

The Role of Clinical Characteristics in Stratifying Sedation Risk: A Cohort Study

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Abstract

Background: Determination of sedation type during gastrointestinal procedures is generally based on risk assessment via the American Society of Anesthesiologists (ASA) classification system, but the reliance of anesthesia risk on clinical factors remains largely uninvestigated. We aim to determine the association between various clinical factors and choice of sedation type during gastrointestinal procedures.

Methods: This single-center, retrospective cohort study used electronic medical records to identify patients receiving colonoscopy or endoscopy at Rhode Island Hospital. The electronic medical record was queried for history of alcohol abuse, opioid abuse, polysubstance abuse, prescriptions for psychotropic or opioid medications and ASA classification. Logistic regression was used to measure how patient characteristics correlated with sedation type.

Results: Totally, 2,033 patients were included in the study; 1,080 patients received moderate sedation and 853 received monitored anesthesia care (MAC). Three hundred fifty-four (60.2%) MAC patients had a history of alcohol abuse compared to 234 (39.8%) moderate sedation patients ($P < 0.2334$); 178 (62.9%) MAC and 105 (37.1%) moderate sedation patients had a history of opioid abuse ($P < 0.001$); 203 (73.6%) MAC and 73 (26.4%) moderate sedation patients had a history of polysubstance abuse ($P < 0.001$); and 815 (75.1%) MAC patients had psychiatric comorbidities versus 270 (24.9%) in the moderate sedation group ($P < 0.001$). In the MAC cohort, alcohol, opioid, polysubstance abuse and psychiatric history were associated with previous failure of moderate sedation ($P < 0.0001$).

Conclusions: For a subset of patients, clinical factors including alco-

hol, opioid, polysubstance abuse and psychiatric history, in addition to ASA classification, play an important role in sedation management.

Keywords: Sedation type; Gastrointestinal procedures; ASA classification; Clinical factors; Sedation management

Introduction

Anesthesiologist administered sedation comprises a growing proportion of procedural sedation for endoscopic procedures in the USA. It is estimated, for example, that over half of colonoscopies currently are performed with monitored anesthesia care (MAC). The cost of anesthesia-delivered propofol sedation is a separate charge from the endoscopy procedure and can range from \$150 to \$1,500 per case [1]. In 2016, the USA spent 17.8% of its gross domestic product (GDP) on health care, approximately twice as much as other high-income countries, yet health care utilization rates in the USA were largely similar to those in other nations [2].

Evaluation of the appropriate use of and need for anesthesiologist services during endoscopy is often based on risk assessment. Studies frequently utilize the American Society of Anesthesiologists (ASA) classification of physical status to determine patient risk. Patients are generally not felt to require MAC support unless they are ASA class III or greater. This however may be an oversimplified way to examine the utility of and need for MAC. Despite its widespread use, the ASA classification system has been shown to result in inconsistent assignments even among anesthesiologists [3]. Several factors may determine whether the assistance of anesthesia providers is needed including patient risk factors for sedation, the depth of sedation, and the urgency and type of endoscopic procedure performed. In this study, we examine how additional patient specific variables including alcohol abuse, substance abuse and psychiatric history may impact the choice of moderate sedation (MS) versus anesthesia-assisted sedation and the response to the chosen form of sedation, relative to the ASA class. Clinical characteristics may be more relevant than ASA status in determining whether patients should receive MS versus modified anesthesia care for gastroenterology procedures.

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Materials and Methods

Study design

This single-center, retrospective cohort study included all patients who underwent colonoscopy or upper endoscopy at Rhode Island Hospital between January and December 2015. Patients undergoing endoscopic ultrasound or endoscopic retrograde cholangiopancreatography were excluded. Endoscopists included attending gastroenterologists at Rhode Island Hospital, who might also have been assisted by fellows. The study was approved by the Institutional Review Board at Rhode Island Hospital; and was conducted in compliance with the ethical standards of the responsible institution on human subjects as well as with the Helsinki Declaration. Suitable patients were identified using International Classification of Diseases, Ninth Revision (ICD-9) coding from a search of the ProVation MD Endoscopy Computer System (ProVation Medical, Inc., Minneapolis, MN) and specific clinical and demographic variables were retrieved from the electronic health record EPIC (Epic Systems Corporation, Verona, WI).

Cohort selection

Patients with MS-assisted gastrointestinal procedures and anesthesia-assisted deep sedation procedures were identified from ProVation using ICD-9 coding. Patients who did not have ASA classification documented were excluded. In the MS cohort, the endoscopist provided sedation using midazolam and fentanyl. For the MAC cohort, an anesthesiologist provided sedation. MS failure was defined as procedures using MS that were aborted due to inadequate sedation.

