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Is ASA classification useful in risk stratification for endoscopic procedures?

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Abstract

Background—The American Society of Anesthesiologists' (ASA) physical status classification is a measurement of co-morbidity and is a predictor of peri-operative morbidity and mortality.

Objective—To assess the predictive ability of the ASA class for peri-endoscopic adverse events

Design—retrospective cohort analysis

Setting—74 sites in the USA comprised of academic, community/HMO and VA/Military practices affiliated with the Clinical Outcomes Research Initiative (CORI) database

Patients— 18 years who underwent an endoscopic procedure between 2000–2008

Interventions—EGD, colonoscopy, flexible sigmoidoscopy, ERCP

Main outcome measurements—immediate adverse event requiring an unplanned intervention

Results—A total of 1,590,648 endoscopic procedures were performed on 1,318,495 unique patients. The majority of patients were designated as ASA class I or II (I: 27%, II: 63%). An immediate adverse events occurred in 0.35% of all endoscopic procedures (n=5,596) and was proportionally highest for ERCPs (1.84%). Increasing ASA class was associated with higher prevalence and a stepwise increase in the odds ratio of serious adverse events for EGD (II: 1.54 [95% CI 1.31–1.82]; III: 3.90 [95% CI 3.27–4.64]; IV/V: 12.02 [95% CI 9.62–15.01]); and colonoscopy COL (II: 0.92 [95% CI 0.85–1.01]; III: 1.66 [95% CI 1.46–1.87]; IV/V: 4.93 [95% CI 3.66–66.3]). This trend was not significant for FS and ERCP.

Limitations—retrospective, end point is a surrogate for peri-procedure morbidity

Conclusions—ASA class is associated with increased risk of adverse events at endoscopy, particularly for EGD and colonoscopy. It is useful in endoscopic risk stratification and is an important quality indicator for endoscopy.

Keywords

ASA class; endoscopy; adverse events; complications; risk stratification; CORI

Introduction

The American Society of Anesthesiologists (ASA) has designed and utilized a patient physical status classification, the ASA Class. It is reflective of a patient's co-morbid illness and general fitness for undergoing anesthesia as well as surgery. It has been used by anesthesiologists and surgeons for over 50 years and serves as a critical communication tool aiding in the pre-operative assessment of a patient. Furthermore, it has been shown to accurately predict peri-operative morbidity and mortality (1–3). This measure may also be a predictor of gastrointestinal endoscopy related complications, but has yet to be validated.

The ASA classification is a 6 point scale used to describe a spectrum of co-morbid illness (Table 1). An ASA class 1 patient is a healthy patient. An example of an ASA class II patient is one with well controlled hypertension on a beta blocker and an ASA class III example is a patient with chronic obstructive pulmonary disease on home oxygen. The most common patients of a routine endoscopic practice are ASA classes I, II, and III.

To date, there has been a paucity of literature on the use of ASA classification in the pre-procedure endoscopy setting, though it often used by both endoscopists and anesthesiologists. Based on prior survey data of 124 endoscopists in a wide variety of clinical settings, endoscopists appear to understand and use the ASA class system (4); 84% of respondents stated that they used the ASA classification all or most of the time. When asked to categorize 5 hypothetical patients, 69% assigned the correct ASA class with 95% of respondents within 1 class of the correct response. Furthermore, ASA has been entered into a previous multivariate model assessing for cardiac complications in endoscopy (5), and ASA has been shown to be associated with adverse endoscopic events (6) in a prior abstract but no published study has assessed if and how well adverse events can be predicted by a patient's ASA class.

Therefore, we hypothesize that increasing ASA class is associated with higher rates of peri-procedural adverse events in endoscopic procedures. The aims of the present study are to describe the prevalence of immediate endoscopic adverse events stratified by ASA class and endoscopic procedure type in a large national endoscopic database (The Clinical Outcomes Research Initiative, CORI) and thus, assess the predictive ability of the ASA grade for these immediate endoscopic adverse events.

Methods and Subjects

Clinical Outcomes Research Initiative

This study is a retrospective analysis of the CORI database, which is a large national multi-center consortium whose members are committed to using CORI as its endoscopic reporting system. During the study period of 2000–2008, the consortium was made up of 74 unique practice sites, comprised of 74% community practices, 15% VA and 12% academic practices. Participating sites agree to use a structured computerized report generator to produce all endoscopic reports and comply with quality control requirements. The site's data files are transmitted electronically to a central data repository - the National Endoscopic Database. The data that are transmitted from the local site to the National Endoscopic Database do not contain patient or provider identifiers and qualify as a Limited Data Set under 45 C.F.R. Section 164.514(e)(2). After completion of quality control checks, data from all sites are merged in the data repository for analysis. Procedure counts are monitored on a weekly basis for atypical activity. The repository is checked for anomalies on a daily basis. Any unusual activity prompts follow-up contact by CORI staff.

