Scientific Article

Combining Procedures Under General Anesthesia

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Abstract: ***Purpose:*** *The purpose of this study was to analyze cases in which dentistry was combined with other procedures during a single outpatient general anesthetic (GA) in a children's hospital. Financial and time savings were evaluated for a subgroup of combined care patients.* ***Methods:*** *Records of 120 patients who received combined dental and one other procedure under GA were reviewed. All were treated as outpatients, and dental procedures were more than just radiographs. Descriptive statistics were calculated for: (1) patient characteristics; (2) procedures; (3) times for procedures; (4) anesthesia; (5) recovery; and (6) total time in hospital. Records of 18 patients with combined dentistry and extraction of third molars were compared to 36 patients receiving the same procedures during separate GAs to evaluate time and costs for combined vs separate procedures.* ***Results:*** *Patients ranged from 2 to 21 years, and 98% had special health care needs. Oral surgery (41%) and otolaryngology (23%) were most frequently combined with dentistry. Estimated mean savings for patients receiving dentistry and third molar extractions in combination were 312 minutes and $2,177.* ***Conclusions:*** *Combining care offers an economical vehicle for providing medical and dental care to patients needing multiple procedures. Awareness of the efficiency of combined care may lead to more combinations of procedures when possible. (Pediatr Dent 2007;29:397-402) Received July 30, 2006 / Revision Accepted November 3, 2006.*

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The American Academy of Pediatric Dentistry recognizes the importance of hospital-based general anesthesia (**GA**) for the treatment of pediatric dental patients: (1) who are unable to cooperate; (2) who experience significant anxiety; (3) for whom local anesthesia is ineffective; (4) requiring significant surgical procedures or immediate comprehensive oral care; and (5) for whom GA may protect the developing psyche and/or reduce medical risks.[1]

Restorations placed under GA for treatment of early childhood caries have been reported to be of higher quality than those placed while utilizing conscious sedation.[2] Both dentists and parents have increasing interest in GA for treatment of uncooperative pediatric dental patients.[3,4]

Although there is a risk of adverse events with each exposure to GA (including sore throat, nausea/vomiting, having memory of the procedure, death, and brain damage), treatment in the operating room (**OR**) is generally safe.[5-7] Treatment in the OR, however, is costly for patients and families, the health care system, and society as a whole. The 2% of Medicaid-eligible children who receive such treatment account for 25% of Medicaid dental expenditures.[8] Optimizing the use of facilities and personnel enhances efforts to manage the increasing costs of surgery.[9,10] A study of anesthesia costs concluded that increasing OR efficiency and decreasing time in the hospital offered the most promise for reducing costs.[11] Costs associated with hospital treatment under GA have been the subject of multiple reports.[3,12-14] In addition to medical and dental fees, there are family costs (ie, lost wages while bringing a child to the dentist) and societal costs (children missing school) of treatment under GA.[14] Those who can least afford to miss work and school disproportionately need to take time for dental care.[15] It has been demonstrated that GA can be more efficient than repeated visits for restorative care.[14]

Although it seems intuitive that combined care should result in both time and cost savings, there has been minimal exploration of combining dental and medical treatment under GA in the literature. A pediatric dentist reported coordinating treatment for 4 patients who had dentistry combined with other surgeries and provided a rationale for combined treatment in the OR.[16] In a 6-case series of multiple proce-

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dures under a single GA in a hospital urology department, one included dental treatment. The combined approach demonstrated cost savings and no increase in morbidity; the estimated savings were 40% for the combined urologic and dental surgery patient.[17] A description of 80 children receiving dental care under GA reported combined medical and dental procedures in 3 cases (4%).[18] A review of patients with epidermolysis bullosa (**EB**) found that 42% of dental GAs also included medical treatment.[19] A case report of an EB patient highlighted the benefit of combined treatment. The dentist initiated contact with the patient's physician, and esophageal dilation was combined with dental treatment in one OR session.[20] There is a need for a larger case series with contemporary information to guide current practice.

