>
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<tr>
<td>O’Brien et al., 1983</td>
<td>Australia</td>
<td>12 years</td>
<td>1316</td>
<td>&lt;3-&gt;15</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>90</td>
<td>-</td>
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<td>Enger et al., 1985</td>
<td>USA</td>
<td>1977-1982</td>
<td>200</td>
<td>1-52 (mean: 7.7)</td>
<td>22</td>
<td>28</td>
<td>47</td>
<td>-</td>
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<td>Netherlands</td>
<td>1968-1980</td>
<td>221</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>-</td>
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<tr>
<td>Mitchell et al., 1985</td>
<td>UK</td>
<td>1979-1983</td>
<td>96</td>
<td>6-25+</td>
<td>92</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>4°</td>
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<tr>
<td>Grytten et al., 1989</td>
<td>Norway</td>
<td>1975-1983</td>
<td>1067</td>
<td>0-74</td>
<td>14</td>
<td>86</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Boulanger, 1990</td>
<td>Belgium</td>
<td>-</td>
<td>46</td>
<td>1.5-14</td>
<td>18.8</td>
<td>81.2</td>
<td>-</td>
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<td>Tarján et al., 1990</td>
<td>Hungary</td>
<td>1981-1986</td>
<td>180</td>
<td>2-16</td>
<td>-</td>
<td>49</td>
<td>51</td>
<td>-</td>
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<td>Vermeulen et al., 1991</td>
<td>Belgium</td>
<td>1983-1988</td>
<td>933</td>
<td>1-60+</td>
<td>10.5</td>
<td>35.6</td>
<td>23.3</td>
<td>83</td>
<td>4.6</td>
<td>30.1°</td>
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<td>O’Sullivan et al., 1991</td>
<td>UK</td>
<td>1984-1987</td>
<td>80</td>
<td>2-11</td>
<td>-</td>
<td>21.3</td>
<td>9.7</td>
<td>33.9</td>
<td>44.6</td>
<td>-</td>
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<tr>
<td>Holt et al., 1991</td>
<td>UK</td>
<td>5 months</td>
<td>103</td>
<td>9.0±4.4</td>
<td>-</td>
<td>8</td>
<td>8</td>
<td>1</td>
<td>4°</td>
<td>-</td>
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<tr>
<td>Holt et al., 1992</td>
<td>UK</td>
<td>1990-1991</td>
<td>2081</td>
<td>0-15+</td>
<td>1.82</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.0</td>
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<tr>
<td>Sheehy et al., 1994</td>
<td>USA</td>
<td>-</td>
<td>44</td>
<td>mean: 4.5</td>
<td>18.27</td>
<td>-</td>
<td>18</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Nunn et al., 1995</td>
<td>UK</td>
<td>1979-1983</td>
<td>96</td>
<td>6-26+</td>
<td>-</td>
<td>37.5</td>
<td>62.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Nunn et al., 1995</td>
<td>UK</td>
<td>1983-1993</td>
<td>358</td>
<td>0-26+</td>
<td>8.0</td>
<td>21.4</td>
<td>60.3</td>
<td>10.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Harrison et al., 1998</td>
<td>UK</td>
<td>1991-1995</td>
<td>1000</td>
<td>1.75-24.2 (mean: 8)</td>
<td>77.7</td>
<td>22.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Jamjoom et al., 2001</td>
<td>Saudi Arabia</td>
<td>1995-1997</td>
<td>555</td>
<td>2-9+</td>
<td>8.6</td>
<td>35.7</td>
<td>-</td>
<td>55.1</td>
<td>0.6</td>
<td>-</td>
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</table>

Med: medical condition  
Behav: behavioural and/or management problems  
MR: physical and/or mental handicapped  
Tx/caries: need extensive treatment and/or presence of caries  
Surg: surgical procedures  

°not recorded  
young age, single visit comprehensive treatment  
orthodontic extraction, trauma  
family lived far from source of care and others  
local anaesthesia problems  
infection, patient’s demand, young, pain, and allergy to local anaesthesia.  
amelogenesis imperfecta and others
differences between adults and children are essential to ensure the safety of GA. Children usually have large heads, short necks, relatively large tongues, tonsils and adenoids, and narrow nasal passages. In addition, a child’s weight and height can be helpful in predicting the clinical response to drugs. Small children usually have higher metabolic rates, fluid requirements per hour, oxygen consumption per minute and energy and carbohydrate metabolism [Campbell et al., 1982]. Children also experience rapid fluid exchanges that can be reflected in periods of overhydration or relative dehydration. The latter is an important consideration as fasting is required prior to GA and the resultant dehydration can lead to hypotension during induction with anaesthetic agents.

