Epidemiology of Ambulatory Anesthesia for Children in the United States: 2006 and 1996

Jennifer A. Rabbitts, MB, ChB,* Cornelius B. Groenewald, MB, ChB,* James P. Moriarty, MSc,† and Randall Flick, MD, MPH*

BACKGROUND: There are few data that describe the frequency, anesthetic type, provider, or disposition of children requiring outpatient anesthesia in the United States (US). Since the early 1980s, the frequency of ambulatory surgery has increased dramatically because of advances in medical technology and changes in payment arrangements. Our primary aim in this study was to quantify the number of ambulatory anesthetics for children that occur annually and to study the change in utilization of pediatric anesthetic care over a decade.

METHODS: The US National Center for Health Statistics performed the National Survey of Ambulatory Surgery in 1994 through 1996 and again in 2006. The survey is based on data abstracted from a national sample of ambulatory surgery centers and provides data on visits for surgical and nonsurgical procedures for patients of all ages. We abstracted data for children who had general anesthesia, regional anesthesia, or monitored anesthesia care during the ambulatory visit. We obtained the information from the 2006 and 1996 databases and used population census data to estimate the annual utilization of ambulatory anesthesia per 1000 children in the US.

RESULTS: In 2006, an estimated 2.3 million ambulatory anesthesia episodes of care were provided in the US to children younger than 15 years (38 of 1000 children). This amount compares with 26 per 1000 children of the same age group in 1996. In most cases, an anesthesiologist was involved in both time periods (74% in 2006 and 85% in 1996). Of the children, 14,200 were admitted to the hospital postoperatively, a rate of 6 per 1000 ambulatory anesthesia episodes.

CONCLUSION: The number and rate of ambulatory anesthesia episodes for US children increased dramatically over a decade. This study provides an example of how databases can provide useful information to health care policy makers and educators on the utilization of ambulatory surgical centers by children. (Anesth Analg 2010;111:1011–5)

The introduction of the first freestanding ambulatory surgery centers (ASCs) in the 1970s resulted in a rapid increase in the proportion of operations performed on an outpatient basis, from <10% in 1979 to 50% in 1990.[1] The number of ASCs continues to increase, with a 150% increase per 100,000 population reported in metropolitan areas from 1993 to 2001.[2] The number of Medicare-certified ASCs increased 64% between 2000 and 2007, from 3028 to 4964.[3] Improvements in surgical and anesthetic techniques have increased the proportion of procedures performed on an outpatient basis to >70% of the total surgical interventions currently performed in the United States (US).[1]

No quantification has been made of the pediatric procedures occurring on an outpatient basis in the US. As the country enters an era of health care reform, epidemiologic data on the utilization of medical resources may be helpful to policy makers as health care expenditures are analyzed. For example, current Medicare payments to freestanding ASCs are less than for corresponding services in hospital-based outpatient departments. In addition, copayments and charges to patients are generally less at ASCs than at hospitals. Almost 90% of all US freestanding ASCs are wholly or partially owned by physicians and 96% are for-profit institutions.[4]

The purpose of this study was to describe, for the first time, the utilization of freestanding and hospital-based ASCs in regard to their care of children. We quantified the number of ambulatory anesthesia episodes occurring annually for children in accordance with age group, anesthetic type, and anesthesia provider and described the change in utilization over a decade. Secondary analyses examined the distribution of perioperative time and disposition and used unplanned admission as an end point.

METHODS

The National Survey of Ambulatory Surgery (NSAS) is the only US national study of ambulatory surgery in hospital-based and freestanding ASCs.[5] We abstracted the data for ambulatory anesthesia of children from this public database for 1996 and 2006. National census data were used to estimate utilization rates.

The NSAS Database

The NSAS was performed by the National Center for Health Statistics on a nationally representative sample of surgery centers that perform ambulatory procedures. The complete sampling and survey methods have been described[5] and select data have been published for patients of

From the *Department of Anesthesiology, and the †Division of Health Care Policy & Research, Mayo Clinic, Rochester, Minnesota.

Accepted for publication June 10, 2010.