The purpose of this project was to analyze data collected from patient visits to the operating room at a pediatric hospital. The aims were to:

1. describe the dental case mix in the OR;
2. analyze the frequency with which other services were involved in combined care;
3. qualitatively describe combined care patients;
4. determine the initiating party;
5. quantify time parameters; and
6. analyze the time and costs of the most frequently combined procedures compared to the procedures done separately.

Methods

Children's Hospital and Regional Medical Center (**CHRMC**) is a 245-bed, tertiary-care pediatric teaching hospital in Seattle, Wash. Medical and dental attending surgeons and residents provide treatment in the OR at CHRMC. This institutionally approved study reviewed records of patients who received treatment under GA between January 1, 2003, and December 31, 2004. The surgical log of all patients treated under GA by pediatric dentists at the CHRMC was reviewed to identify patients treated in combination with other departments. All patients included in the study were admitted and discharged on the day of surgery.

Group 1 was comprised of 120 patients who received dental treatment combined with 1 other surgical or diagnostic service. Inclusion criteria were: (1) treated by dentistry; and (2) only one other service with admission and discharge on the day of treatment.

Exclusion criteria were: (1) the dental treatment was only radiographs; and (2) a combination of more than one other service or patient was admitted to the inpatient service following treatment.

Data gathered for group 1 included: (1) date of birth; (2) date of surgery; (3) medical diagnosis; (4) second service and surgeon; (5) primary language; (6) ethnicity; (7) gender; (8) payer; (9) medical diagnosis; (10) treatment details; (11) initiating service; (12) primary service; (13) sequence of servi-ces; (14) time in hospital; (15) surgical time; and (16) recovery time.

Group 2 was designed to compare time and financial parameters for combined care as opposed to care completed separately. Means of the time and cost parameters for the 18 patients of the 120 who received dental treatment—combined with extraction of third molars by an oral surgeon—were compared to the means of:

1. the sum of a group of 18 similar patients who received dental treatment only; and
2. a group of 18 similar patients who underwent only extraction of their third molars.

Extraction of third molars was selected for comparison, as it was the single procedure most frequently combined with dentistry. Data gathered from the medical record included: (1) time in hospital; (2) surgical time; and (3) recovery time. Obtained from financial records were fees for: (1) OR facilities; (2) anesthesia; (3) recovery room; (4) hospital supplies; and (5) medications.

A single dentist examiner collected data from the medical records; ambiguities were resolved by consensus of dentists familiar with the project. The hospital financial department compiled all hospital fees.

Data analysis. Descriptive statistics were calculated for the patients receiving combined treatment, including: (1) means and standard deviations for quantitative measures; and (2) frequency and percent for categorical variables.

Group 2 means and standard deviations were calculated for time and financial data. One-way analysis of variance (ANOVA) was used to estimate and test the statistical significance of the contrast between the average time and financial values of the patients receiving combined vs the sum of the average time and financial values of the 2 patient groups receiving single treatment, assuming unequal variances based on a 2-sided test. Financial measures were logarithmically transformed prior to running the 1-way analysis to normalize the data. The significance level for the comparisons was predetermined at .05.

Results

During the study period, hospital dentists treated 936 patients in the OR and 23% received combined care (214/936). Of the subjects with combined care, 56% (120/214) met the inclusion criteria. Reasons for exclusions were:

1. postoperative admission (45%);
2. combined care by 3 or more services (23%); and
3. treatment type not meeting inclusion criteria or incomplete medical records (32%).

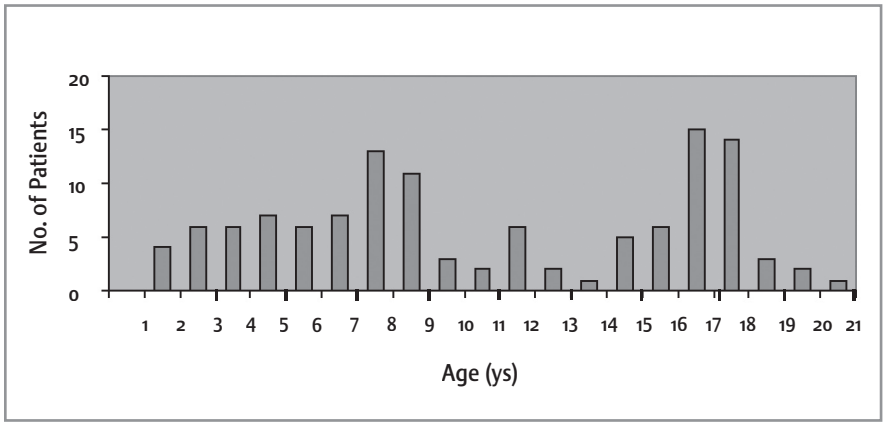

Figure. Numbers and age of patients who received combined care under general anesthesia (2003-2004).

