AMBULATORY SURGERY

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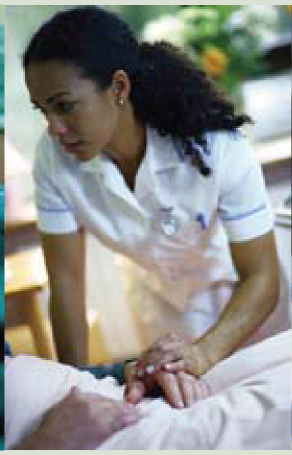

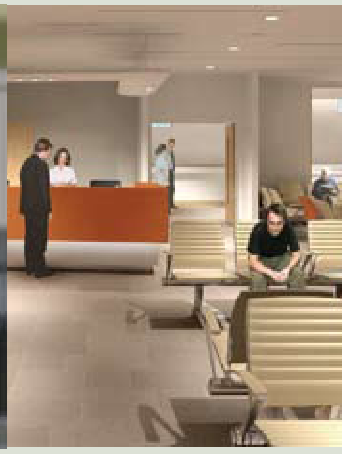

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Editorial

Mark Skues, Editor-in-Chief

As I write, plans are being formulated to develop the next congress of the IAAS and the China Ambulatory Surgery Alliance to be held in Beijing in May 2017. Preliminary information of the planned Scientific Programme will be available imminently on the IAAS website, so keep visiting the site to view what I know will be a flagship for the ongoing development of exemplary management and outcomes in international Ambulatory Care.

This quarter's edition of the Journal contains a number of seemingly disparate papers, with an overall theme of coalescence of data to infer new information.

An ophthalmological review comes from the Accreditation Association for Ambulatory Health Care where they examine the trends in anaesthesia during extraction of cataract over a four and a half year period. They cite a rise in the use of topical anaesthesia, with a fall in peri- and retrobulbar techniques, together with an increase in the rate of oral sedation, and the reasons why this might have occurred.

Professor Jim Philip has contributed an extended abstract to the Journal, evaluating the role of inhalational agent monitoring for ambulatory surgery, providing graphic trends of what actually happens to inspired and expired concentrations over the course of an anaesthetic. He makes a plea for more manufacturers of anaesthetic machines to consider adding graphical formats and servo controlled feedback to automate the control of end tidal agent concentration, thereby facilitating more precise control of ambulatory anaesthesia.

Jianjun Wang and co-workers have followed up their publication of last year with a paper that describes the effect of a number of variables on access to Ambulatory Surgery Centre care, showing the influence on access from family income, population density and the proportion of families with young children.

Ledger et al have provided another ophthalmogical review describing useful data of over 4000 patients undergoing cataract surgery in their institutions, seeking the rate of capsular rupture and/or vitrectomy that in other studies are cited with an incidence of 1.9%. Gratifyingly, they reported a rate of zero percent, but cite their intention to evaluate a rate of posterior capsule rupture and vitreous loss, should it rise above 1.8% to "intensive review".

And finally . . . A plea for submission of papers to the Journal. It is a little surprising that given International meetings in Paris in January 2016 and Barcelona last year, that the plethora of published abstracts highlighting exemplary standards of care and outcomes have not yet been translated into submissions for *Ambulatory Surgery*. Please try and encourage your colleagues or trainees to consider forwarding their work to a publication now in its 22nd year. Both Doug McWhinnie and I are keen to accept work related to any component of ambulatory care, with support for translation or encouragement of more junior members to add something of note to their developing curricula vitae. So, let's get those creative juices flowing… I'll look forward to your contributions.

Mark Skues
Editor-in-Chief

Guidelines for establishing quality outcomes in cataract surgery in an ambulatory surgery center

Anthony Mannarino, Pamela Ledger & Katie Hooven

Abstract

Purpose: The purpose of this paper will suggest best practice guidelines that should be implemented in ambulatory surgery centers for review of cataract complications. The paper will also assess and compare a physician's rate of posterior capsule rupture (PCR) with published literature.

Methods: A retrospective chart review encompassing 2010-2015 which evaluated 4,028 consecutive patients who underwent a routine cataract procedure with one physician at three locations.

Results: Over the five year period, 4,028 cases experienced no PCR, for an incidence rate of 0%. Surgeon volume showed no signs of correlation with the rate of PCR.

Conclusions: Posterior capsule rupture remains a huge concern for patients undergoing cataract procedures. The results of this study include a lower incidence of previously published literature. Suggested guidelines found in the article will only add to the growing body of literature to inform future policy.

Keywords: Posterior Capsule Rupture, Vitrectomy, Cataract Surgery, Best Practice.

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Introduction

Cataract procedures are one of the most commonly performed procedures in the United States. The goal in healthcare is to provide optimal patient care while performing continuous quality improvement. Complications in medicine and surgery will occur but the goal should be to minimize them. With the rise of the Accountable Care Organizations (ACOs), outcomes will increasingly come under scrutiny as we attempt to measure the provision of necessary and quality care. With the advances in medicine and technology, the complication rates during cataract surgery have decreased dramatically, but still remain an issue for patients who experience a complication.

As previously stated, cataract surgery is the most common outpatient surgical procedure in the developed world. It has the highest rate of success of any surgical procedure, and represents a large expenditure of health care dollars. Due to its reproducibility, it lends itself easily to a convenient examination of the metrics involved. To create a simple method of quality measurement for the institution, the ambulatory surgery center selected the rate of capsular rupture and/or subsequent vitrectomy as the core measurement of acceptable surgical performance.

It is well recognized that the rate of vitrectomy is often underreported. The posterior capsule may be ruptured and the surgeon does not always proceed to vitrectomy. The reasons are: 1) the rupture is small and vitrectomy is not indicated, 2) the indication for vitrectomy is borderline and the surgeon often, for reasons of time, elects to forgo the vitrectomy or 3) the surgeon will use a simple but ineffective weck cell vitreous division to avoid the reporting of and the cost of using automated vitrectomy. After a posterior capsule rupture, if the surgeon avoids the use of automated vitrectomy, when truly indicated, it can potentially harm the patient's result. The center recognizes that if surgeon's outcomes are being evaluated, the temptation to keep the reported vitrectomy rate low may lead to poor decisions.

The rate of posterior capsular rupture and vitreous loss (PCR/VL) has long been accepted as the core measurement of quality in cataract surgery. This parameter is easily measured and tracked. The surgery center has elected to use this measure as the "gold standard "to define quality and define quality surgery. To avoid ambiguity, the surgery center considers posterior capsular rupture (PCR) with or without vitreous loss (VL) or vitrectomy in any fashion to be the same parameter. For the purposes of this review, a PCR with or without a vitrectomy will be considered to be the same event.

Background

The literature was reviewed regarding the rate of PCR/VL. Many of the studies, although informative and well conducted, pertain to residents in training or at least include residents and fellows performing surgery in large academic settings. These institutions vary greatly from the work done at the ambulatory surgery center; therefore the guidelines are conceived to inform the progress of attending surgeons in non-academic large volume community settings [1–3]. An example of how experience influences results is provided by the excellent study by Martin [4]of his first 3,000 cases of phacoemulsification where the first 300 cases had a vitreous loss rate of 4% and the last 300 cases had a loss rate of 0.7%, for an overall rate of 1.3%. The paper by Ionides et al of 1,533 cases shows a total rate of 4.1%, however the rate for residents in the study was 5.3% versus the consultants, or attending's at the rate of 1.2% [5]. Tan and co-workers reported a series of 2530 phacoemulsifications with a 3.6% vitrectomy rate; however the rate for consultant surgeons was 2% [6]. Mearza et al reported a rate of vitreous loss in 1614 eyes to be 2.66% with the rate for consultants being 2.3% [7]. A 2006 study of 2,727 cases by Ang and Whyte [8] gave a rate of 1.7%, however of 45 posterior capsule ruptures, 15 (33.3%) were during resident surgery. Muhtaseb et al reviewed 1,441 patients with a PCR/VL rate of 4.4%, however only 28.4% of the procedures were performed by attending surgeons. The same study quotes a posterior capsule rupture rate of

26% to 36% for phacoemulsification in eyes with posterior polar cataracts [9]. One thousand consecutive cases were analyzed by Zaidi et al in 2007 with a vitreous loss of 1.1% and a 0.4% rate of capsular tear without vitrectomy for a combined rate of 1.5% Consultant surgeons directly preformed 16.5% of the cases. The rest were performed by trainees with supervision by a consultant [10].