Supported by the Department of Anesthesiology, Mayo Clinic, Rochester, MN.

Disclosure: The authors report no conflicts of interest.

Address correspondence and reprint requests to Randall Flick, MD, MPH, Department of Anesthesiology, Mayo Clinic, 200 First St. SW, Rochester, MN 55905. Address e-mail to flick.randall@mayo.edu.

DOI: 10.1213/ANE.0b013e3181ee8479

all ages who had both surgical and nonsurgical procedures.[6,7] In summary, eligible hospital-based facilities were identified from the SMG Marketing Group, Inc., Hospital Market Database[5] and included all short-stay or general (medical, surgical, or children's) noninstitutional, nonfederal hospitals in the 50 states and the District of Columbia with 6 or more beds staffed for patient use. Eligible freestanding facilities were identified from the SMG Free-Standing Outpatient Surgery Center Database and the Health Care Financing Administration Provider of Services Public Use File.

Hospital-based and freestanding ASCs consisted of hospitals that were state regulated or certified for Medicare that performed at least 50 ambulatory procedures in the previous year and excluded dental, podiatry, pain, abortion, family planning, and birthing centers. The included procedures were both surgical and nonsurgical (e.g., lumbar puncture, computed tomographic scanning) procedures performed on an ambulatory basis in general operating rooms, dedicated ambulatory surgery rooms, and other specialized rooms, including endoscopy units and cardiac catheterization laboratories.

A multistage probability design was used, in which independent samples of hospitals and freestanding ASCs were selected at the first or second stages and visits to these facilities were selected at the final sampling stages.[5] An NSAS medical abstract form (Appendix) was used to collect data for each sampled visit during which >1 procedure may have been performed. Data were abstracted from the medical record by facility staff in 30% of cases and by US Census Bureau personnel in 70% of cases. Data abstracted for the NSAS database included patient characteristics, payment information, surgical and nonsurgical procedures, surgical visit information (e.g., perioperative times, anesthesia provider, type of anesthesia), and patient disposition.

In 2006, data were collected for approximately 52,000 ASC visits at 437 centers (142 hospital-based and 295 freestanding centers), with an overall response rate of 74% of sampled centers.[6] Survey responses were received from 75% of sampled hospital-based ASCs and 74% of sampled freestanding ASCs. In 1996, data were collected for 125,000 ASC visits to 488 centers, with an overall response rate of 81% of sampled centers.[7] Survey responses were received from 91% of sampled hospital-based centers and 70% of sampled freestanding ASCs.

Data Abstraction from the NSAS Database

We abstracted data pertaining to type of anesthetic administered, anesthesia provider present, procedure time variables, primary procedure, gender, source of payment, and discharge status. We combined the data of patients younger than 15 years with data from the population census to estimate the rate of visits to an ASC for ambulatory procedures with anesthesia for US pediatric patients. Age categories were <1 year, 1 to 4 years, and 5 to 14 years based on available census data. All statistical analyses were conducted with Stata/SE 10.1 software (StataCorp LP, College Station, TX). Where data were missing, we categorized the result as "not specified" (e.g., for the anesthesia provider category in 1996 data).

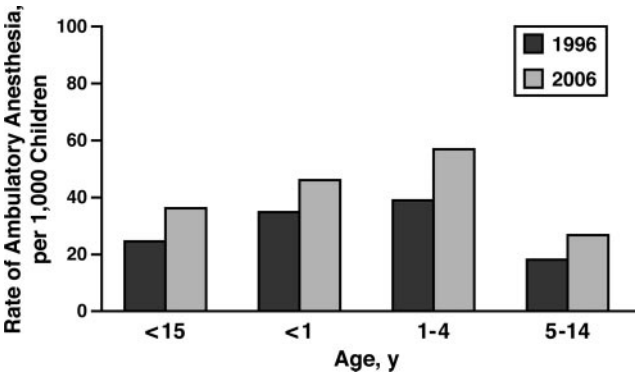

Figure 1. Rate of ambulatory anesthesia for children in 1996 and 2006. Rate increased from 26 per 1000 children younger than 15 years in 1996 to 38 per 1000 children of this age group in 2006.