Approximately 20% of a child’s body weight consists of muscle mass, compared with 40% in the adult. The brain occupies approximately one quarter of the total body surface area in infancy, while the ratio in an adult changes to 1:8 (brain:body surface). Inhalational anaesthetic agents are transported to the brain and occupy a larger volume of it with respect to body mass and result in a quicker onset of action producing a more profound effect in children [Campbell et al., 1982]. The occurrence of malignant hyperthermia is rare, but this serious complication has been estimated to have a higher frequency in children than in adults undergoing GA, probably because of the different levels of muscle mass.

The anatomy of the upper and lower respiratory tract affects the margin of safety in paediatric patients. The narrow nasal passages and glottic opening, hypertrophied tonsils and adenoids, larger tongue, greater volume of secretions, and narrowing of the trachea at the cricoid ring can predispose child patients to respiratory obstruction. Furthermore, young children have fewer alveoli and the ratio of alveolar surface area to lung size is proportionally greater in children, allowing for greater alveolar ventilation per unit area. The ratio of alveolar ventilation to functional reserve capacity is significantly different in children compared with adults. This difference ratio, combined with a higher respiratory rate, helps to explain the greater speed of induction in children. Unfortunately, because of the smaller functional reserve capacity and high metabolic demand for oxygen, if a child becomes obstructed or apnoeic, hypoxia can occur more rapidly than in an adult [Campbell et al., 1982].

The child who has a congenital cardiac abnormality should be afforded special care and consideration. The cardiac output is high in healthy children and the blood flow is directed towards vessel rich tissues. Therefore, a shorter induction period in children increases the risk of obtaining a high concentration of inhalational agent in the myocardium [Campbell et al., 1982].

The drug interactions that may occur during dental GA for children need to be considered because the commonly used anaesthetic agents, muscle relaxants, narcotics and other adjuvant drugs differ in their pharmacokinetics and pharmacodynamics in the young child as compared with the adult. The greater relative volumes of total body water and of the extracellular fluid compartment, proportional weight of the brain, heart, liver and kidney masses to the body weight, and the difference in glomerular filtration rate are crucial factors that warrant consideration in the provision of GA in paediatric patients [Bett and Downes, 1997].

Local anaesthetics (LA) containing vasoconstrictor agents, such as epinephrine for the reduction of post-operative pain or control of haemostasis during surgical procedures, are commonly administered under GA. However, the interaction of the epinephrine and halothane can lead to increased cardiac irritability, which may cause cardiac arrhythmias and even fibrillation. The strongest concentration of epinephrine acceptable for use as a haemostatic agent is 1:100,000 and the flow of halothane should not exceed 10ml/10minutes [Troutman and Mayer, 1971]. Anaesthetic agents, such as enflurane and isoflurane have less potential for causing cardiac complications and so are safer for use with vasoconstrictors, at least in older children and adults.

Complications and safety of general anaesthesia

The provision of GA for dentistry is a controversial topic which was illustrated by a report published in 1990 concluding that GA should be avoided and that alternative techniques should be used whenever possible [Poswillo, 1990]. Nevertheless, the use of GA for the extraction of teeth in children and adolescents remains a common practice in the UK where the report was commissioned [Smallridge et al., 1990].

