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Original Article

Dental Treatment for Special Needs Patients Under General Anaesthesia: A 14-year Experience from South Bosnia and Herzegovina

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We conducted a retrospective analysis of records of special needs patients (SNPs) who received dental treatment under orotracheal-intubation general anaesthesia (OIGA) at Caritas Centre St. Family in Mostar, Bosnia and Herzegovina during the 14-year period from January 2005 to December 2018. Of the 7,085 SNPs who received dental treatment, 1,220 (17.2%) received dental treatment under OIGA: 829 (67.9%) males and 391 (32.1%) females. The patients' mean age was 18.3 ± 10.9 years (747 paediatric and 473 adult patients). Mental retardation and psychiatric problems were the most common medical conditions (81.22%). The most common indication for dental treatment under OIGA was behaviour management (87.21%), and 81% of the patients had an urgent need for treatment. Many of the patients had restorative treatment (3,833) and tooth extractions (3,681). From 2011 onwards, the number of tooth extractions decreased significantly. Annual trends revealed a rapid increase of patients every year. The mean dental treatment duration was 95.3 ± 12.1 min; the mean time under OIGA was 98 ± 8.5 min. No serious adverse effects occurred. There was increase of annual trend of SNP in OIGA. The number of extractions decreased while the number of preventive and restorative dental treatments increased.

Key words: special needs patients, general anaesthesia, dental treatment, dental care, mental retardation

Special needs patients (SNPs) are persons with physical, intellectual, medical, emotional or social disabilities, or a combination thereof [1]. These limiting conditions often require healthcare interventions by specialized services under special healthcare needs [2]. As medical care providers, we should enable these special services to ensure the delivery of optimal medical care for SNPs. In regard to oral health, SNPs often have poor oral health and oral hygiene, a higher rate of untreated caries, a higher prevalence of gingivitis, and greater severity of periodontal disease [3, 4], which can affect a person's capacity to chew, speak, and maintain one's appearance [5]. Infections of the oral cavity can also pose a great risk for SNPs with regard to the various chronic diseases or comorbidities that they might have. Special needs patients coming for dental treatment often have a higher anxiety rate compared to other patients, which might lead to inadequate dental care [6].

With the aging and higher life expectancy of the special needs populations in many countries, there is a need for regular and optimal dental treatment to prevent disease and improve the quality of life of special

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needs patients [7, 8]. Importantly, there are additional burdens for patients, caregivers, and dental practitioners associated with the delivery of dental health care to SNPs [9]. For example, SNPs very often have barriers to regular dental care in a conventional dental environment due to problems such as a lack of financial resources, the need for a surgical table instead of a dental unit (for patients with developmental anomalies of vertebrae or limbs), time limitations, and a lack of access to dental treatment under general anaesthesia (GA). However, dental treatment under GA is a last resort for meeting the dental needs of SNPs [10-12].

Approximately 5% of persons with special needs will require dental care under GA because behaviour management is necessary so that optimal dental care can be provided [13]. The most common indications for GA among paediatric special needs patients are a lack of cooperation, multiple morbidities, and paediatric autism, whereas in adult SNPs, the most common indications for GA are cognitive impairment and multiple morbidities [14]. In many cases, suboptimal home care, an incomplete medical history, poor preoperative management, lack of cooperation, and/or developmental abnormalities make it a challenge to prepare anaesthesia for patients with special needs. Accordingly, for special needs patients, teamwork among the dentist, dental assistant, and anaesthesiologist is a prerequisite to achieve dental treatment under GA that will result in minimal side effects [14].

There has been no exact number of special needs patients in Bosnia and Herzegovina, but according to the country's Social Service Centre approx. 8-9% of the total number of inhabitants (among whom 11,000-20,000 are children) are individuals with special needs, and this number is increasing every year. Data on the exact number of SNPs with a need for dental treatment under GA in Bosnia and Herzegovina are missing in part because there is no institutionalized approach to SNP dental treatment under orotracheal-intubation general anaesthesia (OIGA).