Data Abstraction from the National Hospital Discharge Survey

To help interpret the trends observed in the utilization of ambulatory surgery facilities, we abstracted a limited amount of information from the National Hospital Discharge Survey. The survey is a national database of inpatient medical and surgical care that is similar to the NSAS database.[8,9] It does not include information on the administration of anesthesia during procedures performed at inpatient facilities, and therefore, we could not differentiate the procedures performed with anesthesia from the noninvasive procedures (including imaging studies) or procedures performed without anesthesia. To help interpret the change in rate of utilization of ASCs for surgical procedures, we abstracted the number of inpatient visits in both 1996 and 2006 for which tonsillectomy or adenoidectomy, or both, was listed as the first procedure. We combined the data on inpatients younger than 15 years with population census data to estimate the rate of these procedures.

RESULTS

Utilization of ASCs for Children, 2006

In 2006, 2,300,651 (standard error [SE], 315,651) ambulatory anesthesia episodes of care were performed for patients younger than 15 years in the US, which is a rate of 38 ambulatory anesthetic procedures per 1000 children (Fig. 1). Among these cases, anesthetics were given to 1,329,976 (SE, 160,647) boys and 1,071,650 (SE, 168,697) girls, or rates of 43 (SE, 5.2) per 1000 boys and 36 (SE, 5.7) per 1000 girls. Data by age group and type of anesthesia are provided in Table 1.

The 3 most frequently performed procedures were tonsillectomy, adenoidectomy, and myringotomy with ear tube.[6] Data regarding the provider of anesthesia are displayed in Table 2.

Perioperative Data

The breakdown of perioperative times is displayed in Figure 2. Of the children who received anesthetics, 12,030 were admitted postoperatively to an inpatient facility (data on those patients readmitted after discharge were not available), for a rate of 6 (SE, 1.3) inpatient admissions per 1000 ambulatory anesthetics. An estimated 2,193,686 (SE, 311,507) of the 2,401,626 children receiving ambulatory

Table 1. Ambulatory Anesthesia Sessions for Monitored Anesthesia Care or Regional or General Anesthetics Only by Age Group, 2006 and 1996

Age, y	MAC (SE)	Regional (SE)	General (SE)	Total (SE)	Overall rate per 1000 children
2006					
<15	44,462 (10,149)	26,484 (7036)	2,241,985 (313,649)	2,300,651 (315,651)	38
<1	—[a]	—[a]	196,991 (36,173)	202,412 (36,363)	49
1–4	—[a]	—[a]	963,733 (141,654)	974,915 (141,977)	60
5–14	38,215 (9823)	11,156 (3741)	1,081,261 (145,287)	1,123,295 (147,728)	28
1996[b]					
<15	53,943	14,776	1,490,686	1,522,883	26
<1	—[a]	—[a]	138,661	140,639	37
1–4	12,283	3177	633,454	640,424	41
5–14	39,351	9338	718,571	741,820	19

MAC = monitored anesthesia care; SE = standard error.
[a] Sample size was too small or SE was too large.
[b] 1996 Data did not contain some of the survey sampling variables needed to accurately estimate the SEs and thus the SEs are not reported.

Table 2. Anesthesia Provider Involved During Admission to Ambulatory Center When Anesthesia Was Provided by an Anesthesiologist or CRNA Only, 2006 and 1996

Age, y	Anesthesiologist only (SE)	CRNA only (SE)	Both anesthesiologist and CRNA (SE)
2006			
<15	1,389,393 (209,784)	603,695 (158,713)	292,630 (52,055)
<1	130,681 (23,159)	52,145[a]	18,375[a]
1–4	577,712 (89,577)	256,924[a]	135,772 (25,799)
5–14	681,000 (104,418)	294,626 (69,382)	138,483 (26,847)
1996[b]			
<15	936,944	219,716	314,919
<1	95,883	17,738	24,910
1–4	387,108	93,878	137,596
5–14	453,953	108,100	152,413

CRNA = certified registered nurse anesthetist; SE = standard error.
[a] Sample size too small or SE too large.
[b] Data of 1996 did not contain some of the survey sampling variables needed to accurately estimate the SEs and thus the SEs are not reported.