Demographic and procedure data were collected in patients ≥ 18 years of age regardless of indication for the following procedure types from 2000–2008: upper endoscopy (EGD), colonoscopy (COL), endoscopic retrograde cholangiopancreatography (ERCP) and flexible sigmoidoscopy (FS).

Primary Outcome: any adverse event

The primary measure of a procedure associated adverse event was defined as the rate of any immediate adverse event that prompted an unplanned intervention. This data are extracted directly from the endoscopic report and is a required entry for endoscopists using the CORI reporting system. Figure 1 demonstrates a screenshot of what the endoscopist sees as they complete their endoscopic report. The endoscopist is required to indicate if any unplanned intervention was required or if there was any complication during or immediately after the procedure. The following are unplanned interventions used to define the outcome of any adverse event: medication administration for sedation reversal or otherwise, transfusion, surgery, aborting the procedure, administering cardiopulmonary resuscitation (CPR), use of cautery (otherwise unspecified), admission to the hospital, emergency room (ER) referral, or other. While administering IVF or supplemental O₂ is an option for an endoscopist to check as a unplanned intervention, we notably excluded these from analysis since we did not feel that the severity of intervention was tantamount to the other potential interventions. Since the report is completed at the conclusion of the procedure, the adverse event outcome is reflective of an intra-procedure event or one that is immediately recognized after the procedure and thus recorded in the report.

Sub group analysis: serious adverse events

The list of potential unplanned interventions listed above and in Figure 1 varies considerably in their clinical significance and in attempt to capture the most serious and threatening complications associated with endoscopy, we performed a subgroup analysis of the following unplanned interventions, collectively termed serious adverse events”: hospital admissions, CPR, surgery, and ER referral.

Data analysis

For descriptive analysis of procedure data, we used Cochran-Armitage test of trend to examine increasing rates of any adverse event and serious adverse events with increasing ASA class. The relation of ASA class to risk of an adverse event was quantified with odds ratios (OR) and 95% confidence intervals (CI) obtained from multivariate logistic regression. A separate model was generated for each procedure type and for any adverse event and serious adverse events. Each model was adjusted for age (categorical), gender and practice type (Community/HMO, Academic or VA/Military). All analyses were performed using SAS version 9.2 software (SAS Institute, Cary, NC).

The Clinical Outcomes Research Initiative (CORI) national database was given approval by the IRB of the Oregon Health & Science University (eIRB #7331) in October 2011. This specific study utilized a limited dataset and was therefore exempted from further IRB review.

Results

General

A total of 1,590,648 procedures were performed during the study period in which an ASA class was documented. These procedures were performed in 1,318,495 unique patients. Table 2 contains the distribution of procedures as well as overall demographics and demographics stratified by procedure type. Overall, EGD (34.2%) and colonoscopy (60.3%)

comprised the majority of procedures. While ERCP accounted for only 1.2% of all procedures, the cohort included 18,575 ERCP procedures. The most common age group overall and for colonoscopy was the 50–59 year old patients (29.6%). The <50 year olds was the most common age group amongst those who underwent EGD (29.3%), flexible sigmoidoscopy (29.6%) and ERCP (31.5%). There was a relatively even distribution of male and female patients. The majority of procedures were performed in a community setting (73.5%) except for ERCP in which there was an equal split between community and academic (37.8% each). Eighty-one percent of all procedures were completed in an outpatient setting. While the type of sedation administered for the procedure is not a required CORI selection for endoscopists, 58.2% (925,510) of all procedures reported a method of sedation. Of these, 91.2% (843,780) were administered moderate conscious sedation; 7.6% (70,217) were administered deep sedation or general anesthesia (1.2% no sedation, 0.008% other)

ASA class

The majority of patients undergoing procedures were ASA class II (62.8%). ASA class II was the most prevalent ASA class across all procedure types. ASA class I was the second most prevalent class for EGD, colonoscopy and FS; however ASA class III was the second most prevalent class for ERCP. The proportion of patients that were ASA class IV or V was exceedingly small (0.7% of all procedures).

