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Analysis of the American Society of Anesthesiologists Physical Status Scale Reliability in Anaesthesia Practice: An Observational Study

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Abstract

Objective: Anaesthesiologists use the American Society of Anesthesiologists physical status (ASA PS) classification to assess patients' overall health. The primary objective of this study was to predict the prognostic value regarding peri-operative variables until discharge from hospital and post-operative outcomes. The secondary objective was to evaluate the inter-rater agreement of the ASA scores assigned at the outpatient department (OPD) vs. operating theatres (OT).

Methods: A total of 227 adults scheduled for elective surgery were assigned the ASA grade in preoperative OPD and on the day of surgery. The type of anaesthesia and surgery were noted. The operating time, post-operative ventilation, intensive care unit (ICU) stay, post-operative stay, bronchopulmonary complications, cardiac complications, renal dysfunction and any mortality until discharge from hospital were noted. Descriptive statistics were used to report the primary objective. For the secondary objective, Pearson's correlation test was used for inter-rater reliability.

Results: The ASA grading done at OPD and at OT was the same. It was found that the higher the ASA grade of a patient, the longer was the ICU stay. Patients with higher ASA PS scores were at a comparatively milder risk of developing remaining peri-operative and post-operative complications.

Conclusion: The correlation was the highest with the ICU stay. The inter-rater ASA grades assignment at the clinics and the OT were found to be almost perfect.

Keywords: ASA physical status assessment, classification, peri-operative physical status

Introduction

Anaesthesiologists generally categorise patients based on their overall health and severity of their disease using the conventional American Society of Anesthesiologists physical status (ASA PS) classification (1). However, it does not include age, the complexity of surgery and systemic disease leading to surgery or incidental surgery.

The current study was designed to ascertain the inter-rater reliability in assigning ASA PS scores and its correlation with morbidity and mortality.

Methods

After an institutional ethics committee approval (EC/179/2014 dated 12 January 2015) and informed consent, this prospective observational study included 227 patients. Patients aged 18-65 years scheduled for elective surgery 90 days from the first assessment were included. Patients who refused to give their consent, belonged to the ASA V and VI, and underwent emergency surgery were excluded from the study. The primary outcome was the ASA classifica-

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tion prognostic value with respect to peri-operative variables (e.g., duration of surgery, blood loss and duration of intensive care unit stay, post-operative complications and mortality until discharge from hospital and post-operative outcomes). The secondary outcome was to evaluate the inter-rater agreement in assigning ASA PS scores at the outpatient department (OPD) and operating theatres (OT) and identify sources of variability and its correlation with morbidity and mortality in a tertiary care centre. At the preoperative OPD, the first anaesthesiologist with at least 3 years of experience, documented the patient information, clinical details of patients and assigned the ASA grade. Within 90 days from the first ASA assessment, the patient was assigned a date of his or her elective surgery. On the day of the surgery, a second anaesthesiologist independently evaluated the patient and assigned an ASA grade. Peri-operative variables assessed were the type of anaesthesia, the type of surgery performed, operative time, intra-operative blood loss, post-operative ventilator support, ICU stay, post-operative stay and bronchopulmonary complications. The type of surgery performed was labelled as the minor, moderate or major.

a. Minor (soft tissue wound repair, perineal surgery),
b. Moderate (colostomy, hernia repair and cholecystectomy),
c. Major (bowel surgery, abdominal thoracic surgery, peripheral vascular intervention).

Any new onset myocardial ischaemia or infarction, urinary tract infection, anastomotic leak, wound site infection, mortality, morbidity due to concerned illness until discharge from hospital were also noted. The ASA score was then correlated with morbidity and mortality.

Statistical analysis

Baseline study participant characteristics were analysed using descriptive statistics. Parametric analysis was done using the analysis of variance (ANOVA), while the non-parametric correlation analysis was done using the Spearman correlation test. Categorical data were analysed using the chi-squared test. Each parameter was stratified into various categories, and the correlation among them was determined by calculating the p-value. A p-value <0.05 was considered to be statistically significant.