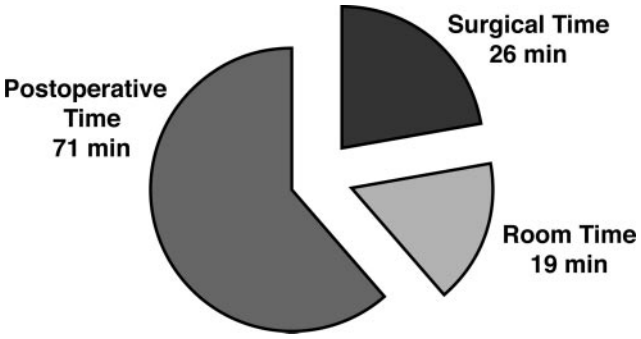

Figure 2. Mean perioperative times for children younger than 15 years. Postoperative time accounted for the largest portion of the perioperative period during pediatric visits to ambulatory surgery centers for surgical procedures. Room time = the difference between total operating room time (from entrance into until exit out of the operating room, or 45 [2] minutes) and surgical time (from the operation's start to its finish, or 26 [1] minutes); postoperative time = from entrance into until exit from the recovery room, or 71 (3) minutes; perioperative time = from entrance into the operating room until exit from the recovery room.

anesthesia were recorded as having routine discharge (913 of 1000 ambulatory anesthetics; SE, 138).

Payment Information, 2006

In 2006, the cost of 1,547,744 visits to ASCs for children younger than 15 years was paid by private or commercial insurance or through self-pay. For the other visits, the cost of 816,185 visits was paid through public forms of funding (e.g., Medicaid, TRICARE). Of the visits for which funding was known, the cost for 65% of visits was paid from a private or commercial source and for 35% of visits from a government source.

Utilization of ASCs for Children, 1996

In 1996, an estimated 1,522,883 ASC visits included anesthesia administration, which is a rate of 26 ambulatory anesthetic procedures per 1000 children younger than 15 years. Data by age group and type of anesthetic are provided in Table 1. Data regarding the provider of anesthesia are displayed in Table 2.

Payment Information, 1996

In 1996, most (1,142,481) of the ASC visits for children were funded through private or commercial insurance or self-pay; 494,665 (30%) were funded through public sources (including Medicaid and TRICARE). Of the visits for which funding was known, 70% of visits were paid from a private or commercial source and 30% from a government source.

Rate of Inpatient and Ambulatory Tonsillectomy and Adenoidectomy, 1996 and 2006

The rate of inpatient tonsillectomy or adenoidectomy, or both, in 1996 was 0.39 (SE, 0.08) per 1000 children younger than 15 years. In 2006, it was 0.18 (SE, 0.04) per 1000

Table 3. Rates of Tonsillectomy or Adenoidectomy, or Both, per 1000 Children Performed on an Ambulatory Basis[a] and an Inpatient Basis,[b] 2006 and 1996

	Rate per 1000 children (SE)	
Age, y	Ambulatory[c]	Inpatient
2006		
<15	9.7 (2.0)	0.18 (0.04)
<1	—[d]	—[d]
1–4	13.2 (2.8)	—[d]
5–14	9.2 (2.0)	—[d]
1996		
<15	5.3	0.39 (0.08)
<1	—[d]	—[d]
1–4	6.2	—[d]
5–14	5.5	—[d]

SE = standard error.
[a] From National Survey of Ambulatory Surgery data.
[b] From National Hospital Discharge Survey data.
[c] Ambulatory data from 1996 did not contain some of the survey sampling variables needed to accurately estimate SEs and thus SEs are not reported.
[d] Sample size was too small or SE too large.

children of that age. By comparison, the rate of ambulatory tonsillectomy or adenoidectomy, or both, in 1996 was 5.3 per 1000 children younger than 15 years; in 2006, it was 9.7 (SE, 2.0) per 1000 children of that age. Information by age is provided in Table 3.