We thus conducted the present study to obtain the details of the provision of dental treatment for SNPs under GA in south Bosnia and Herzegovina (based on volunteer dental medical teams) and to report the use of OIGA during a recent 14-year period. Our findings will raise awareness of the inequalities that special needs patients face in society and in the healthcare system of Bosnia and Herzegovina, and they highlight the tremendous effort of volunteers who are now filling the healthcare gap for SNPs.

Patients and Methods

After approval from the Institutional Ethics Board (01-1632/17) and in full accordance with the Declaration of Helsinki (2008), we analysed the medical records of the 7,085 special needs patients treated at the dental clinic of Caritas Centre St. Family in Mostar, Bosnia and Herzegovina during the 14-year period from January 2005 through December 2018. The patients were children, youths, adults, and elderly individuals with disabilities living in Bosnia and Herzegovina and neighbouring cross-border areas of southern Croatia and Montenegro. This research was undertaken with the understanding of the patients or their parents or caregivers who provided informed consent for the use of outpatient GA and the dental treatment.

Patients who received only a dental examination, tooth cleaning, preventive dental treatment or a dental treatment intervention without GA were excluded from the study (5,865 patients). All patients were examined by an experienced dentist who performed a dental examination prior to treatment and formulated a treatment plan specifically for the patient. The pre-anaesthesia assessment included the patient's history, data on any recent respiratory infection, a detailed physical examination, and thorough pre-operative clinical assessments and data on earlier anaesthetic procedures and possible complications. The patients continued their chronic medical therapy. Preoperative laboratory findings were rarely required. For the prophylaxis of bacterial endocarditis, we followed the new recommendations of the American Dental Association [15]. Premedication with benzodiazepines was not carried out. For some patients, verbal and written instructions were given to a parent or caregiver regarding the patient's food intake from midnight on the day before treatment and early attendance on the day of treatment.

Outpatient OIGA was performed using a mixture of sevoflurane inhalation anaesthetics (Sevorane; Abbott Laboratory, Queenborough, Kent, UK), nitrous oxide, and oxygen. A local anaesthetic (Ubistesin 1/200,000, 3M Australia, North Ride, Australia) was given as postoperative analgesia in patients with complicated surgical procedures due to prolonged postoperative

analgesia [16].

Each patient's dental medical team consisted of a dentist, an anaesthesiologist, an anaesthetist, and a dental nurse. Anaesthesia was achieved with a mixture of oxygen and 50% nitrogen oxide (N_2O) with sevoflurane (8% concentration). When the loss of palpebral reflexes occurred and the jaw relaxed, intravenous thiopental (2 mg/kg) was added, and the patient was manually ventilated. Orotracheal intubation was then performed. The GA was maintained with a mixture of oxygen, 50% nitrogen oxide and sevoflurane (1.5-2%). Muscle relaxants were not used. Opiates or long intravenous analgesics were not added during the GA.

During the OIGA, continuous monitoring was carried out according to the guidelines of the American Association of Anesthesiologists [17], including pulse oximetry, electrocardiography, noninvasive blood pressure measurement, end tidal (et)CO_2 measurement, the oxygen concentration, and ventilation exclusion alerts. A qualified anaesthesiologist and anaesthetist were constantly present. After the patient's intubation, spontaneous breathing was again established. Upon the completion of anaesthesia, the tube was removed, spontaneous breathing started, and the patient was moved to his/her right side in order to prevent aspiration of saliva and airway blockade by the tongue.

The patient was then moved to a post-anaesthetic recovery room for 1 h, accompanied by the anaesthesiologist and anaesthetist. The post-anaesthetic care room was equipped with an oxygen source, a T-oxygenator, and an aspiration pump. The consciousness level and vital signs (oxygenation, ventilation, and circulation) were constantly monitored. After the patient entered the third phase of waking up from the OIGA, the tube was removed. After a clinical examination, instruction notes were given to the patient, parent or caregiver. All of the patients were released from the clinic on schedule.