Hyams et al studied 137 eyes with pseudoexfoliation (PXF) and 1,364 eyes without and found an incidence of capsular break of 2.9% in both groups. Vitreous loss was 1.5% in the PXF group and 2% in the control eyes. It is important to note that in the hands of these experienced surgeons PXF did not confer an increased incidence of PCR/VL in the absence of phacodonesis or lens subluxation [11]. The landmark 2001 report by Gimbal et al reports 18,470 cases with a posterior capsule tear rate of 0.45% [12]. The most recent article by Chen et al in 2014 [13] showed a 0.68% rate of posterior capsule rupture and vitreous loss during phacoemulsification in 3,339 cases for four attending surgeons in a small non-academic cataract surgical center. Of particular note is that only cases deemed acceptable for topical anesthesia were included in the study and cases requiring additional anesthesia or those in a hospital setting were excluded.

Two articles stand out due to the number of patients included in the sample size. The 2003 report from Chan et al [14] includes 8,230 consecutive cataracts from a predominantly Asian population in a tertiary ophthalmic center with a posterior capsular rupture rate of 1.9%. This study however also included cases of extracapsular cataract extraction (not phacoemulsification). The Cataract National Dataset electronic multicenter audit by Narendran et al [15] included 55,567 operations with an overall PCR/VL rate of 1.92%This study includes 406 surgeons of all training levels in the English National Health Service. The study is difficult to utilize in our model of non-academic, community based cataract surgery done solely by attending surgeons due to the many grades of surgeons and the complex nature of the case stratification in this large study. An excellent table summarizing published rates of vitreous loss is provided in the article by Chang [16].

Methods

A retrospective chart review was done from 2010-2015 on 4,028 cases. Study approval was granted through the Medical Advisory Board of the Ambulatory Surgery Center in Bucks County, PA. Surgical procedures were performed by the Lead Author (AM) at three locations within the Bucks County, PA. The three institutions are 1) multispecialty ambulatory surgery center, 2) an ambulatory surgery center, and 3) a large suburban hospital. There were no patient exclusions. The cases included were peer reviewed by another attending MD.

Results

Of the 4,028 cases reviewed, the PCR rate was found to be 0%. Of all the included cases, 896 were the highest risk type; these were performed in the hospital outpatient surgery setting. These risk factors included: oxygen dependent patients, mentally ill patients, patients with severe movement disorders, patients with severe physical deformities who were difficult to position and those who were considered to be greater than ASA class three.

Implications

Identifying and investigating complication rates is paramount to provide best practice to patients. Publishing complication rates and strategies for best practice will enhance accuracy in reporting a provide surgeons with a benchmark for comparison. Previous suggestions have been to prepare a national database in order to identify outliers on the negative side but this endeavour is costly and is only as accurate as the information provided [3].

Insurance companies, mainly Medicare, are the main reimbursement bodies for cataract surgery. Complications during the procedure leads to increased follow up, longer procedure times, and ultimately more money per procedure. A way to identify surgeons with best practice, and review cases with complications should be paramount for the future. It is a goal to provide a model for the effective evaluation of cataract surgical quality in a non-academic community based environment among experienced attending surgeons. Although copious articles have been written on rates of various cataract surgical complications and their predisposing factors, this is the first attempt to codify a framework to assess the fundamental quality outcome measurement in the most commonly performed surgical procedure.

As we move into an era of cost accountability it will be increasing necessary to identify the provision of quality care. Complications, in the end, are far more costly than a simple review of a cost per case analysis. A surgeon may have a slightly lower cost per case, but if the complication rate is excessive, this will lead to an overall higher cost in terms of reoperations and poor patient outcomes.

After careful review of the literature, the ambulatory surgery center intends to examine on a quarterly basis the PCR/VL rate of each surgeon. The case load of any surgeon with a rate that equals or exceeds 1.8% will be intensively reviewed. We acknowledge that certain variables are beyond the control of the surgeon to a great extent and therefore we exclude from the calculations:

1. The following type of cataract: Posterior polar cataract
2. The following circumstances:
   a. eyes with known subluxated lenses from any cause including trauma or pre-existing collagen vascular disorders
   b. patients with severe pseudoexfoliation noted in the second eye with the first eye having experienced PCR/VL
   c. eyes known or discovered at the time of surgery to have loose zonules
   d. eyes with greater than three intravitreal injections of any agent
   e. eyes with dark brown or black cataracts

Two rates will be calculated. The "raw rate" will include all cases and results. This rate will be tabulated but not considered in the outcome analysis for the purpose of following surgeon quality. The "corrected rate" will exclude the above listed factors and give a more realistic assessment of surgical quality. It is acknowledged that the degree of surgical difficulty varies by region and patient population and some surgeons, by the nature of the practice, will be exposed to more advanced pathology which will affect outcomes.

As mentioned above, a corrected PCR/VL rate of 1.8% will trigger an intensive chart review. However during review the following conditions will be given special consideration due to their higher level of inherent risk:

1. Eyes with synechi (adhesions) which need to be broken at the time of surgery due to trauma or severe inflammatory disease
2. Eyes requiring pupil expansion
3. Eyes with prior extensive filtration surgery
4. Eyes with prior par plana vitrectomy

Conclusions

The goal is to identify cataract surgeries that do not meet quality measures that are objective and easily identified. This allows us to review surgical performance in a timely manner to improve and maintain a high level of patient safety and satisfaction with a cost effective delivery of care for the most commonly performed surgical procedure. We intend to refine these parameters over time and predict that the acceptable corrected rate of 1.8% will drop over time. Participation by similar community based ambulatory centers would allow for large numbers to be analyzed in a short period of time leading to widespread acceptance of a uniform measurement of cataract surgical outcomes. The surgery center intends to publish under separate cover an analysis of the total complication rates, to include other experienced surgeons performing cataract surgeries.