Clinical characteristics and covariates

We evaluated history of alcohol and substance abuse, opioid use, psychiatric diagnoses and ASA status. ASA status was determined by the endoscopist at the time of the procedure. History of alcohol and substance abuse, opioid use and psychiatric diagnoses were obtained from EPIC and active at the time of the procedure. Additional covariates that were retrieved were age, gender, concurrent medications at the time of the procedure, number of prior endoscopic procedures and sedation choice, as well as whether the patients had a history of failed endoscopies due to sedation issues.

Measured outcomes

The primary outcome measured was incidence of MS failure. Secondary outcomes included identifying clinical characteristics that may have contributed to MS failure related to history of alcohol or substance abuse, opioid use and psychiatric diagnoses. We evaluated these characteristics for all three cohorts including MAC, MS and MS failure.

Data synthesis and statistical analysis

Chi-square tests of independence were used to determine associations between sedation type and patient characteristics, including gender, age, and ASA status. P values reported show the significance of the associations. Multivariate logistic regression was run to determine the contribution of each clinical characteristic on the choice of sedation. Student's *t*-tests were used to determine differences in the frequencies of alcohol, opioid, and polysubstance abuse, as well as psychiatric diagnosis between the two cohorts. Further analyses of abuse rates and psychiatric diagnosis were performed via Student's *t*-tests on subcategories of ASA II class patients, and ASA II class patients who failed MS. P values reported show the significance of the differences.

Results

A total of 2,033 patients underwent upper endoscopy or colonoscopy at Rhode Island Hospital between January and December 2015. There were 1,064 male patients and 969 female patients. For these procedures, 1,180 patients received MS and 853 received MAC. The breakdown of demographics as well as ASA classifications of all the patients included in the study is shown in Table 1.

There was no difference in alcohol abuse in MAC compared to MS patients (23.4% and 27.1% respectively, $P < 0.2334$) though the MAC cohort had significantly higher rates of opioid and polysubstance abuse. Substance abuse rates for all study groups as well as a breakdown for ASA II patients can be found in Table 1.

Seventy-seven percent of patients who received MS and 23% of MAC patients were ASA I ($P < 0.0001$). In ASA II, III and IV, more patients received MAC (Table 1). MAC patients were significantly more likely to be taking psychotropic and opioid medications as well as have polysubstance use disorder.

On multivariate regression (Table 2), age, sex, alcohol abuse, polysubstance abuse, and psychiatric diagnosis were found to significantly affect the choice of sedation. Psychiatric diagnosis had the largest contribution, with alcohol and polysubstance abuse contributing the same proportion, all preferring MAC over conscious sedation.

For ASA II, there was a higher proportion of MAC utilization but also a significant difference in rate of opioid abuse, polysubstance abuse and psychiatric diagnosis (Table 3). In the MAC cohort, alcohol, opioid, polysubstance abuse and psychiatric diagnoses were associated with previous failure of MS. For ASA II patients who received MAC, all clinical factors, including alcohol abuse, opioid abuse, polysubstance abuse and psychiatric history were significantly associated with failure of MS (Table 4).

Discussion

As the frequency and utilization of endoscopic procedures continue to rise, the appropriate allocation of endoscopic and

Table 1. Demographics and ASA Classification for All Patients

| | MAC, n (%) N = 1,180 | Sedation, n (%) N = 853 | P value (Bonferroni corrected) |
|-----------------------|-------------------------|----------------------------|--------------------------------|
| Gender | | | |
| Male | 674 (66.2) | 390 (33.8) | P < 0.001 |
| Female | 506 (52.2) | 463 (47.8) | |
| Age | | | |
| Age < 18 | 47 (88.7) | 6 (11.3) | P < 0.001 |
| Age 18 - 40 | 145 (60.4) | 77 (39.6) | |
| Age 41 - 60 | 459 (58.8) | 321 (41.2) | |
| Age 60+ | 529 (54.1) | 449 (45.9) | |
| ASA | | | |
| ASA I | 198 (77.0) | 69 (23.0) | P < 0.001 |
| ASA II | 525 (38.9) | 824 (61.1) | |
| ASA III | 128 (33.6) | 253 (66.4) | |
| ASA IV | 2 (5.6) | 34 (94.4) | |
| Alcohol abuse | 354 (60.2) | 234 (39.8) | 0.10 |
| Opioid abuse | 178 (62.9) | 105 (37.1) | 0.04 |
| PolySUD | 203 (73.6) | 73 (26.4) | P < 0.001 |
| Psychiatric diagnosis | 815 (75.1) | 270 (24.9) | P < 0.001 |

MAC: monitored anesthesia care; ASA: American Society of Anesthesiologists; PolySUD: polysubstance use disorder.