The following patient data from dental records were collected: the age of the patient at the time of treatment (the dates and places of birth and treatment), gender, medical condition, indication for dental treatment under GA, urgency of the procedure, time under anaesthesia and duration of treatment, type of dental procedure (preventive-only vs. restorative or surgical), and annual trends. The data were analysed with the GraphPad statistical program (La Jolla, CA, USA). The following statistical methods were used: descriptive statistics, Student's *t*-test, and the χ^2 test. The level of significance was set to 95% probability ($p < 0.05$).

Results

From January 2005 through December 2018, there were 7,085 SNPs who visited the dental clinic of Caritas Centre St. Family. Only 1,220 (17.21%) of these patients required dental treatment under OIGA. All 1,220 patients had undergone a pretreatment dental examination prior to their treatment under OIGA, and 81% of them had an urgent need for treatment. Table 1 summarizes the data of the patients' backgrounds.

There were significantly more males (n = 829, 67.9%) than females (n = 391, 32.1%) (χ^2 test, $p < 0.0001$). The patients' ages ranged from 2 to 67 years old, and the mean age was 18.3 ± 10.9 years (747 paediatric and 473 adult patients). There was no significant difference in age between the males and females except in the 12-18 years age group (*t*-test, $p < 0.05$) (Table 1). Of the 747 paediatric patients, there were 97 patients with primary dentition and 650 patients with mixed or permanent dentition. The average number of carious deciduous teeth among the children < 7 years old was seven (range, 3-12).

Mental retardation and psychiatric problems were the most common medical condition (n = 991, 81.22%), followed by syndromes, autism, and seizure disorders (Table 2).

The most common indication for dental treatment under OIGA was behaviour management (n = 1,064, 87.21%), followed by surgical procedures (n = 87, 7.13%) (Table 3). The medically compromised SNPs (n = 51, 4.18%) included patients with cardiac diseases. The mean dental treatment duration was 95.3 ± 12.1 min, and the mean time under OIGA was 98 ± 8.5 min. Preoperative drugs taken by the SNPs were antibiotics prescribed by anaesthesiologists and sedatives that were given by parents or caregivers.

Regarding postoperative complications, there were no serious adverse effects for any of the patients who underwent OIGA. There were no deaths and no reported incidents of emesis associated with OIGA. None of the patients had required mechanical ventilation. Minor post-treatment complications occurred in three patients (0.002%) who had agitation or sleepiness, but these patients did not have significantly prolonged recoveries.

The annual trend in the number of SNPs receiving dental treatment under OIGA increased every year from 38 in 2005 to 162 in 2018 (Fig. 1A). There were 892 control examinations in addition to the pre- and post-treatment examinations that were performed for all of the SNPs included in the study. Most of the patients had restorative treatment (3,833) and tooth extractions (3,681), followed by preventive care, prosthodontics, and endodontics (Table 4). Overall, the SNPs underwent 2,636 dental treatments. The number of treated teeth per patient ranged from 1 to 23. The restorative treatments included all types of restorative materials (glass ionomer cement, compomer material, and stainless steel crowns).

From 2011 onwards, the number of tooth extractions

Table 1 Patients' age and gender distribution

Age Group (years)	Male	Female	Total (%)
2–4	18	17	25 (2.05)
5–7	41	31	72 (5.09)
8–11	98	70	168 (13.77)
12–18	353*	127	482 (39.51)
19–50	312	131	451 (26.97)
More than 50	7	15	22 (1.80)
Total	829**	391	1,220

*$p<0.05$, **$p<0.0001$.

Table 2 Medical conditions (from the patients' medical records)

Medical condition	Number of patients (%)
Mental retardation and psychiatric problems	991 (81.22%)
Syndromes	121 (9.91%)
Autism	87 (7.13%)
Seizure disorders	21 (1.72%)

Table 3 The distribution of special needs patients (SNPs) per indication for OIGA

Indication for OIGA	Number of SNP (%)
Behavior management	1,064 (87.21%)
Surgical procedure	87 (7.13%)
Medically compromised	51 (4.18%)
Multiple caries	18 (0.98%)

Table 4 Dental treatment procedures

Dental treatment	Number of teeth/Number of treatment
Restorative treatment	3,833/834
Tooth extraction	3,681/711
Preventive care	*/681
Prosthodontics	–/231
Endodontics	–/179
Total number of treatment	2,636

*all oral cavity; – no data.