Any adverse event

An adverse event, as previously noted, was defined as an event that prompted an unplanned intervention at the time of or shortly after the endoscopic procedure based on the endoscopic report, excluding administration of IVF or oxygen (Figure 1). Of the total 1,590,648 procedures, 5,596 (0.35%) experienced an adverse event that required an unplanned intervention. The proportion distribution of any unplanned intervention for an adverse event is presented in Table 3. Of these, the majority were medication administration (33.8%), sedation reversal (30.3%) or “other” intervention (39.5%). When “other” intervention was checked, the endoscopist often described in free text the intervention performed. The free text mainly described atropine administration, trendelenburg positioning, or ordering of imaging such as abdominal xray, esophagram or computed tomography.

Overall EGD and colonoscopy had the highest total number of adverse events (1,811 and 3,357, respectively) because they comprised the majority of procedures; however as a proportion of procedure type, as depicted in Figure 2, the highest rate of immediate adverse event was with ERCPs in which 1.84% of ERCPs resulted in a need for an immediate unplanned intervention. The trend in the increasing unadjusted prevalence of an adverse event for with higher ASA class for EGD, colonoscopy and ERCP was noted to be significant (unadjusted prevalence trend $p < 0.0001$ for EGD and colonoscopy, and $p = 0.0004$ for ERCP).

Figure 3 contains the multivariate odds ratios (adjusted for age, gender and practice type) for the risk of any adverse event with increasing ASA class within each procedure type. For EGD, there was an increase in the risk of an adverse event with increasing ASA class with an ASA IV/V class patient having $12.02 \times [95\% \text{ CI } 9.62\text{--}15.01]$ the risk of an adverse event than a class I patient (reference 1.0). For colonoscopy, a similar stepwise trend in increasing risk for adverse events with increasing ASA class was observed. For flexible sigmoidoscopy, the association between ASA class and adverse events was not significant with multiple overlapping confidence intervals among the ASA classes. In ERCP, there was a general trend towards more adverse events with increasing ASA class however the association between the two in the multivariate model was not significant.

An increasing prevalence of any adverse event was observed for increasing age groups across all procedure types (Table 4) ($p < 0.0001$ for all procedures).

Serious adverse events

The serious adverse event rate (hospital admission, surgery cardiopulmonary resuscitation or emergency room referral) was 0.03% (470). Table 3b contains the proportion distribution of these serious adverse events. The most common serious adverse event was hospital admission (51.1%) followed by emergency room referral (19.6%). As a proportion of procedure type, the serious adverse event rate was highest for ERCP (0.27%, 51), followed by EGD (0.03%, 175), colonoscopy (0.02%, 201) and flexible sigmoidoscopy (0.01%, 7). In multivariate analysis, similar to the results of the adverse event regression, the risk of a serious adverse event increased with increasing ASA class for EGD and colonoscopy (EGD: ASA I: 1.0 reference, II: 2.88 95% CI [1.43–5.80], III: 7.16 [3.47–14.79], IV/V 32.18 [14.54–71.24]; colonoscopy: ASA I: 1.0 reference, II: 0.98 [0.68–1.43], III: 1.67 [1.01–2.78], IV/V: 9.68 [4.00–23.46]). Due to the small numbers of serious adverse events for flexible sigmoidoscopy ($n=7$), the regression model was invalid. As was the case for any adverse event associated with ERCP, there was a general trend towards more serious adverse events with increasing ASA class however the association between the two in the multivariate model was not significant.

Discussion

CORI is a large endoscopic database providing data from a significant number of procedures across various practice types in the United States. This large dataset allows evaluation of relatively rare events such as peri-endoscopic adverse events. This study demonstrates that endoscopic adverse events are rare, occurring in 0.35% of all cases and even more rare are serious adverse events such as hospital admission, surgery, having to perform CPR or ER referral (0.03%). As expected, the vast majority of patients undergoing endoscopic procedures are ASA class I or II. Increasing ASA class is a predictor of adverse events and serious adverse events for EGD and colonoscopy and demonstrated a trend for ERCP. In models for all four procedure types, increasing age was also observed to be associated with increased adverse events. This is the first study to focus primarily on ASA class as a predictor of endoscopic complications and validates the use of ASA class designation in the endoscopic setting. The results presented confirm the importance of co-morbid illness as a predictor of endoscopic complications.