anesthesia resources is important, especially since endoscopic outcomes have not shown to be superior with MAC [4]. Various classification systems have been developed to accurately predict sedation failure during an endoscopic procedure. In 2014, Braunstein et al developed the Stratifying Clinical Outcomes Prior to Endoscopy (SCOPE) score, which considers a host of patient characteristics like alcohol and benzodiazepine use in determining whether they will fail endoscopist-controlled sedation [5]. Similarly, in 2020, the high conscious sedation requirements (HCSR) risk score was developed by McCain et al, which predicts sedation failure by such clinical characteristics [6]. However, neither of these scores directly considers the option of more powerful and costly anesthesia care. ASA classification has historically been used to deter-

Table 2. Multivariate Regression of Anesthetic Choice as a Function of the Identified Clinical Characteristics

| | Odds ratio (95% CI) | P values |
|-----------------------|-----------------------|-----------|
| Age | 0.984 (0.978 - 0.990) | P < 0.001 |
| Sex | 0.644 (0.524 - 0.790) | P < 0.001 |
| Alcohol abuse | 1.29 (1.02 - 1.65) | 0.04 |
| Opioid abuse | 0.778 (0.568 - 1.06) | 0.12 |
| PolySUD | 1.54 (1.11 - 2.13) | 0.01 |
| Psychiatric diagnosis | 4.66 (3.67 - 5.90) | P < 0.001 |
| ASA status | 1.03 (0.821 - 1.28) | 0.82 |

CI: confidence interval; PolySUD: polysubstance use disorder; ASA: American Society of Anesthesiologists.

mine the need for anesthesia-assisted sedation for endoscopic procedures [7]. However, this classification system, which is based upon medical comorbidities does not account for other patient characteristics that can contribute to MS failure, including polysubstance abuse, history of opioid use and psychiatric medications. Specifically, for the ASA II classification, the presence of these other characteristics may justify the use of anesthesia services given the difficulty in adequately sedating these patients.

A recent review article by Adams et al aimed to investigate factors associated with the increasing utilization of MAC for endoscopic procedures [8]. They found female gender and procedural indication to be the most significant factors associated with MAC utilization, and to a lesser extent, when the endoscopist was a surgeon and when the procedure was performed in a non-hospital setting. The authors did note in their review that substance abuse, opioid history and benzodiazepine history have been poorly studied in relation to MAC utilization.

In 2015, Patel et al evaluated whether excessive alcohol use, chronic opioid or benzodiazepine use or polysubstance use were correlated with higher amounts of fentanyl and midazolam used for MS for colonoscopies [9]. They found overall similar amounts of fentanyl and midazolam were used to sedate patients in the control arm as well as those with history of excessive alcohol use; however, patients in the opioid group required significantly more fentanyl and midazolam to achieve adequate sedation.

In 2012, Bal et al prospectively studied whether sex, alcohol abuse, physical and sexual abuse, and anxiety predicted

Table 3. Substance Abuse Rates and Psychiatric Comorbidity for ASA II Patients

| | Conscious sedation, n (%) N = 525 | MAC, n (%) N = 824 | P value (Bonferroni corrected) |
|-----------------------|--------------------------------------|-----------------------|--------------------------------|
| Alcohol abuse | 104 (19.8) | 172 (20.9) | 0.05 |
| Opioid abuse | 25 (4.8) | 92 (11.2) | P < 0.001 |
| PolySUD | 19 (3.6) | 100 (12.1) | P < 0.001 |
| Psychiatric diagnosis | 140 (26.7) | 528 (64.1) | P < 0.001 |

ASA: American Society of Anesthesiologists; MAC: monitored anesthesia care; PolySUD: polysubstance use disorder.

difficulty with sedation, as measured by the Richmond agitation sedation scale [10]. They found that of these factors, only pre-procedural anxiety predicted difficulty with sedation, and alcohol abuse and physical/sexual abuse were insignificantly associated with sedation difficulty. In a similar 2005 study, Pena et al studied prior endoscopic procedures, history of drug and alcohol use, and nervousness before procedure to predict adverse endoscopic experiences [11]; similar to Bal et al [10], they found nervousness and psychotropic drug use to be significantly associated with adverse events. Other interesting patient factors that have been considered include marijuana use, which was found to be associated with higher sedation demands by Twardowski et al in 2019 [12].

Recently, Lee et al analyzed nurse-administered propofol sedation in gastrointestinal procedures for difficult-to-sedate patients, or those with history of alcohol or opioid abuse, marijuana use, and post traumatic stress disorder (PTSD) [13]. They found marijuana users required higher sedation for both upper endoscopies and colonoscopies, patients with PTSD required higher fentanyl for colonoscopies, and those with history of alcohol abuse needed higher dosages of fentanyl on upper endoscopies.