The risks of morbidity and mortality must be considered by both the paediatric dentist and anaesthetists and discussed with the child’s parents. The mortality rate associated with dental GA is considered to be extremely low, and the decision to utilise GA always involves a judgement based on the known medical risks. A review of the deaths associated with dentistry in England and Wales during the decade 1980-1989, which was compared with the period 1970-1979, indicated that the number of deaths...
during all forms of dental anaesthesia (including sedation, LA and GA) were 120 and 71 in the two study periods respectively. However, the frequency of GA being directly responsible for death decreased from 54 cases in the 1970s to 18 cases in the 1980s, and according to the authors the reasons for this change could simply be a reduction in use of GA for dental procedures [Coplans and Curson, 1993]. By contrast, the mortality rates, when the GA was administered in the dental office, did not change significantly from 1971 to 1990 [Murray, 1993]. Data from studies on the incidence of mortality related to the use of GA for dental procedures are shown in Table 2, in which data for LA and GA for dental treatment are also compared. LA is undoubtedly safer, the mortality rate being almost zero. In fact in one review of the complications of LA there was not a single recorded death [Jorgensen and Hayden 1965]. Although a recent study reported three deaths that were apparently related to LA (prilocaine with felypressin), all three deaths appeared to be secondary to other medical complications, such as rheumatic heart disease [Coplans and Curson, 1993].

More substantive conclusions can be drawn from a review of more than 100,000 GA administered in hospitals to all types of patients over a 30 year period in the USA. This revealed a mortality rate of 1 to 2 deaths per 10,000 GA that were delivered in hospitals, to all types of patients [Keenan, 1994]. During the period 1984-1989 in the USA, the reported mortality rate for patients who underwent out-patient anaesthesia was 1 in 1,000,000 [D’Eramo, 1992]. Another similar study, based on the records of 1,500,000 patients between 1990 and 1994, indicated that the mortality rate had reduced to zero [D’Eramo, 1999].

Morbidity is considered to be a more useful variable than mortality when discussing complications associated with GA, because it describes, to some extent, the nature of the problems encountered during anaesthesia. Although life threatening complications rarely occur after GA, discomfort that prolongs or complicates recovery is common.

A recent study in the UK reported that 44% of children suffered from postoperative complications after out-patient dental GA [Enever et al., 2000]. In paediatric dental GA, the most commonly reported postoperative complications are sore throat, headache,
muscle pains, pain from the operative site, nausea and vomiting. Other reported complications included distress, oral pain, extubation spasm, stridor, hypotension, bradycardia, restlessness, prolonged recovery, coughing, hiccups, drowsiness, shivering, sickness, prolonged bleeding, discomfort, laryngeal oedema, laryngospasm, traumatic injury, aspiration, upper respiratory tract infections, dehydration, enuresis, continued crying, psychological trauma, reoccurring bad memories, apnoea, depression and recurrent nightmares [Libman et al., 1979; Persliden et al., 1980; Ogg et al., 1983; Bridgman et al., 1999].

Pulmonary and airway complications and dysrhythmias are the most serious life threatening situations in GA and cause anaesthesia related morbidity. Yanko et al. [1996] described two cases of pulmonary oedema that developed following routine intensive dental treatment under GA, which were possibly caused by postextubation obstruction of the upper airway or heart failure. The long duration of GA required for dental treatment, although less invasive, may increase the risk of these complications.

Laryngospasm and stridor are the main airway complications. Several studies indicated that giving anaesthesia to children with upper respiratory tract infections increased the risk of perioperative respiratory complications [Olsson and Hallen, 1984; Parnis et al., 2001; Tait et al., 2001]. A retrospective study on the incidence of laryngospasm during 156,064 anaesthetics delivered to 136,929 patients reported that the frequency of occurrence was 7.9 per 1,000 anaesthetics and showed that laryngospasm was more common in children than adults. It was postulated that this may have been due to bronchial asthma and respiratory tract infection in the children [Olsson and Hallen, 1984] and laryngospasm occurred more frequently than bronchospasm [D’Eramo, 1992; D’Eramo, 1999; Tait et al., 2001].

Stridor is a symptom of many different problems that produces a narrowed, partially obstructed airway. Postextubation subglottis oedema (croup) occurs occasionally in patients between 1 and 8 years of age [Betts and Downes, 1997]. In spite of the selection of an appropriate tube, children that undergo long anaesthetic procedures can still experience post-intubation croup. This is possibly secondary to surgical manipulation of the jaw against the endotracheal tube during the surgical procedure.