Characteristics of combined care. Ages ranged from 2 to 21 years. Mean age was 11.1 years (±5.5 years SD). Peaks in prevalence were at ages 8 to 9 years and 17 to 18 years; patients of these ages made up 44% of study patients (53/120; Figure). Patients were more often male (62%, 74/120). Ethnicity was 72% Caucasian (86/120), 6% Asian (7/120), 5% Hispanic (6/120), 3% Native American/Native Alaskan (4/120), 2% African American (2/120), and 8% unrecorded (9/120). Only 6% (7/120) needed the assistance of an interpreter.

Medicaid provided coverage for 78% of patients (93/120). Slightly fewer than half had private insurance (55/120, 46%), frequently with Medicaid as a second payer. Three patients were in the hospital's free care program.

Nearly all patients were considered children with special health care needs (**SHCN**; 117/120, 98%). The most common diagnoses were: developmental delay (50%); craniofacial anomalies (23%); seizure disorder (17%); cerebral palsy (16%); and cardiac anomalies (16%; Table 1). Many patients had more than one medical diagnosis (69/120, 56%). Services most commonly combined for patients with a diagnosis of developmental delay were: oral surgery; otolaryngology; and audiology. For patients with craniofacial anomalies, the most frequently combined approaches were: otolaryngology; oral surgery; plastic surgery; and ophthalmology.

The departments of oral surgery and otolaryngology accounted for more than 60% of cases combined with dentistry. The remaining cases included a variety of services (Table 2). Of patients treated in combination with otolaryngology, 85% (23/27) were no older than 10 years of age and the most frequent diagnoses were: developmental delay; and craniofacial anomalies. For treatment involving oral surgery, 84% (41/49) were at least age 15 and the most frequent diagnoses were: developmental delay; seizure disorder; cerebral palsy; and cardiac anomalies. Other services did not demonstrate patterns for age at time of treatment (data available from author).

Initiating services were: (1) dentists (72/120, 60%); (2) the craniofacial team (13/120, 11%); (3) patients' families (11/120, 9%); (4) other departments (14/120, 12%); and (5) unknown (10/120, 8%). The primary admitting service was: (1) dentistry (97/120, 81%); (2) otolaryngology (8/120, 7%); (3) general surgery (5/120, 4%); and (4) other services (10/120, 8%).

Dental treatment usually preceded the second service (75/120, 63%). In 9/120 (8%) cases, dental treatment was followed by procedures such as a:

1. brainstem auditory-evoked response test or an echocardiogram that occurred in the recovery area (5/120, 4%); or
2. diagnostic procedure in the MRI suite (4/120, 3%).

The order of treating services was not recorded for all patients.

The total time in the hospital for the combined treatment ranged from 177 to 682 minutes, averaging 360 minutes. The mean total procedure time was 89 minutes (range=20-193). The mean dental surgical time was 51 minutes (range=3-129). Other services had a mean time of 30 minutes (range=1-142). Mean time spent in recovery was 154 minutes (range=40-421).

Dental procedures frequently provided were: (1) radiographs (111/120, 93%); (2) prophylaxis (108/120, 90%); (3) restorations (96/120, 80%); (4) fluoride application (38/120, 32%); and (5) primary tooth extractions (48/120, 40%). Permanent teeth were extracted by pediatric dentists infrequently (8/120, 7%), given the frequent combination with oral surgery. Occasional procedures included: periodontal surgery; ultrasonic scaling; and orthodontic evaluation.

