Trends and Characteristics of Pediatric Dentistry Patients Treated under General Anesthesia

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Purpose: *The aims of this study were to describe the demographic characteristics of pediatric dentistry patients undergoing dental rehabilitation under general anesthesia (DRGA) at UNC-Chapel Hill during the last 13 years and identify factors associated with multiple (1 versus 2 or more) DRGA visits during that timeframe.* ***Study design:*** *Administrative claims data were used to identify children and adolescents (age <18 years) who underwent DRGA between 1/1/2002 and 12/31/2014 at the UNC Hospitals system. Information on children's age, sex and all treatment-associated CDT codes were collected. Descriptive statistics and bivariate tests of association were used for data analyses.* ***Results***: *There were 4,413 DRGAs among 3,973 children (median age=4 years 8 months, males=55%) during the study period. The annual rate of DRGAs increased over time, peaking (n=447) in 2013. Overall, 9% of children had ≥2 visits with repeat rates up to 18%. There was no association between children's sex and receipt of one versus multiple DRGAs; however, craniofacial cases were more likely (p<0.0005) to have multiple DRGAs compared to non-craniofacial ones.* ***Conclusion***: *DRGAs are on the increase—with the exception of craniofacial and special health care needs patients, multiple DRGAs may be reflective of sub-optimal adherence to preventive and continuing care recommendations.*

Key words: *children, pediatric dentistry, general anesthesia, behavior guidance, health services*

INTRODUCTION

General anesthesia is an important component of the behavioral guidance armamentarium available to deliver dental care to young, pre-cooperative children and individuals with complex medical and behavioral comorbidities[1]. Taking into consideration all risks and benefits, it is a safe and effective means of delivering necessary dental treatment, when conventional and advanced behavior guidance techniques including the use of pharmacologic agents for conscious sedation are not indicated or are ineffective. It allows for the provision of high-quality dental care and improvements in families' child oral health-related quality of life[2] while maintaining a positive experience for pediatric patients with various special healthcare needs, extensive restorative treatment needs, fearfulness, anxiety, uncooperativeness, or complex medical conditions. Of note, recent evidence indicates that parental acceptance of general anesthesia for children's dental treatment has been steadily increasing over the last three decades[3] and is now considered more favorably than active or passive immobilization[4].

Restorative treatment needs arising as a result of early childhood caries (ECC) is a major etiology contributing to the need for dental rehabilitation under general anesthesia (DRGA) among children. Similar, dental caries-related restorative needs are commonplace among older children and adolescents who are treated under GA, including those with special health care needs[5-7]. Based on recent national data from Canada, Schroth and colleagues[8] estimated that the rate of DRGAs due to ECC was 12.1 per 1000 children during a 4-year period, accounting for 31% of all day surgeries performed

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among children under the age of 6. Although representative data for the US currently do not exist, it has been estimated that between 1-3% of children under the age of 5 may undergo DRGA[3,9]. The increased availability of anesthesia expertise and access to operating room facilities are additional contributors to the overall increase as well as regional disparities in DRGA use[9].

Conceptually, the majority of DRGA cases are considered an endpoint of early-onset or severe dental caries, frequently overlaid by sub-optimal use of the dental care system (i.e., non-adherence to recommended preventive care and period recall schedules). While 'upstream' factors and social determinants of health (e.g., social and economic deprivation) are major influences on the development of ECC, other case-specific factors are important, also affecting the use of DRGA (e.g., specific oral health care needs, parental preferences, dental practice style). Importantly, a significant proportion of DRGA patients reportedly return for additional restorative care, which may be a result of sub-optimal follow-up care (e.g., lack of dental home, non-compliance with home care and dietary recommendations) or persistence of the factors that led them to experience the first DRGA[10]. It is thus unsurprising that despite the increase in the demand and utilization of DRGAs there has been no any noticeable decline in disease rates among this population group.

While a subset of repeat DRGA may be done in the context of routine care for patients with special health care needs and craniofacial cases, others might be preventable with optimal preventive care and disease management. A comprehensive understanding of the trends and patient characteristics undergoing DRGA is essential from both clinical and quality of care perspectives—this is especially the case for patients who may experience multiple DRGAs, a phenomenon of clinical significance, conferring impacts on families, communities, and the health care system. Accordingly, this study was undertaken with the purpose of describing the trend of pediatric DRGA in a US academic hospital, and to investigate characteristics of children and adolescents who underwent one or more DRGA treatments.

MATERIALS AND METHOD

This study was based on retrospective review of administrative claims data obtained via the electronic patient records (EPR) of the School of Dentistry, University of North Carolina-Chapel Hill. The investigators extracted and analyzed records of children and adolescents (<18 years of age) who had at least one DRGA with care rendered by the pediatric dentistry service at the UNC-Chapel Hill Hospitals and Ambulatory Surgical Center, between 01/01/2002 and 12/31/2014 (13 years). The study was reviewed and approved by the UNC Institutional Review Board, Office of Human Research Ethics (#15-0498).