DISCUSSION

Over the 10 years between 1996 and 2006, pediatric visits to ASCs during which anesthesia was administered increased almost 50%, from approximately 1.6 million in 1996 to 2.3 million in 2006. During that period, the population of pediatric patients increased only 5.3%, suggesting that the increase in ASC visits requiring anesthesia was the result of a change in overall utilization or a shift in practice from inpatient to outpatient, or both. Overall utilization increased from 26 to 38 ASC visits per 1000 children, representing an almost 40% increase.

Whether this increase in rate of ambulatory anesthesia is attributable to an increase in surgical procedures or a shift of procedures from inpatient to outpatient settings has important implications for health care spending. No data are available that permit a direct comparison of inpatient and outpatient utilization rates for procedures requiring anesthesia.

Therefore, we abstracted the rate of either tonsillectomy or adenoidectomy and of both procedures from the NSAS database and the National Hospital Discharge Survey database, because tonsillectomy and adenoidectomy are common pediatric procedures that may be performed in an inpatient or an outpatient setting and always require anesthesia. The rate of these procedures as an inpatient operation decreased approximately 54% from 1996 to 2006 whereas the rate for the ambulatory setting increased 82%. This change suggests that there may have been a shift of procedures from the inpatient, short-stay hospitals to the hospital-based and freestanding ASCs during these 10 years. This shift is consistent with data from the Medicare Online Survey Certification and Reporting System and the

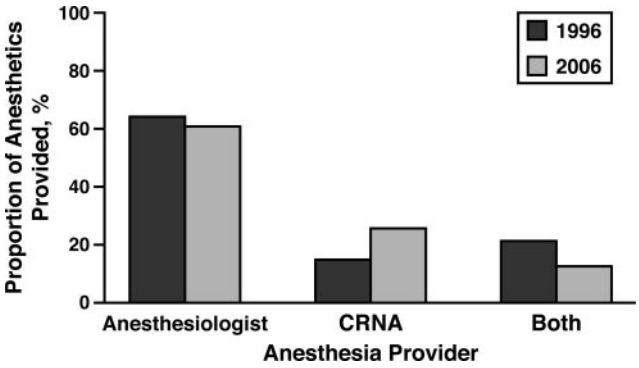

Figure 3. Provider of ambulatory anesthesia for children in 2006 and 1996. An anesthesiologist was involved in most anesthesia episodes for ambulatory surgery in both time periods (61% in 2006 and 64% in 1996). CRNA = certified registered nurse anesthetist.

American Hospital Association Annual Surveys of Hospitals, which showed a 28% increase in hospital-based outpatient surgery and a 4.5% decrease in inpatient surgery from 1993 to 2001.[2] However, these data must be interpreted with caution because there may be a different explanation for this change. For example, surgeons may schedule tonsillectomies as outpatient procedures in children who stay overnight for payment reasons.

During both 1996 and 2006, the highest rate of ASC visits with general anesthesia administration was in the 1 to 4 years age group and the lowest rate was in the 5 to 14 years age group. Most of the ambulatory pediatric anesthesia was delivered by an anesthesiologist in both time periods (74% in 2006 and 85% in 1996). However, with the increased use of ambulatory anesthesia, the proportion of anesthetics provided by a certified registered nurse anesthetist alone increased whereas the proportion of anesthetics provided by a certified registered nurse anesthetist working with an anesthesiologist decreased (Fig. 3). Nongovernmental groups (private and commercial insurance and self-pay) were the funding source for most visits in both 1996 and 2006.

Economic and Educational Implications

This study is an example of how a database can be used to abstract data useful to health care policy makers, administrators, and educators and to provide important information when changes have to be made in health care systems.

The increase in ambulatory anesthesia itself may be interpreted as an increase in health care spending. However, it may be associated with a decrease in inpatient anesthesia, which could decrease health care expenditures.[4] If this trend continues, further savings may occur.