ASA has been found to be a risk factor in cardiopulmonary unplanned events related to endoscopy (5). This retrospective CORI database study included data on 324,737 procedures, which is 1/5 the size of the present study. Sharma et al's study focused on patients who underwent conscious sedation for EGD, colonoscopy, ERCP and endoscopic ultrasound. Independent variables in the multivariate model predicting unplanned cardiopulmonary events in endoscopy included age, gender, practice type, procedure setting (inpatient vs outpatient), ASA class, use of supplemental oxygen and trainee involvement. This model predicted that an ASA class V patient had 7.5× [95% CI 3.2–17.6] the risk of an unplanned cardiopulmonary event than a class I patient (ASA II: 1.05 [95% CI 0.95–1.16; ASA III 1.8 [95% CI 1.6–2.0], ASA IV 3.2 [95% CI 2.5–4.1]). These data mirror that of our ASA class risk findings. Vargo et al found a similar relationship in a cohort of patients who underwent propofol sedation for endoscopy which was the primary focus of their study (7). What the current study adds to the small body of literature assessing the usefulness of ASA class in endoscopy is a very large cohort of patients from diverse practice sites. The volume of procedures allows improved statistical assessment of these relationships between independent variables. Furthermore, the *a priori* outcome of the present study was specifically ASA classification's influence on peri-procedure morbidity.

As stated, we observed an increase in the risk of any adverse event and serious adverse event with increasing ASA class for EGD and colonoscopy; this however was not a linear trend (not a proportional increase in risk for each class increase). This may be a function of the higher proportion of ASA class I and II patients in the cohort, overall. Similarly, the wide confidence intervals for the odds ratio in the ASA IV/V classes most likely reflect the low number of patients with an ASA IV/V who underwent procedures. The model for serious adverse events demonstrates wide and overlapping confidence intervals which further highlights the influence of a small serious adverse event rate on the regression analysis. Nonetheless, graphically and numerically, there is a clear difference in risk of any and serious adverse events in the higher vs lower ASA classes (i.e III/IV vs I/II).

This study has several limitations. Although it collects endoscopic data from diverse practice sites in attempt to provide an accurate representation of endoscopic practice in the U.S., it is not immune to site selection bias. CORI participating sites are comfortable using computers for endoscopic reporting and sharing data from their practice. These practices may differ in important ways from those, which will not use computerized databases nor share their data to monitor quality in their practice. Despite its apparent simplicity, both ASA class and the recording of interventions remain subjective assessments and therefore allow for a certain level of discordance even among qualified specialists about what is reported. ASA classification was designed and most utilized by anesthesiologists in clinical practice. In this database, the classification of patient status was based on endoscopists' assessments. However, a previous survey study demonstrated that indeed endoscopists are relatively good at determining ASA class (4). Despite its subjective nature, its use serves as a critical communication tool among clinical colleagues. As with any endoscopic database study, the quality of the data is reliant upon accurate entry of information by the endoscopist and is therefore subject to human error. The primary outcome of adverse events contained multiple interventions that vary considerably in their clinical severity; some would be considered as a true complication (i.e. need for surgery, CPR etc) while others represent well recognized reactions to endoscopy itself or intravenous sedation (i.e sedation reversal, atropine etc). The multivariate analysis for any adverse event was unable to account for the differences in severity of these outcomes and therefore a subgroup analysis was performed on only serious adverse events to better understand this relationship. Additionally, because the type and depth of sedation administered was not routinely available in the CORI reports for all procedures, it was not included in the multivariate analysis. Finally, what is being tracked by the endoscopic report are immediate acute complications recognized and managed at the time of endoscopy and therefore this data do not reflect delayed complications that occur after the endoscopic report is complete, which may be clinically significant. Our endpoint of an immediate serious adverse event requiring an intervention is a surrogate for peri-procedure morbidity and mortality. Therefore, the data presented here within may be an underestimation of the true adverse event rate.

Notwithstanding these limitations, the study is strengthened by the large national consortium with diverse practice types from which the data are extracted, allowing for the study of practice patterns. It is a likely reflection of true endoscopic practice in the US, the majority of which occurs outside academic centers. CORI has provided the opportunity to validate the ASA classification in endoscopy and establish its importance to gastroenterologists. Most importantly, this study is amongst the first to focus primarily on the ASA class in endoscopy.

Not unlike surgery, outcome prediction and assessment of the degree of peri-procedure risk are important considerations for planning and deciding to perform an endoscopic procedure. Likewise, defining a patient's risk of morbidity can result in improvements to pre-procedure preparation, anticipation of outcomes and quality of care. However, until recently there has

been a paucity of literature regarding the usefulness of implementing the ASA class in gastroenterological procedures. However, it is routinely used in clinical practice without prior validation.