The current dental terminology (CDT) code D9420 (hospital call) was used to define DRGA cases in the EPR data. First, individual cases and treatment instances were identified. Subsequently, information on service area and billing center (e.g., craniofacial vs. pediatric dentistry) and all CDT codes associated with the DRGA treatment were extracted. Additional variables collected included patients' gender and date of birth.

Initial data analyses relied upon descriptive statistics, tabular and graphical methods. Bivariate tests (X^2 for categorical and *t*-test or ANOVA for continuous variables) were used to examine associations between multiple (2 or ≥3 vs. 1) DRGAs and patient characteristics including age and gender. Longitudinal trends in the number of DRGAs during the study period using a non-parametric Wilcoxon-type trend test[11]. A conventional p-value threshold of 0.05 was used as statistical significant criterion. All analyses were done using the Stata 14.1 (StataCorp, College Station, TX) statistical software.

RESULTS

There were 4,413 DRGAs identified during the 13-year study period with 3,973 individuals having these visits (Table 1). A bar graph corresponding to the annual number of DRGAs during the study period (2002-2014) is presented in Figure 1. Overall, the number of DRGAs followed an increasing trend over time and doubled between 2002 (n=201) and 2014 (n=404), having peaked (n=447) in 2013 (non-parametric trend test, p<0.0005). Figure 1 also presents includes an overlaid function representing the proportion of each year's DRGA cases that had a subsequent repeat DRGA. This proportion was highest among patients treated between 2003 and 2005, and ranging between 14% and 18%.

The vast majority (91%) of patients had 1 DRGA, 7% had 2 and 2% had 3 or more (Table 1). Their median age at the DRGA visit was 4 years 8 months (Figure 2) and slightly more than half (55%) were males. There were no significant gender differences over time or between children receiving one versus multiple DRGAs. Cases that were designated as craniofacial were more likely to present for multiple DRGAs compared to non-craniofacial cases (X^2 test, p<0.0005).

Figure 1. The vertical bars illustrate the distribution of the number of general anesthesia (GA) cases (left y-axis) performed by the UNC-Chapel Hill Pediatric Dentistry services according to calendar year (x-axis) between 2002 and 2014 (n=4,413). The proportion of each calendar year's cases that underwent a subsequent (one or more) repeat DRGA is represented by the connected-dot function (right y-axis).

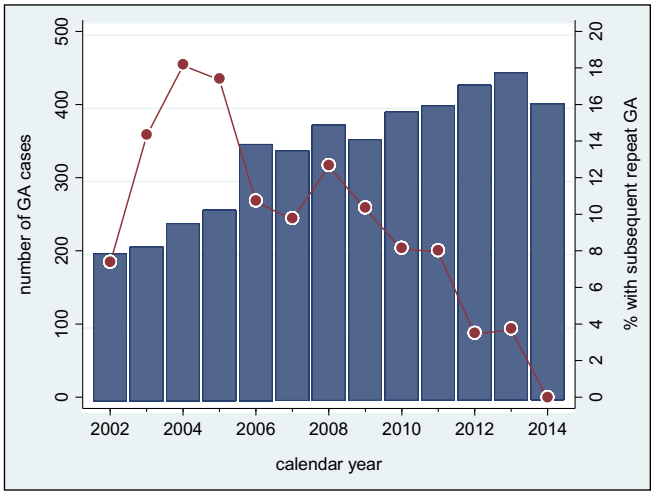
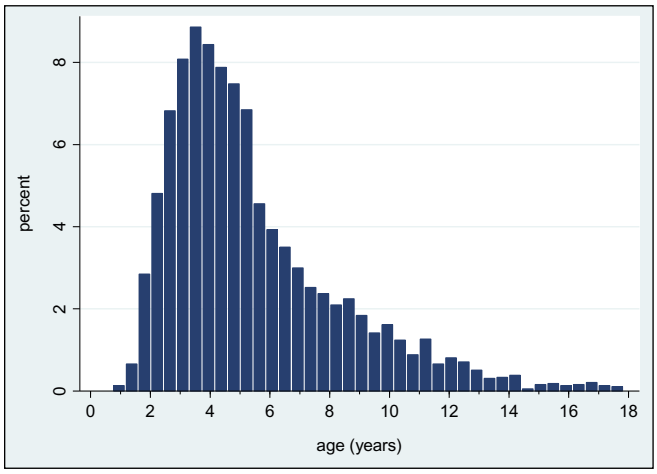


Table 1. Distribution of dental treatments under GA per child treated by the UNC-Chapel Hill Pediatric Dentistry service between 2002 and 2014, and their association with children's characteristics.