Results

A total of 227 patients were enrolled into this study. The distribution of patients according to the ASA grade in both the age groups was as follows: the ASA Grade I was noted in 126 (55.5%) of which 20 (15.87%) were from the older age group, and 106 (84.13%) were from the younger age group; the ASA Grade II was noted in 71 (31.27%), of which 34 (47.89%) were from the older age group, and 37 (52.11%) were from the younger age group; the ASA Grade III was noted in 25 (11.01%), of which 14 (56%) were from the older age group, and 11 (44%) were from the younger age group; the ASA Grade IV was noted in 5 (2.2%), of which 2 (40%) were from the older age group, and 3 (60%) from the younger age group. Among males, 82 (61.65%) were the ASA Grade I, 37 (27.82%) ASA Grade II, 13 (9.77%) ASA Grade III, and 1 (0.75%) ASA Grade IV; among females, 44 (46.81%) were the ASA Grade I, 34 (36.17%) ASA Grade II, 12 (12.77%) ASA Grade III, and 4 (4.25%) ASA Grade IV. Duration of the operation according to the patients' ASA grades was as follows: among patients with the ASA Grade I, 66 (52.4%) had a longer duration of operation, and 60 (47.6%) had a shorter duration of operation; among patients with the ASA Grade II, 43 (60.6%) had a longer duration of operation, and 28 (39.4%) had a shorter duration of operation; among patients with the ASA Grade III, 20 (80%) had a longer duration of operation, and 5 (20%) had a shorter duration of operation; and among patients with the ASA Grade IV, all 5 (100%) had a longer duration of operation. In our study, the mean blood loss in patients with the ASA I was 106.31±69.40 mL; in ASA II 209.86±358.83 mL; in ASA III 379.60±417.70 mL and in ASA IV 1180±538.14 mL.

Only 1 (0.44%) patient each needed longer (>24 hour) and shorter (<24 hour) ventilator support post-operatively, and they belonged to the ASA Grade IV. This finding was statistically significant.

The ability of ASA to predict post-operative bronchopulmonary infection was determined by the proportion of patients in each grade developing the complication. In the present study, only 1 (0.44%) patient had bronchopulmonary infection and belonged to ASA IV.

No participants developed cardiac complications such as new onset myocardial ischaemia, congestive heart failure, conduction abnormality or pericardial effusion.

Wound infection in post-operative period was documented to assess the predictability of the ASA score in patients having a high or low susceptibility to infection. Among the patients with the ASA Grade I, 125 out of 126 (99.21%) did not show wound infection; among patients with the ASA Grade II, 68 out of 71 (95.77%) did not show wound infection; among patients with the ASA Grade III, 16 out of 25 (64%) did not show wound infection; and among patients with the ASA Grade IV, 3 out of 5 (60%) did not show wound infection. Anastomotic leak was noted in only 5 (2.2%) patients. One patient with the ASA Grade I, 3 among patients with the ASA Grade III, and 1 among patients with the ASA Grade IV, had anastomotic leak. Among patients with the ASA Grade I, 124 out of 126 (98.41%) did not have urinary tract infection;

among patients with the ASA Grade II, 69 of 71 (97.18%) did not have urinary tract infection; among patients with the ASA Grade III, 14 of 25 (56%) did not have urinary tract infection; and among patients with the ASA Grade IV, 1 out of 5 (20%) did not have urinary tract infection. There was no mortality in the study.

Using Spearman's correlation coefficient, a positive intermediate correlation of ASA with post-operative ICU stay was found, and a positive weak correlation between ASA with age, gender, operation duration, bronchopulmonary infection, wound infection, anastomotic leak and urinary tract infection was found. These findings are presented in Table 1. As evident from Table 2, ASA was found to have a highest correlation with the ICU stay, that is, the higher the ASA grade of a patient, the longer the ICU stay. For the remaining variables, the correlation was positive, but weaker; that is, patients with a higher ASA grade were at risk of developing complications, but the risk was comparatively mild.

The proportion of patients with ASA grades as recorded in the preoperative anaesthesia clinic and OT were the same, each being 126 (55.5%) with the ASA Grade I, 71 (31.27%) with the ASA Grade II, 25 (11.01%) with the ASA Grade III and 5 (2.2%) with the ASA Grade IV.

Table 1. Correlation of ASA with various parameters

Variable	Spearman's correlation
Age	0.163
Gender	0.062
Duration of surgery	0.144
Post-operative intensive care unit	0.452
Bronchopulmonary infection	0.091
Wound infection	0.181
Anastomotic leak	0.106
Urinary tract infection	0.225

Calculated using Spearman's correlation coefficient

When r is >0.75: Good correlation; 0.25-0.75: Intermediate correlation; <0.25: Weak correlation

Using the chi-squared test, no statistically significant difference was found in the proportion of patients according to the ASA grades as recorded in the clinic and OT. Since the inter-class coefficient was found to be 1, the ASA grading done at the clinic as well as the OT was the same. An almost perfect inter-rater agreement of the ASA grades assigned at the clinics and the OT was found in our study.

The ASA grading done at OPD and at OT was the same. The higher the ASA grade of a patient, the longer was the ICU stay. Patients with higher ASAPS scores were at a comparatively mild risk of developing remaining peri-operative and post-operative complications. There was no mortality or cardiac complications recorded.