Dysrhythmias and serious cardiac complications, associated GA were reported as being the most common intraoperative complication during GA for minor oral surgery [Thurlow, 1972]. Unpremedicated children undergoing dental extractions with a mixture of halothane-nitrous oxide-oxygen anaesthetic have also been noted to experience cardiac dysrhythmias [Thurlow, 1972; Haden, 1985]. More recently, a study confirmed a strong association between halothane anaesthesia and intraoperative ventricular arrhythmias, especially ventricular tachycardia [Blayney et al., 1999]. Other precipitating factors for dysrhythmias include carbon dioxide retention, tracheal intubation, anoxia or severe hypoxia, and the duration of the GA. Occasionally, disturbances of cardiac function may occur during the placement of a throat pack, or a prop or a gag [Braid, 1989].

Morbidity following extractions under GA in general dental practice is common. The longer the period of observation the greater the opportunity for symptoms to occur and so to be reported. Bridgeman et al. [1999] reported that 92% of the children complained of one or more symptoms after GA. Bleeding and emotional distress were common during the immediate post-treatment period. Interestingly, the frequencies of some complications changed after children had been discharged; nausea and vomiting increased, while pain, crying and bleeding declined. Even after a month, the experience of dental GA is said to have imprinted distressing memories in some children. Also, the parents were under stress when they faced these situations. According to Libman et al. [1979] the most frequent complication was postoperative fever (hyperthermia) and this represented 97.5% of all the complications. Generally the temperature shows a decrease in the preoperative and immediate postoperative periods, followed by a rise through the next 4 to 8 hour period. Then a gradual decrease occurs so that, after 20 hours, the temperature can be expected to have returned to the admission level [Morrow et al., 1986].

Only a weak correlation has been established between the frequency of complications and the age of the patient, duration of GA and disabled condition [Persliden and Magnusson, 1980]. In addition, no significant relationship was found between the patient’s preoperative physical status, trauma introduced during intubation, type of anaesthetic used, length of surgery and any postoperative complications [Enger and Mourino, 1985]. Furthermore, no association has been found between postoperative temperature elevation, number of dental procedures and types of treatment performed under paediatric dental GA [Holan et al., 1993].

Nevertheless, the safety aspects of GA need to be emphasised and continuously monitored and must be performed by a competent practitioner according to a standard protocol.
Restorative treatment under general anaesthesia and subsequent re-treatment

Because of the known mortality and morbidity, the outcome of the various treatment modalities and the general health of the child need to be seriously considered prior to the provision of GA. Consequently, only those restorative procedures known to have relatively high success rates should be selected.

Restorative procedures and simple extractions are the commonest types of treatment modalities used in children [Rule et al., 1967; Legault et al., 1972; Mitchell and Murray, 1985; Smallridge et al., 1990; O’Sullivan and Curzon, 1991; Nunn et al., 1995]. Pulp therapy only constitutes a small proportion of all the treatment procedures and, when used, the vital pulpotomy is more frequently employed than the pulpectomy. However, pulp therapy is not recommended for those patients with cardiac problems [Harrison and Roberts, 1998]. Only a very small number of studies have reported including pulpectomies amongst their treatment options [Legault et al., 1972; O’Brien and Suthers, 1983; Enger and Mourino, 1985; Vinckier et al., 2001]. Whether or not the pulpectomy should be performed under GA anaesthesia needs to be discussed, because some authorities think that extraction is the preferred treatment modality for teeth with pulp exposures [Robertson and Hall, 1973]. In addition, no attempt should be made to preserve any primary teeth with a necrotic pulp [O’Sullivan and Curzon, 1991]. In contrast, the preservation of incisors by pulp therapy in children aged three years or younger, even though abscessed or non-vital, has proved to be a highly successful procedure [O’Brien and Suthers, 1983]. Hence, it is possible that the decision not to perform endodontic procedures on posterior primary teeth is anecdotal rather than evidence based.

There are relatively few studies that have reported the treatment outcomes and the frequencies of re-treatment after dental GA [Rule et al., 1967; Legault et al., 1972; Roeters and Burgersdijk, 1985; O’Sullivan and Curzon, 1991; Berkowitz et al., 1997; Tate et al., 2002]. The study by Rule et al. [1967] on mentally compromised and maladjusted children reported that 24.8% of the patients needed restorative procedures to be repeated [Rule et al., 1967], while almost 40% of children with management problems needed additional treatment procedures within a mean time period of 15.6 months after initial treatment [Legault et al., 1972].