References

1. Zare, M, Javadi, M, Einollahi, B, Baradaran-Rafii, A, Feizi, S, Kiavash, V. Risk Factors for Posterior Capsule Rupture and Vitreous Loss during Phacoemulsification. ***Journal of Ophthalmic & Vision Research***, 2009;**4**:208–12.
2. Briszi, A, Prahs, P, Hillenkamp, J, Helbig, H, Herrmann, W. Complication rate and risk factors for intraoperative complications in resident-performed phacoemulsification surgery. ***Graefe's Archive for Clinical and Experimental Ophthalmology*** 2012;**250**:1315–20.
3. Pingree MF, Crandall AS, Olson RJ. Cataract surgery complications in 1 year at an academic institution. ***Journal of Cataract and Refractive Surgery*** 1999;**25(5)**:705–8.
4. Martin KR, Burton RL. The phacoemulsification learning curve: perioperative complications in the first 3000 cases of an experienced surgeon. ***Eye*** 2000;**14(Pt 2)**:190–195.
5. Ionides A, Minassian D, Tuft S. Visual outcome following posterior capsule rupture during cataract surgery. ***British Journal of Ophthalmology*** 2001; **85**:222–4.
6. Tan JHY, Karwatowski WSS. Phacoemulsification cataract surgery and unplanned anterior vitrectomy: is it bad news? ***Eye*** 2002;**16**:117–20.
7. Mearza AA, Ramanathan S, Bidgood P, Horgan S. Visual outcome in cataract surgery complicated by vitreous loss in a district general hospital. ***International Ophthalmology*** 2009;**29**:157–60.
8. Ang GS, Whyte IF. Effect and outcomes of posterior capsule rupture in a district general hospital setting. ***Journal of Cataract and Refractive Surgery*** 2006;**32**:623–7.
9. Muhtaseb M, Kalhoro A, Ionides A. A system for preoperative stratification of cataract patients according to risk of intraoperative complications: a prospective analysis of 1441 cases. ***British Journal of Ophthalmology*** 2004;**88**:1242–6.
10. Zaidi FH, Corbett Mc, Burton BJL, Bloom PA. Raising the benchmark for the 21st century—the 1000 cataract operations audit and survey: outcomes, consultant-supervised training and sourcing NHS choice. ***British Journal of Ophthalmology*** 2007;**91**:731–6.
11. Hyams M, Mathalone N, Herskovitz M, et al. Intraoperative complications of phacoemulsification in eyes with and without pseudoexfoliation. ***Journal of Cataract and Refractive Surgery*** 2005;31:1002–5.
12. Gimbel HV, Sun R, Ferensowicz M, et al. A. Intraoperative management of posterior capsule tears in phacoemulsification and intraocular lens implantation. ***Ophthalmology*** 2001;**108**:2186–92.
13. Chen M, Lamattina KC, Patrianakos T, Dwarakanathan S. Complication rate of posterior capsule rupture with vitreous loss during phacoemulsification at a Hawaiian cataract surgical center: A clinical audit. ***Clinical Ophthalmology***. 2014;**8**:375–8.
14. Chan FM, Chan S, Mathur R, Ku JJ, Chen C, Yong VS, Au Eong K. Short-term outcomes in eyes with posterior capsule rupture during cataract surgery. ***Journal of Cataract and Refractive Surgery*** 2003;**29**:537–41.
15. Narendran N, Jaycock, P, Johnston RL, Taylor, H Adams M, Tole DM, Sparrow JM. The Cataract National Dataset electronic multicentre audit of 55,567 operations: Risk stratification for posterior capsule rupture and vitreous loss. ***Eye*** 2009;**2**:31–7.
16. Chang D. Cataract Surgery Complication Rates: How are we doing? ***Cataract and Refractive Surgery Today*** 2012;53–6.

Monitoring inhaled agents for ambulatory surgery

James H Philip

Abstract

This presentation explores monitoring inhalation anesthetic agents to control the level of general anesthesia for ambulatory surgery.

Keywords: Monitoring.

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Introduction

Several types of anesthesia are used for ambulatory surgery. Regional anesthesia anesthetizes the part of the body that will undergo surgery. General anesthesia anesthetizes the brain and spinal cord and allows surgery to be performed on any part or parts of the body.

Inhaled anesthetics are one of the choices for general anesthesia and this class of drugs and monitoring will be explored here. Inhaled anesthetics are administered with a vaporizer and anesthesia machine that provides a precise concentration of anesthetic drug to the patient. This concentration represents a partial pressure or tension which propagates from the vaporizer to the patient's brain along the path indicated in Figure 1. It passes through vaporizer, breathing circuit, lungs, arterial blood, and arrives in brain and other tissues. It then comes back from these locations to the patient's lungs and breathing circuit and then goes back to the patient so the drug is not wasted. Allowing the drug to be rebreathed by the patient requires monitoring inspired and expired gas concentrations. With proper monitoring and educated adjustment of vaporizer dial setting, anesthetic depth can be controlled accurately, precisely, and inexpensively. More advanced anesthesia machines allow the anesthesia professional to dial in the desired end-tidal concentration and thereby directly control the level in the blood that is perfusing the brain.

Methods

Examples show how theory is applied to clinical practice with conventional anesthesia machines and agent monitors. Graphic Trends with the shortest trend time (6 minutes here) are displayed and photographed.

Results

Figure 2 shows the trend graph of inspired and expired sevoflurane controlled carefully, producing a rapid and stable increase in concentration followed by a rapid fall in concentration. These changes are typically reflected in anesthetic depth changed three minutes later.

Figure 3 shows the effect of turning the vaporizer off at the end of surgery with maximum fresh gas flow (upper) and typical 15 LPM fresh gas flow (lower). Note the slower fall in inspired and expired concentration with the lower fresh gas flow. This will result in slower awakening.

Figure 4 shows the rapid attainment of stable and adequate end-tidal agent concentration and the rapid reduction of this concentration to achieve wake up. Use of the agent monitor to guide adjustment of the vaporizer allows the anesthesia professional to make the adjustments necessary to maintain desired anesthetic depth.

New anesthesia machines by Draeger, GE, and Maquet allow direct setting of desired end-tidal anesthetic level and should allow anesthesia professionals to provide precise control with far less mental and technical effort.

Conclusion

Monitoring inhaled agents for ambulatory surgery can guide anesthesia professionals to precisely control anesthetic depth from induction to emergence. Conventional anesthesia machines with agent monitors and good graphic trends allow anesthesia care providers to do this. Anesthesia machines should do more1. New anesthesia machines with feedback control of end-tidal gases do this automatically.

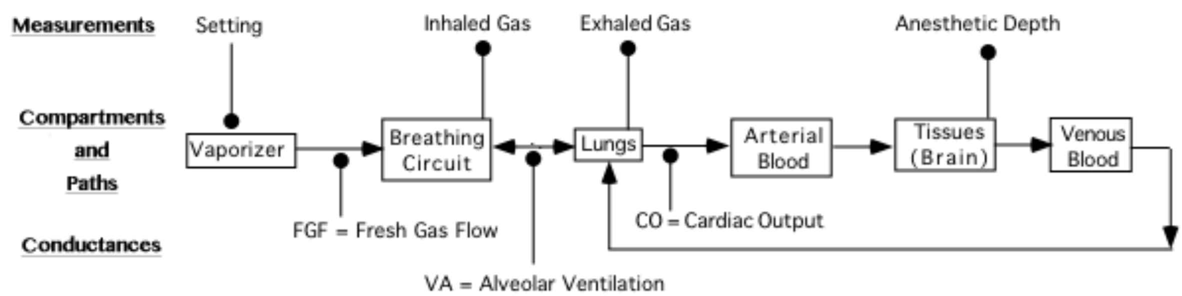

Figure 1

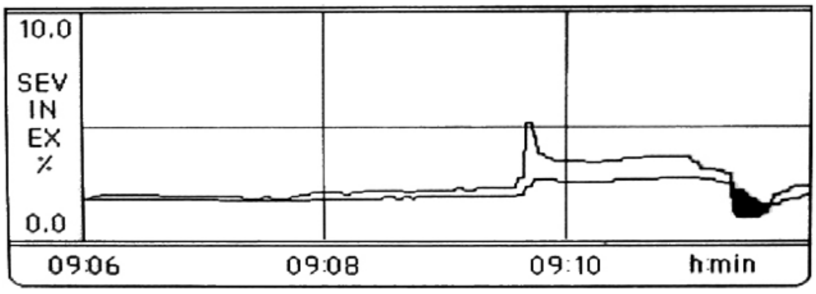

Figure 2 Graphic trend of inhalation agent inspired and expired concentration following bolus up and bolus down using vaporizer, FGF, and captured on agent monitor.

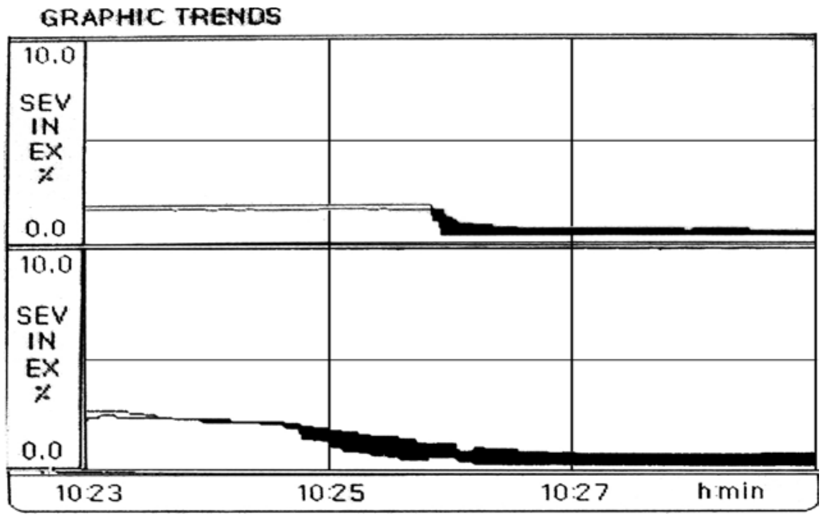

Figure 3 Graphic trend of inhalation agent inspired and expired concentration at emergence with high (top) and lower (bottom) fresh gas flow.