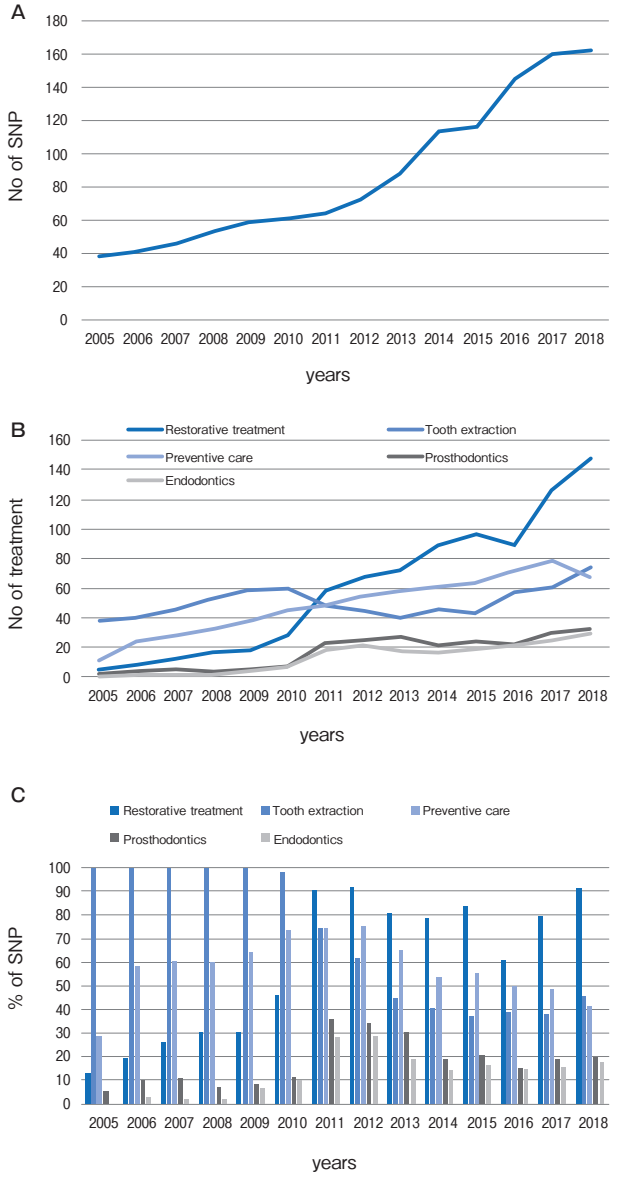

Fig. 1 **A**, Annual trend in the number of SNPs receiving dental treatment under OIGA; **B**, The number of treatments according to the type of dental treatment; **C**, Annual trend in the percent of SNPs receiving dental treatment under OIGA.

decreased significantly, and the number of treatments involving preventive care, prosthodontics, or endodontics increased (Fig. 1B). The annual trend in the number of SNPs receiving dental treatment under OIGA according to our age classification showed similar distribution patterns through the years, with the highest rates of patients between 12 and 18 years old and those between 19 and 50 years old (Fig. 1C). A decreasing pattern of patients between 5 and 7 years old was also observed through the years.

Discussion

In developed countries such as Scandinavian countries and the U.S., special needs patients have health insurance that allows the use of GA in dental care within primary healthcare units [18, 19]. In general, in these countries, dental professionals have a good opportunity for obtaining education about working with SNPs, well-equipped dental clinics, and good cooperation with state institutions and administrations [20, 21]. In addition, some developed countries have worked to resolve administrative difficulties among healthcare institutions and towards SNPs [22, 23]. In south Bosnia and Herzegovina, the dental healthcare of SNPs is neglected, in part because dental procedures conducted under general anaesthesia are not recognized and cover by the nation's health insurance system, even though these patients have basic health insurance. Additional barriers in Bosnia and Herzegovina are dental professionals' insufficient experience and knowledge about treating this population of patients; there is also a lack of SNP cooperation, a lack of awareness about dental healthcare for SNPs among their parents and caregivers, inadequate facilities, and a lack of guidelines regarding how to treat SNP. In addition, patients in rural and underdeveloped areas face greater difficulties when they attempt to access dental treatment in general and especially under GA [22, 23]. All of these factors have contributed to inequalities in society and the health system in Bosnia and Herzegovina and elsewhere [24].