One study that reported the success rates of different types of restorations under GA indicated that approximately 33% of the composite resins and glass ionomer restorations failed, while the success rate of amalgam restorations was over 80%. Nevertheless, stainless steel crowns were by far the most successful restorations, with only 3% needing replacement [O’Sullivan and Curzon, 1991]. Similar results were also reported in an American study in which the failure rate of restorations using composite resin was higher than that of amalgam. Stainless steel crowns enjoyed a high success rate; however, almost 50% of the anterior composite strip crowns failed [Tate et al., 2002].

A recent study compared the quality of different types of restorations that were placed under GA and under conscious sedation. Over 90% of the restorations placed under GA were rated as successful and less than 3% had recurrent caries. This was compared with the 10% which developed secondary caries after treatment under conscious sedation [Eidelman et al., 2000].

The treatment strategy for a medically compromised or disabled patient needs special consideration. Several studies have emphasised that the underlying medical disorders in chronically sick children significantly influenced the pattern of treatment under GA [Rule et al., 1967; Robertson and Ball, 1973; Harrison and Roberts, 1998]. Greater demands by disabled patients for the treatment of new carious lesions or the retreatment of failed restorations have been reported, for example by Roeters and Burgersdijk [1985], who mentioned that only 7.7% of patients did not require further treatment, whereas almost 60% needed additional restorative treatment and extractions. In contrast, Mitchell and Murray [1985] reported that approximately 20% of disabled or anxious patients required further treatment and that 58% of these patients required treatment under GA because of their underlying condition. This is a serious issue because the patient is again subjected to the risks associated with GA. Therefore, for young children and handicapped patients, extraction is generally acknowledged to be the preferred treatment option when there is any doubt about the prognosis of a particular treatment procedure.

From 1960 to 2000, relatively few studies have appeared in the literature that provide data on the frequency of repeat GA. For those that did, the range was from zero up to 17.7% (Table 3). The duration of the follow-up period, the number of recall patients, initial sample sizes, caries activity, and mental status of the children are all variables that could have affected the figures for these repeat anaesthetics.
provision of information on the types of treatment that failed is rare in the majority of studies. Nevertheless, such factors need to be considered because of their value in modifying the operating protocols for paediatric dental treatment under GA. Furthermore, strict treatment protocols based on the longevity of the various types of restorative procedures need to be developed and followed. The use of pre-GA screening and postoperative preventive programs is said to be an effective way of eliminating the need for repeat general anaesthetics for retreatment.

The implementation of regular frequent review visits after completion of dental rehabilitation under GA must be utilised in order to gain a child’s cooperation and confidence by subsequently providing a preventive rather than an invasive treatment. Such visits can encompass advice to the parents and children on diet, oral hygiene, and fluoride supplements. The follow-up of these children by the same person is advocated so as to make them feel more relaxed during the dental visit, and so develop a successful child-dentist relationship.

While the benefits of performing dental treatment under GA are well recognised, it is unjustifiable to subject a child and the parents to the risks and stress of an avoidable GA. Therefore, every effort should be made to provide the treatment using the various other behavioural management techniques rather than GA [Nunn et al., 1995]. Alternatively, conscious sedation combined with LA has proven to be a valuable method for treating some children [Blain and Hill, 1998]. But there will always be a small number of children whose behaviour precludes normal treatment and so will return for repeated GA because of the failure of a particular operative procedure. This problem can be addressed by retrospectively analysing data from long term studies and by centres auditing their own data. Furthermore, these failures serve to highlight the need for an even more aggressive approach towards the preventive care of children and to modify their behaviour so as to avoid further unfavourable outcomes for treatment under GA [Nunn et al., 1995; Harrison and Nutting, 2000].

No matter how good the anaesthetic agent or the anaesthetists, or how simple the dental procedure there is a real risk to the paediatric patient. There is no such thing as a minor GA, therefore no child should be given a GA without clinical justification and the application of appropriate selection criteria is imperative. Consequently, it is mandatory that the various restorative treatment procedures are fully evaluated, using the best available data, to develop operating protocols that minimise the need for retreatment.

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