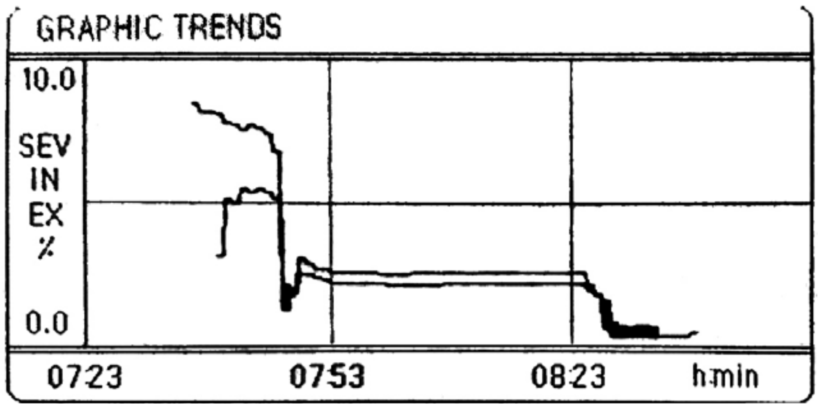

Figure 4 Graphic trend of inhalation agent inspired and expired concentration after carefully controlled VIMA (volatile induction and maintenance) anesthesia.

Reference

1. Philip JH. Anesthesia Machine as a Monitor. In: Ehrenfeld J, Cannesson M. ***Monitoring Technologies in Acute Care Environments***, Springer, 2014, 197–201.

An empirical study of ambulatory surgery access in multilevel context

Jianjun Wang[1], Theresa Ortiz[2], Diana Navarro[2], Roland Maier2, Libing Wang[3] & Summer Wang[4]

Abstract

As a fast-growing sector of the healthcare industry, Ambulatory Surgery Centers (ASC) offer timely and cost-saving services in public health. In this study, large-scale data from the American Community Survey and the Office of Statewide Health Planning and Development (OSHPD) are merged to examine factors of ASC access on multiple dimensions. The analytic method conforms to a well-established CIPP paradigm to justify results-based accountability on what works, for whom, and in which context. While identifying significant impact of family income, population density, and early childhood support, this study further reveals a moderate effect of health insurance coverage on ASC access.

Keywords: Posterior Capsule Rupture, Vitrectomy, Cataract Surgery, Best Practice.

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Introduction

Along with rapid development of medical technology, many operative procedures were moved from in-hospital environments to ambulatory service centers (ASC)[1,2]. The Office of Statewide Health Planning and Development (OSHPD) has been collecting patient origin data since 2005 to monitor the changes in ASC access. During the same period, the U.S. Census Bureau conducted the American Community Survey to gather contextual information for local service planning. Sonier and Lukanen [3] recollected that the ACS [American Community Survey] asks about demographic and socioeconomic characteristics, and that a question on current health insurance coverage was added in 2008. The ACS has a response rate of 98% and collects data from about 460,000 Californians in 160,000 households, acquiring the largest sample of any population survey conducted in California or nationally. In this study, the OSHPD data are merged with information from the American Community Survey to examine factors of ASC access in multilevel context.

Literature Review

In the United States, communities have zip code identifications set by the federal government. Rip [4] attested that the zip or postcode is the smallest geographic unit available by which to analyze hospitalization data. Although the code designation has been around for many years, the OSHPD data collection is relatively new and most researchers are unaware of its existence. Consequently, Weber [5] noted that relative to hospitals, much less is known about ASCs, and few trustworthy national statistics are available. As a pilot study, Wang et al [6] employed the OSHPD data to indicate needs for including contextual factors at both county and community levels. Built on that result, an innovative feature of this investigation is to expand the examination of ASC access through articulation of additional information from the American Community Survey.

Population Demand on ASC Access

In the 21st century, over 55% of the U.S. population relies on employment-based healthcare insurance [7]. Consequently, most young children receive healthcare through their parent's insurance plans. Because many young couples split up after just a few years, divorce issues have often compromised healthcare coverage for newborns. In addition, young children are more vulnerable to inadvertent injuries. Charoo [9] acknowledged that the freestanding ASC environment is less stressful since patients do not feel like they are being admitted to the hospital, which is especially beneficial to the pediatric patient population. To address the population needs, California voters passed Proposition 10 in 1998 to designate child health as a focus area for Children and Families Commissions across 58 counties [10] with state revenue collected from a $.50 per pack tax on tobacco products to fund services for children ages 0–5 and their families.

To ensure equity of the state revenue distribution, Proposition 10 stipulates the designation of more funding to densely populated counties that have a higher birth rate [11]. Therefore, the state investment varies across urban and rural areas. Through incorporation of the large scale data from the American Community Survey, this study is well-positioned to disentangle profound factors of ASC access across the dimensions of population density, insurance supports, and the Proposition 10 impact.

The CIPP Paradigm

While featuring exploratory inquiries in data analyses, this investigation is also grounded on a theoretical framework to enhance the confirmatory aspect of research design. According to Hedges and Rhodes [12], the randomized experiment is the only method known that can yield **model-free** unbiased estimates of causal effects. Alternatively, multilevel analyses depend on the model selection, as pointed out by O'Connell and McCoach [13].

One useful approach to evaluating healthcare service is known as the *Context, Input, Process, Product* (CIPP) model [14]. According to

Valentine [15], the CIPP framework provided a useful organizational scheme for caring and its multiple interrelationships with other components of the health care setting. In this study, factor selection is guided by the CIPP model to support the large scale data analyses.

Ambulatory surgery has been defined as an organized process whereby patients have surgery, recover and are discharged home the same day. This time constraint has made ASC access more germane to residents in local *context*. Based on justification of population demand in the previous section, *population density* is included to describe variability of ASC access across different communities.

The *input* resources are represented by *median income per family*, as well as the funding support from Proposition 10. In Kern County alone, Proposition 10 has channeled over $160 million to enhance child health and development in the past 15 years [16]. Across the state, the American Community Survey incorporated the ongoing collection of community data to represent proportions of the local population under age 6, which were suitable for examining the sustainable impact of Proposition 10. Brady [17] noted that the CIPP model is particularly useful when the product is long-term and sustainable.

In the decision-making *process*, insurance support is particularly helpful to low-income families [18]. Vogt and Romley [19] concurred that in general, ASCs tend to serve a higher-income and more-generously-insured population. While married couples typically had higher incomes [20], father-only groups were in better economic standing than mother-only groups [21]. Unfortunately, more mother-only family groups had young children, under the age of 6, in the household as opposed to father-only family groups [21]. Hence, the supporting platform should also be considered when examining ASC access.

In the *product* phase, the OSHPD data were analyzed to examine the difference in ASC access across various counties and communities. Morrissey [22] reported that for every additional ASC per 100,000 people in a population, a reduction of 4.2% in hospital outpatient surgeries will result. The shift in the healthcare industry has generated strong interests in analyzing ASC access under multilevel contexts [23].

In summary, research literature suggests that the CIPP model is a holistic approach to conducting evaluations of education, health, and other public programs [24]. Through incorporation of the CIPP platform, Table 1 is developed to summarize variable selections for this investigation. Sloane [25] characterized the multilevel approach as a paradigm improvement, stating, "We change the basic research question from what works to what works for whom and in what contexts".

Table 1 Multilevel Variables from OSHPD and ACS Databases

Variable	Level	Data Source
Dependent variable		
Outcome of Ambulatory Service Access	Community*	OSHPD
Independent variables		
Proportion of the population with insurance coverage	County	Census Bureau
Population density	Community	Census Bureau
Median family income	Community	Census Bureau
Proportion of families with children under age 6	Community	Census Bureau

*Community is identified by the ZCTA code from U.S. Census Bureau.