The only specialized dental healthcare for special needs patients in south Bosnia and Herzegovina is carried out at Caritas Centre St. Family in Mostar by a dentist, anaesthesiologist, one dental nurse, and two anaesthetics technician volunteers. Dental treatment for SNPs at our Center began in 2005 with the help of Italian dental professionals and their team of volunteers aiding Bosnia and Herzegovina in the post-war period. The Italian physicians helped us organise our own (and only) dental medical team of professional volunteers that has now played an important role in the provision of dental care for SNPs under general anaesthesia and the necessary follow-up.

In our experience, we have observed how important it is to have a constant, experienced, and dedicated team of professionals in order to provide good treatment for SNPs. Our team was built with professionals with varied experience, knowledge and skills together with empathy and respect toward our patients. As a result, during the follow-ups the special needs patients have shown less anxiety and have begun to be more inclined to attend regular check-ups for preventive treatment. The number of extractions has therefore decreased, and the numbers of preventive and restorative dental treatments have increased. The increase in the annual number of SNPs treated under OIGA can be explained by the public's awareness of the existence of our dental clinic and the availability of GA when appropriate.

Notably, our dental team does not require preoperative laboratory check-ups. Such check-ups are a common practice in other parts of the world, although neither this testing nor abnormal results have been shown to be associated with postoperative outcomes [25]. The professional judgment of the practitioner needs to be the primary determinant regarding whether a preoperative laboratory check-up is needed for a patient, but a careful and detailed clinical examination and consultation with the patient or parent/caregiver prior to the use of OIGA is an imperative. Thorough pre-operative clinical assessments are crucial to reducing the risk of complications associated with dental treatment under OIGA, but in Bosnia and Herzegovina these assessments rarely include preoperative laboratory testing. To circumvent the possible unnecessary stress of needle insertion to our patients, we have used preoperative laboratory testing only when it is deemed necessary.

General anaesthesia eliminates a patient's sensory, cognitive, and somatic motor activities, enabling comprehensive dental care for SNPs [26-28]. The demand for dental care for SNPs under GA increases every year, and the management of these patients poses a challenge for the entire dental medical team. In developed coun-

tries, the provision of general anaesthesia for SNPs has undergone a transition from dental clinics to general hospitals, because standard patient monitoring should include the means for successful resuscitation and the monitoring of various parameters which are usually lacking in dental clinics. The main criteria used to decide a special needs patient's medical suitability for treatment under general anaesthesia are the results of the patient's physical examination and the parent or caregiver's consent based on the patient's present health status, ensuring that the patient can tolerate dental care under general anaesthesia at a dental clinic. Approaches that consider the admission of SNPs to a general hospital for additional tests are more expensive without additional benefit; nevertheless, treatment at a general hospital should be considered for SNPs who have severe medical conditions. Dental clinics can be maintained to meet the demands for dental care for SNPs treated under general anaesthesia.

Both approaches to SNPs (dental clinic or general hospital) do not have a 'gold standard' protocol for the provision of dental treatment under general anaesthesia [10]. The ideal protocol for a special needs patient treated under general anaesthesia should allow the safe induction of anaesthesia with easy airway management. Considering that the management of the patient's airway during dental treatment is shared between the anaesthesiologist and dentist, it can be argued that OIGA is not the method of choice for SNPs. However, for a well-trained team this is not an issue. In addition, the use of OIGA is especially beneficial in SNPs with a neuromuscular disease because aspiration and chronic pneumonitis are excluded and the mucosa is intact. OIGA is also useful for patients with airway abnormalities [29].