Time and cost comparisons. Means of fees and time for patients who had combined oral surgery and dental treatment were compared to the sum of these measures for 2 similar patients treated by the services individually. Combined care saved 312 minutes of hospital time ($P<.001$) and shortened recovery time by 133 minutes ($P<.001$). Surgical times were not significantly different ($P=.32$; Table 3).

Financial analysis revealed significant savings in all areas with combined treatment. Mean savings for combined care were: (a) $451 for OR fees; (b) $436 for anesthesia fees; (c) $505 for recovery fees; (d) $405 for supplies; and (e) $380 for medications. Average nonsurgical fees for patients

Table 1. MEDICAL DIAGNOSES OF PATIENTS RECEIVING COMBINED CARE UNDER GENERAL ANESTHESIA (2003-2004).

Medical diagnosis	No.	%
Developmental delay	60	50
Craniofacial/cleft lip and palate	28	23
Seizure disorder	20	17
Cerebral palsy	19	16
Cardiac anomalies	19	16
Autism	14	12
Down syndrome	9	8
Oncology	9	8
Pulmonary dysfunction	7	6
Otolaryngologic disorders	4	3
Osteogenesis imperfecta type III	3	3
Organ transplant recipient	3	3
Urologic disorders	3	3
Healthy	2	2
Psychiatric disorders	2	2
Fetal alcohol syndrome	1	1
Gastroenterological disorders	1	1
Hematological disorders	1	1
Mental retardation	1	1
Nephrologic disorders	1	1
Obesity	1	1
Ophthalmologic disorders	1	1
Rheumatologic disorders	1	1

Table 2. OTHER SURGICAL SERVICES COMBINED WITH DENTISTRY UNDER GENERAL ANESTHESIA (2003-2004).

Service	No.	%
Oral surgery	49	41
Otolaryngology	27	23
General Surgery	7	6
Audiology	6	5
Ophthalmology	5	4
Gastroenterology	5	4
Neuro Diagnostics	5	4
Urology	5	4
Plastic surgery	3	2
Other	8	7
Total	**120**	**100**

undergoing combined care was $5,604, while the average separate case incurred fees of $7,781. Total mean savings in nonsurgical fees per combined dentistry and oral surgery case was $2,177 (Table 3).

Discussion

GA has become an accepted treatment modality for certain pediatric dental patients.[1] The expense of treatment in the OR mandates its judicious use.[8] A recent review of costs included that, in addition to dental fees, treatment under hospital GA involves between $200 to $2,000 in anesthesia fees and $10 to $30/minute in facility fees.[3] The need to optimize the use of facilities and personnel is driven by efforts to manage the increasing costs of surgical treatment.[9,10,21] While a 10-year study evaluating the mortality associated with hospital GA for dental care in 1- to 6-year-old children found no deaths in more than 22,000 cases, risk is incurred with each anesthetic.[5]

Optimum methodology for analysis of separate vs combined procedures would involve identifying patients needing both services and randomization to separate and combined treatment groups for comparison. As a practical alternative, this study selected patients of similar: age; procedure; and interpreter use. Interpreter use was included, as it may increase some time parameters (eg, waiting for interpreter to arrive prior to postoperative teaching). While this remains controversial in the literature, it was felt to be true at CHRMC.[22]

Extraction of third molars and myringotomy tube placement (**MTP**) were originally selected as procedures for comparison because they were the procedures most frequently combined with dental treatment. It was not possible to identify dental cases to pair with MTP, as separate dental cases had longer surgery times than the dental cases combined with MTP during the study period.

SHCN children often have significant burdens of care and are estimated to account for more than half of all child-related health care costs.[23-25] More than 1 in 5 SHCN families have reported financial problems related to their child's condition, and almost 30% stated that at least one family member was forced to reduce or stop employment. The resources required for the care of SHCN children can contribute to a family's cycle of poverty.[23] Oral rehabilitation under GA can improve the quality of life for selected young and SHCN children.[26,27] An additional example of decreasing the burden of care for this patient population occurred when certain brief procedures which can be difficult for SHCN, such as vaccinations or venipunctures—were also completed in conjunction with dental treatment. Although beneficial to patients, because this treatment was not conducted by an additional surgical or diagnostic service, these patients were not included in this study.