Research Questions

Research questions that guide this investigation are:

(1) What multilevel factors demonstrate profound contributions to ASC access?

(2) How do the results of multilevel modelling fit the empirical data from OSHPD and the American Community Survey?

While the analysis of ASC access leads to identification of significant factors at multiple levels (Question 1), Goldstein [26] cautioned that "These multilevel models are as good as the data they fit; they are powerful tools, not universal panaceas". Hence, Question 2 is developed to confirm the model fit to the multilevel database.

Methods

O'Connell and Reed [27] noted that the goal of multilevel analysis is to attempt to explain variability, which implies that the outcome of interest can be reliably modeled through a well-chosen or predefined set of predictors, covariates, or explanatory variables. Based on variable identification in Table 1, the Hierarchical Linear Model software is employed to conduct multilevel analyses of ASC access in Question 1.

Improvement of the model fit is assessed through a comparison with a null model prior to the introduction of multilevel factors. Garson [28] pointed out that the null model serves two purposes: (1) It is the basis for calculating the intraclass correlation coefficient (ICC), which is the usual test of whether multilevel modeling is needed; and (2) it outputs the deviance statistic (-2LL) and other coefficients used as a baseline for comparing later, more complex models. Therefore, ICC, -2LL, and additional model-fit indices are computed to examine the data support for multilevel modeling (Question 2).

Results

Due to the time required for data processing, the 2012 OSHPD data was released in 2014. This study is grounded on the same data from Wang et al6 to partition variability of ASC access using the OSHPD data from 1,746 communities across California. The new results reconfirmed significant variations of ASC access at both county ($Z=4.07$, $p<.0001$) and community ($Z=35.27$, $p<.0001$) levels. An ICC value of .11 from these authors also supported needs for incorporating multilevel explanatory factors.

Descriptive Findings

One further step in this study is to merge data between OSHPD and the American Community Survey. Descriptive statistics are computed for variables of the CIPP model in Table 2. At the community level, the annual ASC access in each community ranges from zero to 108, resulting in a standard deviation (SD) of 24.92. Because of different scales for measuring predictors at both community and county levels, a recommendation of Quinn and Keough [29] is adopted to standardize variables in Table 2.

Results in Table 2 further indicate a significant correlation between the median family income (X3) and the percent of families with children under the age of 6 (X3). However, strength of the correlation is weak ($r=.12$). Similarly, other correlation coefficients in Table 2 are very small, indicating a minimal co-linearity issue among predictors.

Table 2 Descriptive Statistics for OSHPD and ACS Variables.

Variable	Mean	SD	X	X_2
Dependent variable				
Outcome of Ambulatory Service Access	27.84	24.92		
Independent variables				
Community level				
X_1: Population density (count/square mile)	3185.00	5168.00		
X_2: Percent of families with children under age 6	21.53	41.59	.12*	
X_3: Median family income	72857.00	33939.00	-.03	.01
County level				
X_4: Health insurance coverage (%)	85.59	3.74		

*p<.0001

Multilevel Modeling

Built on the CIPP paradigm for variable inclusion, a full model is expressed for the dependent variable of ASC service access (Y_{ij}) in the ith community in the jth county:

$$\text{Level-1:} Y_{ij} = \beta_{0j} + \beta_{1j} X_1 + \beta_{2j} X2 + \beta_{3j} X_3 + \varepsilon_{ij} \quad (3)$$

where $\varepsilon_{ij} \sim N(0,\sigma_2)$; X_1, X_2, and X_3 represent factors of family income, population density, and the proportion of families with children under age 6 at the community level, respectively.

At level 2, intercepts (β_{0j}) depend on an overall mean (γ_{00}) adjusted by a moderate factor (X_4) and a random deviation for county j (u_{0j}).

$$\text{Level-2:} \beta_{0j} = \gamma_{00} + \gamma_{01} X_4 + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} X_4$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21} X_4 \quad (4)$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31} X_4$$

where $u_{0j} \sim N(0, \tau_{00})$ and X4 represents the percent of *insurance* coverage at the county level. Because β_{1j}, β_{2j}, and β_{3j} are regression coefficients for fixed factors at Level 1, no random component is introduced at Level 2 except for inclusion of X_4 to reflect the impact of insurance coverage.

Results in Table 3 indicate significant influence on ASC access from family income (X_1), population density (X_2), and the proportion of families with young children (X_3) at the community level (α=.01). While the insurance coverage variable (X_4) is insignificant, interaction effect has been found significant between X_3 and X_4 at α=.05, indicating an inseparable impact of insurance coverage and early childhood service on ASC access. Meanwhile, insurance coverage (X_4) does not show significant interaction with X_1 and X_2, and hence, the impact of insurance coverage remains consistent regardless of population density and family income.

Table 3 also includes effect sizes in the result reporting. Cohen30 defined the threshold of effect size as small, d= .2, medium, d= .5, and large, d= .8. More recently, Bloom and coworkers31 reviewed effect size, and cited Lipsey's work32 to treat d=.15 and d=.45 as the small and medium thresholds for empirical studies. In conclusion, variables at the community level demonstrate a significant impact on ASC access at α=.01 (Table 4). The results also show a near medium impact from healthcare insurance coverage (X_4) at the county level.

Table 3: Statistical Testing of Multilevel Effects.

Source	Fixed Effect	F Test	Effect Size
Community	Family Income (X_1)	F(1, 1431)=10.11, p=.0015	.17
	Population Density (X_2)	F(1, 1431)=66.94, p<.0001	.43
	Proportion of Families with Young Children (X_3)	F(1, 1431)= 7.49, p=.0063	.14
County	Insurance Coverage (X_4)	F(1, 38)=1.81, p=.1860	.44
Interaction	X_1* X_4	F(1, 1431)= 1.55, p=.2140	.07
	X_2* X_4	F(1, 1431)= 1.32, p=.2510	.06
	X_3* X_4	F(1, 1431)= 6.05, p=.0140	.13

Model Fit Indices

In examining the model-fit indices, a likelihood-ratio test was used to compare deviances between a null model and a full model.

Table 4: Comparison of the Model Fit Index.

Model	Deviance	Number of Parameters
Null Model	23104.2	2
Full Model	12539.0	12

Chi-Square Test on Improvement of the Model Fit

$\chi 2$ = 23104.2-12539.0=10565.2
df=10
p < .0001

Table 4 illustrates the construction of χ^2 test on improvement of the model-fit index. The result indicates a significant improvement of the full model over the null model [χ^2 (10) = 10565.2, p < 0.0001], which supports adoption of the full model.

To reconfirm the necessity for variable inclusion, Roberts [33] further suggested employment of the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) to include a 'punishment factor' based on the number of parameters estimated. He elaborated that when comparing competing models, one simply needs to consult these statistics to see if the values for each went down from the previous model's estimate. If so, then the new model is considered to be a better model to fit the data than the previous model. With the penalty of AIC and BIC against adding redundant variables, the full model shows smaller values of AIC and BIC while including more variables (Table 5). Therefore, the model-fit indices consistently endorse inclusion of the multilevel variables in this investigation.

Table 5: AIC and BIC Comparison Between the Null and Full Models.

Index	Null Model	Full Model	Difference
AIC	23108.2	12545.0	10553.9
BIC	23112.3	12550.0	10554.7

In summary, the CIPP paradigm from the current research literature demonstrates an effective control of co-linearity among the explanatory variables (Table 2). Results were aggregated for the full model to assess the impact of multilevel factors on ASC access (Table 3). In addition to reconfirming the need for multilevel analyses (Table 4), AIC and BIC indices are presented in Table 5 to show the parsimonious feature of model building, that, according to Kuha [34], provide well-founded and self-contained approaches to model comparison.

Discussion

Although the ASC model has been endorsed by the American Medical Association and the American Society of Anesthesiologists since the early 1970s [35], Cascardo [36] reported that a substantial number of ASCs still fail. While the outcome may reversely impact endorsement of professional organizations, it is more important to proactively examine profound factors behind ASC functioning.