The dramatic increase in pediatric ambulatory surgery has direct implications for residency and fellowship training, and this effect may be the most important impact of this trend. Currently, programs are based at inpatient medical centers, and training at ambulatory anesthesia centers may be limited. As pediatric anesthesia shifts to outpatient and ambulatory centers, education for residents and fellows may need to be adapted to adequately prepare anesthesiologists to manage the unique challenges of ambulatory anesthesia in children.[10,11]

Limitations

The main limitations of this study are those inherent to the NSAS database and the medical charts that were reviewed for it, because our study was reliant on data collected by the National Center for Health Statistics for the NSAS database. There was an average response rate of 74% by sampled hospitals in 2006 and 81% in 1996. Data were extracted from the medical records of sampled patients by nonmedical personnel after training,[5] and it is possible that the medical abstract form (Appendix) was not uniformly interpreted. This process was also limited by the data that were available and retrievable from the medical records. Information was missing for some cases; specifically, the source of funding was unknown for a large portion of the pediatric ambulatory visits in 2006.

The statistical software we used could abstract data only for specific visits and the primary procedure during the visit. These visits potentially could have included multiple procedures and anesthetics that were counted as 1 visit. Sample size was limited in the pediatric population and, therefore, further data could not be reported because of unacceptable standard errors. Also, the 1996 and 2006 NSAS medical abstracts were not identical. For example, the "not-specified" field used in 2006 was not used in 1996, and thus "not specified" in 1996 was defined as no other field filled. Options for payment source were slightly different in the 2 time periods, and therefore, comparisons cannot be made for this category.

In addition, sampling variables were not available for the 1996 NSAS database and thus accurate standard errors could not be calculated for 1996 data. This lack of sampling variables limited the comparisons that we could make between the 2 time periods. Percentages do not add up to 100% because all data represent estimates based on sampling rates and population size.

CONCLUSIONS

The rate of ambulatory anesthesia for children in the US increased by >40% over a decade, partly because of a shift in procedures from an inpatient to an outpatient setting. These databases are useful to health care policy makers, educators, and administrators, as well as other parties involved in health care organization and provision. This type of information is currently of particular importance in this era of health care reform when, to make decisions regarding health care spending and reform, data on utilization of all aspects of health care are needed from all groups.

APPENDIX

Medical Abstract Form of the National Survey of Ambulatory Surgery, NSAS-5 (2-1-2006). (Adapted from US Census Bureau and US Department of Commerce. Available at: http://www.cdc.gov/nchs/data/hdasd/nsas_participant/nsas5.pdf.)

REFERENCES

1. Pregler JL, Kapur PA. The development of ambulatory anesthesia and future challenges. Anesthesiol Clin North Am 2003;21:207–28
2. Bian J, Morrisey MA. Free-standing ambulatory surgery centers and hospital surgery volume. Inquiry 2007;44:200–10
3. Medicare Payment Advisory Commission (MedPAC). June 2008 Healthcare Spending and the Medicare Program: A Data Book. Available at: http://www.medpac.gov/documents/Jun08DataBook_Entire_report.pdf. Accessed February 16, 2010
4. Medicare Payment Advisory Commission (MedPAC). Report to the Congress: Medicare Payment Policy. Available at: http://www.medpac.gov/documents/Mar09_EntireReport.pdf. Accessed February 16, 2010
5. McLemore T, Lawrence L. Plan and operation of the National Survey of Ambulatory Surgery. Vital Health Stat 1 1997;37:I–IV, 1–124
6. Cullen KA, Hall MJ, Golosinskiy A. Ambulatory surgery in the United States, 2006. Natl Health Stat Report 2009;11:1–25
7. Hall MJ, Lawrence L. Ambulatory surgery in the United States, 1995. Adv Data 1997;296:1–15
8. DeFrances CJ, Lucas CA, Buie VC, Golosinskiy A. 2006 National Hospital Discharge Survey. Natl Health Stat Report 2008;5:1–20
9. Graves EJ, Owings MF. 1996 summary: National Hospital Discharge Survey. Adv Data 1998;301:1–12
10. Emhardt JD, Saysana C, Sirichotvithyakorn P. Anesthetic considerations for pediatric outpatient surgery. Semin Pediatr Surg 2004;13:210–21
11. Twersky RS. Educational protocols in ambulatory anesthesia. Ambul Surg 1997;5:117–9