Discussion

The ASA grading has important implications in predicting the peri-operative risk, allocating services and reimbursing anaesthesia services, in addition to being used for statistical data collection and reporting in anaesthesia. The inter-rater reliability for assessing the ASA physical status is critical, and there has been limited evaluation of its reliability in clinical practice. This study aimed at ascertaining the inter-rater reliability in assigning the ASA PS scores, identifying sources of variability and its correlation with morbidity and mortality.

A longer duration of surgery, ICU stay, post-operative ventilator support, more intra-operative blood loss, wound infections, anastomotic leak and urinary tract infection were seen in patients with higher ASA grades. A positive intermediate correlation of ASA with ICU stay and a positive weak correlation between ASA with age, gender, and duration of surgery, bronchopulmonary infection, wound infection, anastomotic leak and urinary tract infection were found in the present study. There was an almost perfect inter-rater agreement of ASA grades assigned at OPD versus OT with the highest correlation with the ICU stay.

Table 2. Post-operative ICU stay

ICU stay	Number percentage	ASA grade I	ASA grade II	ASA grade III	ASA grade IV	Total
Longer (>48 hours)	N	0	0	4	4	8
	%	0.0	0.0	16.0	80.0	3.5
Shorter (≤48 hours)	N	2	8	17	0	27
	%	1.6	11.3	68.0	0	11.9
No ICU stay	N	124	63	4	1	192
	%	98.4	88.7	16.0	20.0	84.6

P-value=0.0023. Calculated using the chi-squared test.

In a study among surgical patients, Wolters et al. (2) reported that 18% were the ASA Grade I, 42.6% ASA Grade II, 34.6% ASA Grade III, and 4.6% ASA Grade IV. Sankar et al. (3) conducted a study on patients undergoing elective surgery and found 5.5% population to be the ASA Grade I, 42% ASA Grade II, 46.7% ASA Grade III, and 5.8% ASA Grade IV.

A cohort study by Pearse et al. (4) among patients undergoing noncardiac surgery found that 25% were the ASA Grade I, 46.4% ASA Grade II, 24.9% ASA Grade III, and 3.3% ASA Grade IV. The difference in distribution of the ASA grades in our study population may be due to the fact that our study included only elective procedures, whereas other studies also included emergency procedures. Our study included 59% participants whose surgery duration was longer (>1 hour). Wolters et al. (2) reported the mean surgery duration to be >1 hour among all the patients. This difference again may be attributable to the selection of only elective surgical patient population in our study.

In addition, in our study, it was shown that a significantly higher volume of blood loss was seen with increasing ASA grades. Wong et al. (5) and Chang et al. (6) reported no significant relation with the ASA classification in their study findings.

A statistically significant difference was found in the duration of ICU stay corresponding to the higher ASA grading in our study. The results by Wolters et al. (2) and Abelha et al. (7) are in agreement with the present study findings.

Wolters et al. (2) reported the duration of post-operative ventilation to be <24 hours in patients with ASA Grades I-III and >24-hour stay in patients with the ASA Grade IV.

In our study, 0.4% of the total patients had bronchopulmonary infection, all of whom belonged to ASA IV. Wolters et al. (2) reported bronchopulmonary infection in 0.5% of those with the ASA Grade I, 2.2% of those with the ASA Grade II, 5.2% of those with the ASA Grade III, and 12.1% of those with the ASA Grade IV, with a significantly higher rate of bronchopulmonary infection in those with higher ASA grades.

In the present study, no cardiac complications were observed. Wolters et al. (2) reported a significantly higher rate of cardiac complications in those with higher ASA grades. This again may be attributed to the selection of an elective patient population for our study.

In the present study, wound infection was observed in 6.6% patients. The incidence of wound infection increased with ASA grades, the difference being statistically significant. Wolters et al. (2) reported a significantly higher rate of wound infection in patients with higher ASA grades. A study by Taylor et al. (8) on the occurrence of wound infection among surgical patients reported the rate as 5.7% in patients with the ASA Grade I, 4.1% with the ASA Grade II, and 3.8% with ASA Grades III or IV. Kastanis et al. (9) in a study that included geriatric population with hip fractures reported wound infection in 6.6% of patients with the ASA Grade II, 4.4% with the ASA Grade III, and 6.5% with the ASA Grade IV.

Our study found a significantly higher rate of wound infection in patients with ASA Grades III and IV; however in patients with ASA Grades I and II, the rates were comparable to the ones reported in the above studies.