Munnich [37] noted that standardized data on ambulatory surgery centers was difficult to access. Instead of waiting for the data availability, an innovative feature of this investigation is to fill the void through merging large scale data from OSHPD and the American Community Survey. To ensure the rigor of this investigation, the variable selection is guided by a well-established CIPP paradigm from the research literature, and multiple approaches have been employed to confirm the model-fit indices.

In addition to intellectual merits on the methodology front, this study enhances the impact of research findings on multiple dimensions. By nature, ASCs are smaller than hospitals on average [5]. Targeting smaller procedures, ASCs are required to have a transfer agreement with Medicare-certified hospitals when special care is needed for patients with greater co-morbidities [38]. The service delimitation has characterized ASC access in the domain of public health. Therefore, this study reconfirmed population density (X_2) as a significant factor of ASC access. Results in Table 4 show a moderate effect size from population density to indicate its practical importance.

Following the CIPP paradigm, family income is an indicator of the input resource to support ASC access. Plotzke [39] reported that an increase of $1000 in family income decreases the likelihood that the child will be without insurance by as much as 2.8%. Accordingly, this investigation reveals a significant relation between family income and ASC access (Table 4). Furthermore, Doerpinghaus [40] asserted that insurance coverage dampens price variation considerably, making price much less important than it might otherwise have been. With inclusion of the insurance factor, the impact from family income seems to be restrained by additional support from healthcare plans, resulting in a small effect size for the family income variable (X_1) (Table 4).

In history, the first ambulatory surgical procedure in the United States was conducted for a young girl who fell and suffered a penetrating head injury in 1650 [41]. During the process of child growth, infants and toddlers have a fragile body structure, and are inexperienced in self-protection. A significant portion of Proposition 10 funding is devoted to supporting health insurance coverage for children at ages 0–5 [42]. In this study, the health insurance factor (X_4) is measured at the county level. In addition, a variable is included from the American Community Survey to track the proportion of families with children under age 6 (X_3) at the community level. The significant interaction effect of X_3 and X_4 indicates a strong insurance protection in communities with a higher proportion of families raising young children in this age group.

Another feature of the multilevel analysis is derived from the data structure in which multiple communities are nested within each county, causing a much larger sample size at the community level. Coe [43] reviewed this issue of statistical difference, and concluded,

> The main one is that the p-value depends essentially on two things: the size of the effect and the size of the sample. One would get a 'significant' result either if the effect were very big (despite having only a small sample) or if the sample were very big (even if the actual effect size were tiny).

From the process perspective, the number of surgeries in ASCs has increased relative to the number of surgeries in hospitals for all types of insurance coverage categories [37]. In particular, Dyer [44] observed that the increase in outpatient visits is driven in part by a rise in high-deductible health insurance policies with large out-of-pocket payments for non-catastrophic services. Hence, insurance coverage offers general support for ASC access. Although the smaller sample at the county level makes it more difficult to attain statistical significance for X_4, a moderate effect size is obtained to reconfirm the broad impact from health insurance coverage on ASC access (see Table 4).

In summary, this study has addressed two questions through multilevel data analyses. The first question tackled dependency of ASC access on both support resources and population demands. From the resource aspect, health care costs are driving American families into financial collapse [45] and freestanding ASCs are known for their mastery of cost containment [9]. Thus, family income and insurance coverage are important factors to identify the support background for ASC access. In addition, this empirical study has linked ASC access to population needs, suggesting more community demands in densely populated areas with a higher proportion of young children in the population.

O'Connell and McCoach [13] suggested that model selection should be guided by theory and informed by data. Asides from following the theoretical framework articulated by the CIPP paradigm, the full model has stronger data support than a null model without inclusion of the multilevel variables. Improvement of the model-fit outcomes was not only suggested by the $\chi 2$ test result in Table 4, but also reconfirmed by application of the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) in Table 5.

Although strengths could have been claimed on both theoretical foundation and empirical support for this investigation, it should be acknowledged that merit of this study is inseparable from the data quality. Locations of ASC access are difficult to document for seasonal farmworkers, especially those who have no zip code affiliation [46]. Proposition 10 pledges support for children ages 0–5 and their families regardless of immigration status; however some parents may choose to avoid public assistance [47]. As additional progress is made by the federal and state governments to resolve these issues in data collection, results of this investigation should be subjected to reconfirmation in future studies.

References

1. Iyengar R. (2011). ***Factors associated with hospital entry into joint venture arrangements with ambulatory surgery centers.*** Richmond, VA: Virginia Commonwealth University.
2. Metzner J, Kent C. (2012). Ambulatory surgery: Is the liability risk lower? ***Current Opinion in Anaesthesiology*** 2012;***25(6)***:654–8.
3. Sonier J, Lukanen E. (2011). A framework for tracking the impacts of the Affordable Care Act in California. Retrieved from http://www.oshpd.ca.gov/HID/DataFlow/docs/ACA/CHCF_Report_Jun2011.pdf.
4. Rip M. (1991). ***Demographic characteristics and the geographical variability by ZIP code of community hospital utilization in Michigan.*** East Lansing, MI: Michigan State University (9216351).
5. Weber E. (2009). ***Measuring welfare from ambulatory surgery centers: A spatial analysis of demand for healthcare facilities.*** Chicago, IL: University of Chicago (UMI Microform 3369506).
6. Wang L, Ortiz T, Navarro D, Maier R, Wang J, et al. An empirical study of ambulatory surgery services in multilevel context. Paper presented at the 142th annual meeting of American Public Health Association, New Orleans, November 2014.
7. Janicki H. (2013). Household economic studies. Retrieved from http://www.census.gov/prod/2013pubs/p70–134.pdf
8. Einhart N. (2013). How to deal with divorce after a short marriage? Retrieved from http://www.tressugar.com/Divorce-Advice-After-Short-Marriage-30740358
9. Charoo E. (2011). ***Critical success factors of medicare-certified ambulatory surgery centers: A qualitative collective case study***. Minneapolis, MN: Capella University (UMI Number: 3481001).
10. Wang J, Henderson J, Harniman J. An empirical study of coexisting relationships between area-specific support and early childhood development. ***Journal of Social Service Research*** 2013;**39(2)**:141–58.
11. Snider D. (2013). An investment in children. Retrieved from http://www.redbluffdailynews.com/business/ci_24465756/denise-snider-an-investment-children
12. Hedges, L. & Rhodes, C. (2014, July). Quasi-experimental designs: Can we estimate causal relations without randomization? Paper presented at the Institute on Education Research Methods for Faculty from Minority Serving Institutions, Evanston, IL.
13. O'Connell AA, McCoach DB. (Eds.) (2008). ***Multilevel modeling of educational data***. Charlotte, NC: Information Age Publishing.
14. Green-Morris G. (2014). ***An evaluation of the effectiveness of providing foot care education in a rural clinic setting***. Hattiesburg, MS: The University of Southern Mississippi (UMI 3584517).
15. Valentine KL. (1989). ***The value of caring nurses: Implications for patient satisfaction, quality of care, and cost.*** Ithaca, NY: Cornell University (UMI 9001333).
16. First 5 Kern (2013). About us. Retrieved from http://www.first5kern.org/about.
17. Brady AC. (2010). ***Evaluation of the implementation of federal and state wellness mandates in Rhode Island school districts.*** Providence, Rhode Island: Johnson & Wales University, ProQuest, UMI Dissertations Publishing, 2010. 3398376.
18. Aliyu Z, Aliyu M, McCormick K. (2003). Determinants for hospitalization in "low-risk" community acquired pneumonia. ***BMC Infectious Diseases*** 2003; **3**:1–7.
19. Vogt W, Romley J. (2009). ***California ambulatory surgery centers: A comparative statistical and regulatory description***. Santa Monica, CA: RAND Corporation.
20. Millward C. (1998). ***Family relationships and intergenerational exchange in later life***. Melbourne, Australian: Australian Institute of Family Studies.
21. Vespa J, Lewis J, Kreider R. (2013). ***America's families and living arrangements: 2012 population characteristics***. Washington, DC: US Census Bureau.
22. Morrisey MA. (2006). Not-for-profit survival in a competitive world. ***Frontiers of Health Services Management, 22(4)***, 35. Retrieved from ProQuest database.
23. Bernstein A, Hing E, Moss A, Allen K, Siller A, et al. (2003). ***Health care in America: Trends in utilization***. Hyattsville, Maryland: National Center for Health Statistics.
24. Green-Morris G. (2014). ***An evaluation of the effectiveness of providing foot care education in a rural clinic settin***g. Hattiesburg, MS: The University of Southern Mississippi (UMI 3584517).
25. Sloane F. Through the looking glass: Experiments, quasi-experiments, and the medical model. ***Educational Researcher*** 2008;***37(1)***:41–46.
26. Goldstein H. (1995). ***Multilevel statistical models***. New York, Halsted Press.
27. O'Connell A, Reed S. (2012). Hierarchical data structures, institutional research, and multilevel modeling. In J. Lott & J. Antony (Eds.), ***New directions for institutional research***. San Francisco: Jossey-Bass.