In conclusion, this study demonstrates that ASA class is associated with an increased risk of any adverse event or serious adverse event which required an unplanned intervention at endoscopy, particularly for EGD and colonoscopy. Therefore, ASA class is indeed a predictor of immediate morbidity in the endoscopic setting. It is therefore a useful risk stratification tool that should be incorporated into an endoscopist's pre procedure planning and provides the practitioner with an additional means for deciding to perform and preparing for a procedure. Such data support the use of ASA class designation as an important quality indicator in endoscopy.

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COL

Patient: Prior exams New Date: 04/10/2012 Time: 04:06 PM

A: Home **B: History** **C: PE / Labs** **D: Proc. Info.** **E: *Indications** **F: Exam Info** **G: Findings/Therapy** **H: Intervent/Events** **I: Assess/Diag** **J: Treatment Plan** **K: Scheduling**

Unplanned Interventions

☐ No Intervention Required

☐ Sed. Reversed as Intervention

☐ Oxygen ☐ Transfusion

☐ HospAdmit ☐ Sent to ER

☐ Surgery ☐ Cautery

☐ IV Fluids

☐ Procedure Stopped

☐ Code 99/CPR

☐ Other

Unplanned Events

Any complications? Y ☐ N ☐

Cardiopulmonary Events

☐ Chest Pain ☐ Arrhythmia

☐ Bradycardia ☐ Tachycardia

☐ Wheezing ☐ Hypotension

☐ Hypertension

☐ Transient Hypoxia

☐ Prolonged Hypoxia

☐ Respiratory Distress

☐ Pulmonary Edema

☐ Vasovagal Reaction

☐ Tracheal Compression

☐ Death ☐ Other

☐ O2 Saturation less than 95%

O2 Sat (%):

Gastrointestinal Events

☐ Bleeding ☐ Peritonitis

☐ Perforation ☐ Abd Pain

☐ Nausea/Vomiting

☐ Other

Other Events

☐ Rash/Hives ☐ Drug React

☐ ProlongdSed ☐ Seizure

☐ DVT ☐ Other

☐ Paradoxical Reaction

Intervention Medications

Medication	Dosage

Intervention Results

Successful? Y ☐ N ☐

☐ Hemostasis Achieved

☐ Vital Signs Stabilized

☐ O2 Desaturation Reversed

☐ Spontaneous Resolution

Notes:

Interventions and Events Expand

F1 Help F2 Schedule F3 New F4 Study F5 Exam F6 Reports F7 Exit F8 Patient F9 Staff F10 Utilities F11 Path Rpt F12 Pathways

Figure 1. CORI Endoscopic Report Screenshot

*Administration of IV fluids and oxygen were not included in analysis of any adverse event

Figure 2. Proportion of procedures with an adverse event

Figure 3.

Results of multivariate logistic regression analysis by procedure type for the outcome of serious adverse event. Each model is adjusted for age (categorical by decade), gender and site type (Community/HMO, Academic, VA/Military).

Table 1

The ASA Classification

Class	Description
ASA I	A normal healthy patient
ASA II	A patient with mild systemic disease
ASA III	A patient with severe systemic disease
ASA IV	A patient with severe systemic disease that is a constant threat to life
ASA V	A moribund patient who is not expected to survive without the operation
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes

Adapted from the American Society of Anesthesiologists website, www.asahq.org/ASA-physical-status-classification-system