Our present findings regarding OIGA are not in agreement with the study reported by Wang *et al.*, who found nonintubational GA to be more beneficial in regard to the procedure duration and side effects, except for a significantly higher desaturation rate in the use of nonintubational GA [14]. In contrast, the results of our analyses revealed a shorter procedure duration with OIGA and no significant side effects. Potential complications during recovery can include emesis, nausea and vomiting, upper airway problems, decreased appetite, and significant hypotension. The present patients with minor side effects did not have significantly prolonged awakening and were released on schedule.

A limitation of our study is that although the vital signs of the patients were monitored continuously in the recovery room, it is difficult to access and evaluate sore throat, aspiration, hyperglycemia, and similar minor side effects in SNPs. Additionally, after the patients were released home, instruction notes were given to parents or caregivers to contact the dentist immediately if any side effect occurred; we did not receive any such calls and we did not call the parents/caregivers about check-ups. It is thus possible that more of the patients experienced a minor side effect, but we did not evaluate this. An additional reason for the low complication rate in this series might be that the majority of the patients had undergone a previous anaesthetic procedure which might have helped prevent complications, and most of the patients had been provided dental care previously at our dental clinic. The dental medical team was thus familiar with the clinical characteristics of many of the patients.

In this study, the most common indication for dental treatment under OIGA was behaviour management, followed by surgical procedures; the medically compromised SNPs included patients with cardiac diseases. This is in line with the other studies [28,30,31]. Ananthanarayan *et al.* reported mental retardation as the most common diagnosis among SNPs who underwent general anaesthesia but also in the context of behaviour management [29]. Those authors also reported slightly less side effects among adult SNPs who were treated under GA for a dental intervention in a hospital setting with minimal morbidity and without extensive preoperative investigations [29].

Regarding anaesthetic strategies for SNPs, different approaches are used. Some medical dental teams prefer intravenous access for induction, but this approach might be difficult to achieve in some SNPs due to their combative or hostile behaviour. Various anaesthetics have been suggested to facilitate the induction and maintenance of GA. Ketamine or midazolam have usually been recommended [29]. At our dental clinic we have used a mixture of sevoflurane inhalation anaesthetics (which is a strong volatile anaesthetic), but we have also used analgesics (and nitrous oxide as a weak gas anaesthetic) but better analgesics in a mixture with oxygen. In anaesthesia, sevoflurane provides hypnosis, amnesia, analgesia, akinesia, and blockage of the autonomic nervous system. Spontaneous breathing is maintained because patients themselves regulate the depth of

anaesthesia (excessive concentrations of sevoflurane will suppress ventilation). The usual time to the loss of consciousness with an 8% concentration of sevoflurane is 60 sec. The introduction of sevoflurane through a mask is also one of the approaches to patients who present difficult intubation, because the spontaneous breathing is maintained and there is no excessive salivation. As far as cost-benefit analyses are concerned, volatile anaesthetics rapidly set-up anaesthesia and equally quickly interrupt it. One of the arguments for the use of sevoflurane is the relative speed of wakening from anaesthesia and the rapid home discharge which contributes to cost reduction. Negative aspects of the use of volatile anaesthetics are the absence of a postoperative analgesic effect and their association with postoperative nausea and vomiting [29, 32].

The mean age of our patients was 18.3 years, but other studies have reported a significant difference in the mean age of the special needs patients [29-31]. The reason for this is that most of the available literature usually focused on either paediatric or adult patients, and in this study we summarised the data for all age groups of SNPs. The proportion of males was higher, and this finding is similar to those of other studies [29, 33].

In conclusion, the results of our present analyses of 1,220 patients with special needs establish that SNP can receive their required dental care safely under OIGA as outpatients with a minimal preoperative evaluation. Additional care should be considered for patients with severe medical conditions, as should psychological and social support. An experienced dental medical team in crucially important to provide safe dental treatment of SNPs under OIGA. The selection of the OIGA should be based on the consideration of a mixture of sevoflurane inhalation anaesthetics, nitrous oxide, and oxygen. Our data could guide future treatment directions and assist the professionals who provide dental treatment for SNPs under general anaesthesia to consider orotracheal intubation as a safe method to decrease complications and provide satisfactory dental treatment.

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