Studies have shown that MAC utilization has substantially increased since 2000 and continues to rise. Gastroenterology societal guidelines recommend consideration for MAC in patients with ASA classification III - IV, anticipated intolerance to MS, and potential for airway compromise. While this leaves room for provider-dependent decision making, little has been studied in regard to the effects of substance abuse and psychiatric medications on MS failure specifically in ASA II patients who would otherwise be classified as lower sedation risk. Furthermore, a review of current literature suggests that over two-thirds of MAC utilization is in patients deemed to be low-risk [7]. These studies do not account for the clinical characteristics

we evaluated here and potentially misidentify these patients as those who would do well with MS.

Adams et al recently looked at predictors of MAC utilization for outpatient gastrointestinal endoscopic procedures using the Veterans Health Administration database, which has seen a similar increase in MAC sedation as in non-Veterans Affairs (VA) studies reported above [4]. The VA system is a non-fee-for-service institution and financial incentives are not a major contributor to provider-dependent medical decision-making. The study population included all patients undergoing outpatient esophagogastroduodenoscopy (EGD) or colonoscopy in the Veterans Healthcare Administration between 2000 and 2013. They found an overall increase in MAC utilization of about 17% per year, with the most rapid increases after 2011. MAC utilization was associated with certain patient characteristics including obesity, obstructive sleep apnea, higher comorbidities, and use of prescription opioids or benzodiazepines. However, the magnitude of these effects was small.

In our study, we sought to examine how opioid and polysubstance abuse as well as psychiatric history affected choice of sedation and failure of MS, specifically among the ASA II classification of patients who would otherwise be considered low-risk. Few prior studies have examined the prevalence of alcohol use, opioid or benzodiazepine use and polysubstance abuse among MAC-assisted endoscopic procedures. Our study is the first to analyze patients by ASA classification and evaluate failure of MS as it relates to these patient characteristics. We found that alcohol abuse, opioid use, polysubstance abuse and psychiatric diagnoses were all associated with previous failure of MS. These characteristics have not been well studied previously and our findings indicate that ASA classification alone does not adequately determine appropriateness of type of endoscopic sedation.

Our study had several limitations including short study

Table 4. Subset Analysis of ASA II Patients Who Received MAC Only Versus Those Who Received MAC After Previously Failing Moderate Sedation (MS)

| | MAC, post-MS failure, n (%) N = 649 | MAC only, n (%) N = 175 | P value (Bonferroni corrected) |
|-----------------------|--|----------------------------|--------------------------------|
| Alcohol abuse | 178 (27.4) | 24 (13.7) | P < 0.001 |
| Opioid abuse | 75 (11.6) | 17 (9.7) | 0.004 |
| PolySUD | 72 (11.1) | 28 (16.0) | P < 0.001 |
| Psychiatric diagnosis | 423 (65.2) | 105 (60.0) | P < 0.001 |

ASA: American Society of Anesthesiologists; MAC: monitored anesthesia care; PolySUD: polysubstance use disorder.

period, single-site analysis, and the fact that not all patients in our cohort had their ASA classification documented. The reasons why MS may have failed were not specified but likely include anxiety, pain tolerance, or medical comorbidities. Furthermore, due to the retrospective design we were reliant on information documented in the electronic medical record for alcohol abuse, psychiatric diagnoses, current medications and other patient characteristics that may not fully reflect the status of each patient at the time they were undergoing their procedures. Additionally, we used ASA status as a marker of overall health and did not assess patient cardiopulmonary status, which can be a major determinant in anesthesia utilization. Future studies should evaluate how these characteristics can help better define the role of MAC in endoscopic sedation in order to decrease MS failure rates and improve patient care. This could potentially lead to the development of a predictive model for choice of sedation using more specific criteria.

Conclusions

ASA II patients who received MAC had significantly higher rates of psychiatric diagnosis, opioid and polysubstance abuse compared with those who received MS; these factors correlated with previous failure of MS. While ASA classification screens for anesthesia risk, ASA II status does not adequately account for clinical factors which might predict the failure of MS for routine endoscopic procedures and should be considered separately in determining sedation type.

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None to declare.

Financial Disclosure

None to declare.

Conflict of Interest

The authors declare that they have no conflict of interest.

Informed Consent

For this type of study formal consent is not required, and this study was approved by the Rhode Island Hospital Institutional Review Board.

Author Contributions

Elliott Rebello: data analysis and manuscript preparation. Dionne Rebello: data acquisition and manuscript revision. Sehrish Jamot: data acquisition and analysis. Fabian Vargas:

data acquisition. Jason Machan: data acquisition. Harlan Rich: manuscript revision.

Data Availability

Any inquiries regarding supporting data availability of this study should be directed to the corresponding author.

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