Table 2

Demographics

Characteristic	All procedures	EGD	Colonoscopy	Flexible Sigmoidoscopy	ERCP
Total # of procedures n (% of total)	1,590,648	543,950 (34.2%)	958,428 (60.3%)	69,695 (4.4%)	18,575 (1.2%)
Total # of patients	1,318,495	416,431	824,604	63,971	13,489
Age group					
n (% of total # of procedure type)					
< 50	344,145 (21.6%)	159,577 (29.3%)	158,108 (16.5%)	20,608 (29.6%)	5,852 (31.5%)
50 – 59	470,942 (29.6%)	127,464 (23.4%)	319,445 (33.3%)	20,238 (29.0%)	3,795 (20.4%)
60 – 69	384,706 (24.2%)	113,455 (20.9%)	253,424 (26.4%)	14,490 (20.0%)	3,337 (18.0%)
70 – 79	282,446 (17.8%)	96,667 (17.8%)	172,328 (18.0%)	10,186 (14.6%)	3,265 (17.6%)
≥ 80	108,409 (6.8%)	46,787 (8.6%)	55,123 (5.8%)	4,173 (6.0%)	2,326 (12.5%)
Gender					
n (% of total # of procedure type)					
Female	763,091 (48.0%)	265,143 (48.7%)	463,125 (48.3%)	26,112 (37.5%)	8,711 (46.9%)
Female (excluding VA)	740,282 (46.5%)	256,680 (55.9%)	450,858 (53.8%)	24,602 (53.5%)	8,142 (58.0%)
Site Type					
n (% of total # of procedure type)					
Community/HMO	1,169,273 (73.5%)	381,811 (70.2%)	744,299 (77.7%)	36,145 (51.9%)	7,018 (37.8%)
Academic	187,007 (11.8%)	77,005 (14.2%)	93,117 (9.7%)	9,867 (14.2%)	7,018 (37.8%)
VA/Military	234,368 (14.7%)	85,134 (15.7%)	121,012 (12.6%)	23,683 (34.0%)	4,539 (24.4%)
Inpatient/Outpatient					
n (% of total # of procedure type)					
Inpatient	74,950 (4.7%)	41,688 (7.7%)	21,252 (2.2%)	4,048 (5.8%)	7,962 (42.9%)
Outpatient	1,289,170 (81.0%)	419,882 (77.2%)	805,426 (84.0%)	55,205 (79.2%)	8,657 (46.7%)
Unknown	226,528 (14.2%)	82,380 (15.1%)	131,750 (13.7%)	10,442 (15.0%)	1,956 (10.5%)
ASA Class					
n (% of total # of procedure type)					
I	427,496 (26.9%)	128,803 (23.7%)	268,969 (28.1%)	27,242 (39.1%)	2,482 (13.4%)
II	999,506 (62.8%)	331,674 (61.0%)	621,730 (64.9%)	35,856 (51.5%)	10,246 (55.2%)
III	153,888 (9.7%)	76,896 (14.1%)	65,631 (6.9%)	6,058 (8.7%)	5,303 (28.6%)

Characteristic	All procedures	EGD	Colonoscopy	Flexible Sigmoidoscopy	ERCP
IV	9,543 (0.6%)	6,417 (1.2%)	2,073 (0.2%)	520 (0.8%)	533 (2.9%)
V	215 (0.0%)	160 (0.0%)	25 (0.0%)	19 (0.0%)	11 (0.1%)

EGD: esophagogastroduodenoscopy; VA: Veterans Affairs; ASA: American Society of Anesthesiologists

Table 3

a. Any Adverse Event (n=5,596)	
Medication administered	33.8%
Sedation reversal	30.3%
Procedure aborted	16.8%
Use of cautery *	5.1%
Hospital admission	4.3%
Emergency room referral	1.6%
Blood transfusion	1.5%
Surgery	1.3%
Cardiopulmonary resuscitation	1.2%
Other	39.5%
b. Serious Adverse Event (n=470)	
Hospital admission	51.1%
Emergency room referral	19.6%
Surgery	14.9%
Cardiopulmonary resuscitation	14.5%

Percentages represent proportion of all adverse events and are not mutually exclusive

Other category included atropine administration, trendelenburg positioning, or ordering imaging

* no further specification provided by endoscopist

Percentages represent proportion of all serious adverse events

Table 4

Association between age and any adverse event

	EGD			Colonoscopy			Flex. Sig.			ERCP		
	Total	AE	n (% of total)	Total	AE	n (% of total)	Total	AE	n (% of total)	Total	AE	n (% of total)
Total N	543,950			958,428			69,695			18,575		
<i>Age</i>												
<50	159,577	338 (0.21%)		158,108	235 (0.15%)		20,608	12 (0.06%)		5,852	66 (1.13%)	
50 – 59	127,464	353 (0.28%)		319,445	795 (0.25%)		20,238	21 (0.10%)		3,795	68 (1.79%)	
60 – 69	113,455	402 (0.35%)		253,424	1,011 (0.40%)		14,490	25 (0.17%)		3,337	69 (2.07%)	
70 – 79	96,667	419 (0.43%)		172,328	962 (0.56%)		10,186	18 (0.18%)		3,265	75 (2.30%)	
80	46,787	299 (0.64%)		55,123	354 (0.64%)		4,173	10 (0.24%)		2,326	64 (2.75%)	
Test for trend		<.0001			<.0001			<.0001			<.0001	

AE: adverse event; EGD: esophagogastroduodenoscopy