A retrospective analysis comparing the costs of treating 100 patients who had concurrent otolaryngology surgeries to

Table 3. COMPARISON OF ORAL SURGERY TIME AND FEES: SEPARATE VS COMBINED CARE UNDER GENERAL ANESTHESIA (2003-2004)

	Group (mean±SD)			Combined care savings	*P*-value
	Dentistry + oral surgery	Dentistry	Oral surgery		
In hospital time (mins)	381 ± 87	346 ± 81	347± 67	312	<.001
Recovery time (mins)	166 ± 82	128 ± 66	171 ± 57	133	<.001
Surgical time (mins)	98 ± 29	74 ± 34	36 ± 22	12	.32
OR fee (dollars)	2545 ± 1024	1220 ± 409	1776 ± 717	451	<.001
Anesthesia fee (dollars)	1406 ± 339	1117 ± 338	725 ± 207	436	<.001
Recovery fee (dollars)	500 ± 143	437 ± 117	568 ± 176	505	<.001
Supply fee (dollars)	828 ± 232	444 ± 165	789 ± 308	405	<.001
Medication fee (dollars)	325 ± 125	306 ± 212	399 ± 126	380	<.001

patients who had similar staged procedures found that those with concurrent procedures had shorter: anesthesia times; surgical times; hospital stays; and lower inpatient charges.[28] The present study also demonstrates the economy of combined care; all parameters confirmed time and financial efficiencies. Savings in recovery time illustrate the benefit: following anesthesia for completion of multiple procedures, a patient has a single recovery period.

While this study was limited to patients who had 2 procedures combined, this practice has been extended at CHRMC to include 3 or more services. The savings should be magnified when 3 services are combined. Another population that could benefit from combined care is patients admitted to the hospital postoperatively:

1. for facilitation of recovery;
2. for treatment of an underlying medical condition; or
3. due to a history of previous difficulty following GA.

Even greater savings are anticipated for patients admitted postoperatively.

The CHRMC dental department primarily treats SHCN children, a population that requires frequent medical services. The departments combining with dentistry in the OR correlated with the medical diagnosis of the patients. Patients with diagnoses necessitating team care were frequently involved in combined care that required services available on the team (ie, patients with craniofacial anomalies were commonly treated by dentistry and another service on the craniofacial team). A potential benefit of this study was to highlight non-craniofacial patients with predictable dental treatment needs that may be combined. For instance, when an oncology patient requires placement of a central venous catheter, a dental examination prior to surgery can lead to an opportunity to provide combined care.

There are challenges in securing payment for dental treatment in the OR, and reimbursement for anesthesia services is a persistent problem.[29] Given the difficulty in obtaining third party reimbursement for GA to provide dental care, combined care may offer an opportunity for patients to obtain financial support for GA for dental care.

The benefits of combined care must be weighed against increased scheduling complexity. Cases that involve multiple services require additional time for: presurgical planning; coordination; and insurance predetermination. It is not possible to combine all types of surgical procedures with dental care; establishing the appropriateness of procedures for combination adds to the logistic complexity. Surgeons in this study were typically salaried hospital employees who sacrificed OR time to allow combined care. Those compensated on a fee-for-service basis may have less incentive to give up OR time for combination with other services.

This retrospective study depended on the accuracy and completeness of medical records. Given the inclusion criteria, it was not possible to analyze savings for procedures other than dentistry combined with oral surgery. While this study has confirmed the efficiency of combined care, areas for further study in this field exist. It is relevant to evaluate extension of combined care to outpatient surgery centers. Evaluating case selection and perception of efficiency of combined care from the perspective of providers will help refine patient selection. A study of postoperative morbidity comparing combined care with treatment completed separately would confirm the perceived safety of this treatment modality.

Conclusions

Based on this study's results, the following conclusions can be made:

1. Dental treatment can be combined with a variety of surgical and diagnostic procedures to provide efficient and less costly care to pediatric patients, particularly patients with special health care needs.
2. Awareness of the benefits of combined care to patients and efficiency should lead to a broader utilization of the combined service approach when appropriate.

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