	1 GA n (row %)	2 GAs n (row %)	≥3 GAs n (row %)	*P**
Entire sample	3,619 (91)	288 (7)	66 (2)	
CFC†	71 (63)	29 (26)	12 (11)	<0.0005
NOT CFC†	3,584 (92)	259 (7)	54 (1)	
Males	2,001 (91)	153 (7)	42 (2)	0.3
Females	1,618 (91)	135 (8)	24 (1)	
Age (yrs., mean)	5.4 (2.8)	5.4 (3.3)	5.5 (3.3)	0.9

*X^2 tests for categorical variables and ANOVA for age; †Designated as craniofacial case

Figure 2. Age (in years) distribution of children treated under general anesthesia (GA) by the UNC-Chapel Hill Pediatric Dentistry service between 2002 and 2014 (n=3,973).



DISCUSSION

This study utilized administrative claims data of an academic hospital over a 13-year period and found an increasing trend of general anesthesia cases performed by the pediatric dentistry service. Considerable proportions (up to 18% per year) of patients returned for a repeat DRGA with craniofacial patients being more likely to have multiple GA visits. We found no significant association of patients' age and gender with the likelihood of having a DRGA. These data add to expanding knowledge base of DRGA utilization and determinants and set the stage of future qualitative and intervention studies aimed to understand families' dental care itineraries after a DRGA as well as ways to improve compliance with post-operative care recommendations.

General anesthesia is a crucial adjunct for providing dental care to pediatric patients who are unable to cooperate due to young age, extent of restorative treatment needs or special healthcare needs. Recent reports indicate that academic hospitals treat substantial proportions of ASA II and III patients under GA for dental treatment[12,13]. At this time, there are no standards of care or evidence from randomized clinical trials to guide systematic selection of cases for conscious sedation or DRGA[14,15]. The increasing numbers of DRGA cases done over time is consistent with multiple reports in the literature highlighting the increased demand for GA and sedation services[14,16]. The increased utilization parallels the higher acceptance and consequently demand for DRGA due to changes in parenting styles[4], as well as the persistence of ECC as the most common childhood disease.

This study's findings are in general agreement with previous reports in the literature. Age and gender distributions of patients treated for DRGA are generally varied, since different studies have been undertaken in diverse environments and using different inclusion criteria. Regarding repeat DRGAs, previous studies have reported rates of 11% for a second and 2% for a third GA visit in Germany[6], 9% in England[7] and between 7-10% in a review by Mallineni[14]. The considerable proportion of repeat DRGA is unsurprising given the fact that restorative care for ECC, via DRGA or other restorative means does not equate treatment of the disease[17]. In fact, recent evidence confirms that the disease trajectory among children who underwent DRGA persists in adulthood[18]. Patients treated via DRGA are frequently experiencing a "twin disparity"[19] of disproportionate disease burden and inadequate access to dental care. In spite of this, opportunities exist to improve DRGA patients' post-operative follow-up with recommended periodic care and overall treatment recommendations[10,20].

The study's findings should be viewed in light of its limitations. This investigation did not consider variations in cases' baseline behavior scores which could influence the need for future DRGA versus conventional care[21]. Moreover, it did not consider providers' variation in choice of restorative procedures and treatment needs at each DRGA, while the choice of restorative materials and techniques during DRGA has been shown to influence the need for re-treatment[22]. Finally, the overall rate of repeat DRGAs was estimated using the entire sample of patients who had such visits during a 13-year timeframe, not allowing sufficient observation time for more recent cases (e.g., years 2012-2014) to experience repeat treatments. For this reason, the overall repeat DRGA rate of 9% is an underestimate and the year-specific estimates of 14-18% derived from earlier calendar years are more representative of the "true" repeat rate. In spite of these limitations, these results add to growing knowledge base of DRGA utilization and provide initial insights into the frequency and determinants of repeat DRGAs.

CONCLUSIONS

The review of pediatric dentistry DRGAs done during the last 13 years at UNC-Chapel Hill, revealed that the rate of DRGAs increased over time to reach over 400 per year in 2014. About 10% of patients were treated more than once (range: 2-7 times) under GA during the 13-year study period. There was no association of patients' age (at the first DRGA) and gender with repeat treatments. Craniofacial patients were significantly more likely to undergo multiple DRGAs compared to non-craniofacial patients. Multiple DRGAs may be reflective or sub-optimal adherence to preventive and continuing care recommendations. Future analyses involving medical history, behavioral, treatment needs and referral information among this patient population will help elucidate additional individual predictors of multiple pediatric DRGAs.

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