28. Garson, G. (2014). Introductory guide to HLM with HLM 7 software. Retrieved from http://www.sagepub.com/upm-data/47529_ch_3.pdf
29. Quinn G, Keough M. (2002). ***Experimental design and data analysis for biologists***. Cambridge: Cambridge University Press.
30. Cohen J. (1988). ***Statistical power analysis for the behavioral sciences*** (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
31. Bloom H, Hill C, Black A, Lipsey M. (2006). ***Effect sizes in education research: What they are, what they mean, and why they're important***. Washington, DC: Institute of Education Sciences.
32. Lipsey MW. (1990). ***Design sensitivity: Statistical power for experimental research***. Newbury Park, CA: Sage Publications.
33. Roberts JK. (2004). An introductory primer on multilevel and hierarchical linear modeling. ***Learning Disabilities – A Contemporary Journal,*** 2004; **2(1)**:30–8.
34. Kuha J. (2004). AIC and BIC: Comparisons of assumptions and performance. ***Sociological Methods & Research*** 2004;**33**:188–229.
35. York, J. E., Thompson, M. K., & Perez-Cruet, M. J. (Eds.). (2002). ***Outpatient spinal surgery***. St. Louis, MO: Quality Medical.
36. Cascardo D. Guidelines for setting up an ambulatory surgery center. ***Podiatry Management***, 2014; **33(8)**:127–32.
37. Munnich, E. (2013). Essays in health economics. Notre Dame, IN: University of Notre Dame (UMI Number: 3585305).
38. Burden, N. (2000). ***Ambulatory surgical nursing***. Philadelphia, PA: Saunders.
39. Plotzke M. (2008). ***Incentives in healthcare: The effect of ambulatory surgical centers and SCHIP***. Saint Louis, Missouri: Washington University (UMI Number: 3316665).
40. Doerpinghaus H. (1990). Effect of ambulatory surgery policy provision on medical expense insurance claims. ***Journal of Risk and Insurance*** 1990;**57**:608–22.
41. Earle AS. (Ed.) (1983). ***Surgery in America: From the colonial era to the twentieth century***. New York, NY: CBS.
42. Free Library. (2014). ***California county provides children's health insurance***. Retrieved from http://www.thefreelibrary.com/California+County+Provides+Children%27s+Health+Insurance. -a069414024
43. Coe R. (2002). ***It's the effect size, stupid: What effect size is and why it is important***. Paper presented at the Annual Conference of the British Educational Research Association, University of Exeter, England.
44. Dyer D. (2012). ***Patient awareness of physician conflicts: Does patient awareness of physician financial conflicts of interest impact patient healthcare decision making?*** Charleston, SC: Medical University of South Carolina (UMI 3515308).
45. Halvorson G. (2013). ***Don't let health care bankrupt America: Strategies for financial survival***. Retrieved from http://www.amazon.com/Dont-Health-Care-Bankrupt-America/dp/1493570277.
46. Hansen E, Donohoe M. Health issues of migrant and seasonal farmworkers. ***Journal of Health Care for the Poor and Underserved*** 2002;**14**:153–64.
47. Dall A. (2012). ***Two outreach and enrollment case studies: Clinica Sierra Vista and La Clínica de La Raza***. Sacramento, CA: California Primary Care Association.

Trends in Anesthesia Use in Cataract Extraction with Lens Insertion: 2010–2015 AAAHC Institute for Quality Improvement Study Results

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Abstract

Aim: To examine the trend in anesthesia use during cataract extraction with lens insertion.

Methods: Data were collected from 2010 to January-June 2015. Non-routine, complicated cases were excluded.

Results: Topical anesthesia and oral sedation use increased during the study period. The use of peribulbar and retrobulbar anesthesia dropped significantly from 20% and 7% respectively in 2014 to 10% and 4% respectively in the first half of 2015.

Conclusion: The downward trend in peribulbar and retrobulbar use may be due to increased use of single dose medications, restrictions on compounding within the ASC, and the cost of commercially prepared hyaluronidase.

Keywords: cataract extraction with lens insertion; ambulatory surgery; anesthesia use.

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Introduction

The Accreditation Association for Ambulatory Health Care Institute for Quality Improvement (AAAHC Institute) has conducted an annual or semiannual cataract extraction with lens insertion study since 1999 with the most recent study completed in June 2015. The study examines processes and outcomes associated with cataract extractions with lens insertions performed in the ambulatory setting. The studies are conducted to help organizations measure their performance, benchmark versus similar organizations, receive information on best practices, and use the information for quality improvement studies. The purpose of this article is to examine the trend in the types of anesthesia and sedation administered from 2010-2015.

Part of the rationale for studying cataract is that it is one of the most frequently performed procedures in ambulatory care. A cataract is a cloudiness or opacity in the normally transparent crystalline lens of the eye. This cloudiness can cause a decrease in vision and may lead to eventual blindness. Cataract surgery is a common procedure in which the cloudy lens is removed and replaced by an artificial intraocular lens. Age-related cataract affects more than 24 million Americans1. That number may rise to 30 million by 20202. Cataract accounts for approximately one half of adult (over age 40) low vision cases. [3] In 2006, of the approximately 2.8 million cataract surgeries performed in the ambulatory setting, 59% (more than 1.6 million) of these were performed in freestanding facilities. [4] The American Academy of Ophthalmology (AAO) has established guidelines for cataract surgery (2011). [5] Cataract surgery has increased steadily, peaking in 2011 at a rate of 1,100 per 100,000 people or approximately 3 million annually. [2] On average, routine, uncomplicated cataract surgery in the United States costs $3,432 per eye if a patient paid directly for the procedure, according to a report of full-year 2014 fees commissioned by AllAboutVision.com from a leading industry analyst. (In 2010 the average was about $3,279, in 2011 it was $2,699, in 2012 it was $3,429 and in 2013 it was $3,230.) [6]

Methods

The AAAHC Institute collected real-time data every six months beginning January 2010 through January–June 2015. Both type of sedation and type of anesthesia used were among the data collected from study participants.

All organizations providing ambulatory cataract extraction with lens insertion comprise the potential population. Every six month beginning in January–June 2010 through January-June 2015, the AAAHC Institute solicited participation from AAAHC accredited organizations via blast email and fax and the wider ambulatory health care population via the AAAHC Institute website (www.aaahc.org/institute). Six-month data were combined to report annual data over the 5-year study period. This report represents selected findings for those 867 responding organizations. Demographic information is supplied below.

Results

In 2010–2015, topical anesthesia administered as proparcaine or tetracaine drops, cellulose pledgets or lidocaine jelly, use increased from 64% to 86% of cases. The use of peribulbar anesthesia varied between 10% in the first half of 2015 to 20% in 2014. Retrobulbar anesthesia was used in as many as 14% of patient in 2012 but decreased to 4% by the first half of 2015. As the table above shows, IV sedation was used in a large percentage of total cases – from a low of 74% in 2012 and 2013 to a high of 86% in the first half of 2015. The use of oral sedation more than doubled during this period (6% to 15%).

Table 1 Organisation participation / cases submitted.

Year	Organisations Registered for the Study	Organisations that participated in the Study	Number of Routine (uncomplicated) Cases Submitted
2010	178	155	4946
2011	242	210	5449
2012	174	152	4455
2013	165	142	3786
2014	140	129	3615
2015 (Jan-Jun)	86	79	2127

Table 2 Cataract Surgery Volume.

Year	Range (min–max)	Median	Total
(min – max)	Median	Total	307,162
2011	100 – 10,299	1,600	348,249
2012	17 – 10,000	1,330	290,744
2013	200 – 10,000	1,600	285,754
2014	120 –- 16,000	1,600	266,034
2015 (January – June)	92 – 8,000	1,800	163,568

Table 3 Organisation Type.

Year	Single Specialty ASC	Multispecialty ASC
2010	65%	35%
2011	68%	32%
2012	66%	35%
2013	71%	29%
2014	80%	20%
2015 (Jan–Jun)	70%	30%

Table 4 ASA Grade as a percentage of the total.

Year	ASA 1	ASA 2	ASA 3	ASA 4
2010	4%	61%	34%	1%
2011	5%	56%	38%	1%
2012	4%	63%	33%	0%
2013	6%	60%	34%	0%
2014	6%	63%	31%	0%
2015 (Jan–Jun)	5%	61%	34%	0%

Table 5 :Analgesia and sedation used during the study periods.

Year	IV Sedation	Topical analgesia	Peribulbar block	Retrobulbar block	Oral Sedation
2010	85%	64%	17%	11%	6%
2011	79%	68%	16%	10%	6%
2012	74%	64%	14%	14%	8%
2013	74%	78%	18%	5%	11%
2014	91%	78%	20%	7%	11%
2015 (Jan–Jun)	86%	86%	10%	4%	15%

Discussion

In 2010 to the first half of 2015, peribulbar blocks were consistently used more frequently than retrobulbar blocks with one exception. Peribulbar and retrobulbar blocks were both used in 14% of the cases in 2012. Beginning in 2013, the gap between the use of retrobulbar and peribulbar widened with the use of retrobulbar tapering off in the first half of 2015 to just 4% of cases. Also of note is that beginning in 2013, the use of topical anesthesia and oral sedation increased steadily. In 2010, the use of topical anesthesia and oral sedation was 64% and 6% respectively. These percentages held relatively constant until 2013 when topical anesthesia and oral sedation use jumped to 78% and 11% respectively and in the first have of 2015 their use was 86% and 15% respectively. Topical anesthesia use as a percent of cases exceeded IV sedation use in 2013 and the first half of 2015.

Just as cataract surgery has evolved over time, so have the types of anesthesia used for the procedure. In the 1800s, topical cocaine anesthesia was used. In 1945 the modern technique of retrobulbar anesthesia was formally described and eventually lead to the development and use of peribulbar and sub-tenons anesthesia. As the technique of phacoemulsification with foldable IOLs has grown so has the use of topical anesthesia. There are several advantages of topical anesthesia (i.e., no perforation risk, no extraocular muscle injury, or central nervous system disruption) and patients can leave surgery without an eye patch which may explain the increase in its use over the study period. Topical anesthesia is most often used in uncomplicated cases in patients who can tolerate the microscopic light [7,8]

The data show that the use of retrobulbar anesthesia relative to peribulbar has steadily declined over the study period. This may be the result of the associated higher risks of hemorrhage or injury to the optic nerve associated with retrobulbar blocks.[9,10] However, a recent study by Cochrane found no difference in pain perception during surgery, no difference in complete akinesia or need for additional injections nor any difference in the development of severe complications. [11].

There may be a downward trend emerging in the use of peribulbar and retrobulbar anesthesia for cataract extraction with lens insertion surgery. The use of both peribulbar and retrobulbar anesthesia dropped significantly from 20% and 7% respectively in 2014 to 10% and 4% respectively in the first half of 2015. This may be due to increased use of single dose medications, not being able to compound within the ASC, and the cost of hyaluronidase now that it is commercially prepared.

Limitations and Questions for Future Study

In 2010-January-December of 2015, the limitations of this study include the number of organizations participating and the number of patients/procedures recorded for each facility. However, the facilities participating represented small (less than 20 annual cataract extraction with lens insertion procedure volumes) to large practices (over 15,000 annual cataract with lens extraction procedure volumes) and both single (69% median) and multi-specialty (29% median) facilities. The proportion of single to multispecialty practices remained similar at approximately 2 single to 1 multispecialty organizations with the exception of 2014 in which the ratio was 4 single to 1 multispecialty organization. Additionally, results should be reviewed remembering that the AAAHC Institute's general practice is to use small sample sizes in its studies, with the plan that organizations will participate from year to year —allowing trending of information and increasing statistical power.

Audit/Screening Methodology

This study used a self-reporting data collection method. Clinical staff members were directly involved in the data collection to promote buy-in and support of the comparisons. Each organization was asked to submit a sampling of procedures to form a composite profile of their practice. In 2010 to the first half of 2015, data were collected during a six month period (January-June or July-December) for a total of 11 study periods. For this article, data collected for six month periods were combined to analyze the data on an annual basis over the past 5 years. While organizations could participate in both the January-June and the July-December timeframe in any given year or from year to year, an analysis of the data show the relative small percentage of repeat participants did not skew the overall results.

In 2010 to the first half of 2015, organizations collected their data on printed forms and then entered the data they collected in online surveys forms that mirrored the printed forms. AAAHC Institute staff performs cleaning/checking for consistency and completeness of data before analyzing.

For more information regarding this study, contact AAAHC Institute at 847-853-6060 or info@aaahc.org. Further updates will be posted on the AAAHC Institute website at www.aaahc.org\institute.

About AAAHC Institute for Quality Improvement

The AAAHC Institute, which sponsored the 2010 through January-June 2015 Cataract with Lens Insertion Studies, was created by the AAAHC as a nonprofit subsidiary to offer clinical performance measurement and improvement opportunities to ambulatory health care organizations and others interested in quality patient care.

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References

1. http://www.ncbi.nlm.nih.gov/pubmed/19506195
2. Gollogly HE, Hodge DO, St. Sauver JL, Erie JC. Increasing incidence of cataract surgery: Population-based study. ***Journal of Cataract and Refractive Surgery*** 2013; **39.9**:1383–9.
3. The Eye Diseases Prevalence Research Group. Causes and prevalence of visual impairment among adults in the United States. ***Archives of Ophthalmology*** 2004;**122**:477–85.
4. Centers for Disease Control and Prevention. National Survey of Ambulatory Surgery. 2006. Calculated from April 2010 revised data for sums of weighted values of cases from Procedure Code 1 = 13.19, 13.41, 13.43, 13.59, 13.70, and 13.72 for freestanding facilities versus freestanding and hospital-based facilities: ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Datasets/NSAS/.
5. American Academy of Ophthalmology Cataract and Anterior Segment Panel. ***Cataract in the adult eye***. San Francisco (CA): American Academy of Ophthalmology (AAO). 2011.
6. http://www.allaboutvision.com/conditions/cataract-surgery.htm
7. Boulton JE, Lopatatzidis A, Luck J, Baer RM. A randomized controlled trial of intracameral lidocaine during phacoemulsification under topical anesthesia. ***Ophthalmology*** 2000;**107**:68–71.
8. Pang MP, Fujimoto DK, Wilkens LR. Pain, photophobia, and retinal and optic nerve function after phacoemulsification with intracameral lidocaine. ***Ophthalmology*** 2001;**108**:2018–25.
9. Ripart J, Mehrige K, Rocca RD. ***Local and regional anesthesia for eye surgery***. The New York School of Regional Anesthesia. August 2013.
10. Fahmi A, Bowan R. Administering an eye anaesthetic: principles, techniques, and complications. ***Community Eye Health*** 2008; ***21(65)***:14-7.
11. Alhassan MD, Kyari F, Ejere HOD. Comparison of two forms of local anesthesia for cataract surgery. ***Cochrane***. July 2015.

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