In our study, the anastomotic leak was recorded in 2.2% participants. A significant difference was found in the proportion of patients with and without the anastomotic leak. Wolters et al. (2) reported anastomotic leak in 0.6% of those with the ASA Grade I, 1.3% of those with the ASA Grade II, 1.5% of those with the ASA Grade III, and 1.6% of those with the ASA Grade IV. Bakker et al. (10) conducted a study among patients undergoing colonic surgery and reported anastomotic leak in 7.1% with ASA Grade I/II and 9.2% with ASA Grade III/IV, with a higher ASA grade being associated with an increased risk of anastomotic leak. The present study found similar rates of anastomotic leak in patients with ASA Grades I and II, but higher rates in patients with ASA Grades III and IV, compared to the ones reported in the above studies.

In the present study, 91.6% of patients did not show any urinary tract infection. A significant difference was found in the proportion of patients with and without urinary tract infection. Wolters et al. (2) reported urinary tract infection in 2.1% of those with the ASA Grade I, 4.6% of those with the ASA Grade II, 6.1% of those with the ASA Grade III, and 5% of those with the ASA Grade IV. Kastanis et al. (9) reported urinary tract infection in 5.3% of patients with the ASA Grade II, 3.3% with the ASA Grade III, and 16.1% with the ASA Grade IV. Compared to the above studies, the present study found comparable rates of urinary tract infection in patients with ASA Grades I and II, but higher rates in patients with ASA Grades III and IV.

In our study, no mortality was found in the study population during the entire post-operative stay in the hospital. Wolters et al. (2) reported the mortality rate of 0.1% in ASA I, 0.7% in ASA II, 3.5% in ASA III, and 18.5% in ASA IV after any surgical procedure in the hospital.

Using the Spearman's correlation coefficient, a positive intermediate correlation of ASA with post-operative ICU stay was found; and a positive weak correlation between ASA with age, gender, and duration of surgery, incidence of bronchopulmonary infection, wound infection, anastomotic leak and urinary tract infection was found. Also, the mean blood loss was higher with increasing ASA grades and found to be statistically significant using the one-way ANOVA test.

Abelha et al. (7) in their study found that the ASA Grades III and IV were significantly associated with a longer ICU stay. Sankar et al. (3) found that ASA grades in the OT correlated more with age. While the present study did find a correlation between higher ASA grades and longer ICU stay, no correlation of ASA with age was found.

Our study found that the ASA grade showed an almost perfect inter-rater agreement of the ASA grades assigned at the preoperative anaesthesia clinics versus OT. A review of studies conducted by Parenti et al. (11) found that the ASA grade had a moderate inter-rater reliability, although some studies analysed by them did report a good reliability. Jacqueline et al. (12) conducted a questionnaire study among paediatric anaesthesiologists and found the inter-rater agreement to be moderate, which improved when the ASA grades were grouped into I/II and III/IV. Cuvillon et al. (13) also reported a moderate inter-rater reliability of ASA grading in patients undergoing elective surgery.

Ihejirika et al. (14) in a study on inter-reliability of ASA grades in orthopaedic trauma patients found that the inter-reliability was moderate but that it was significantly higher in anaesthesiologists who reported that they were comfortable with the ASA grade as against those who were not. Sankar et al. (3) reported a moderate inter-reliability in the ASA grades recorded in the clinic and then in OT.

One of the limitations of our study was that only patients undergoing elective surgery were taken into consideration. Besides, data were not collected in all specialties of surgery, and a high number of younger patients were a part of the study.

To sum up, this study evaluated the inter-rater reliability of the ASA PS scale in clinical practice. Both the raters participated in the clinical engagement for the ASA PS and had a degree of inter-rater agreement for a subjective rating scale, despite inherent subjectivity. Even when assessed well before surgery in an outpatient clinic, the correlation with the ICU stay length was high. The OT anaesthesiologist knew the ASA physical status assigned in the OPD clinic. However, it permitted both to independently assign ASA PS.

The inter-rater reliability of the ASA PS scale in clinical practice was evaluated and established. The correlation with the length of stay in ICU was high. The OT anaesthesiologist knew the ASA PS score assigned in OPD but could independently assign ASA PS. Both the raters independently gave the ASA PS score for a subjective rating scale. A limitation to the study was that data were only from one institute for elective surgery.

Conclusion

The present study also found the largest proportion of patients with the ASA Grade I, and the proportion declined as the grades increased. A longer duration of the procedure, greater intra-operative blood loss, and a longer ICU stay and post-operative ventilator support were more common in patients with higher ASA grades. Wound infections, anastomotic leak and urinary tract infection were also more common in patients with higher ASA grades. A positive intermediate correlation of ASA with ICU stay and a positive weak correlation between ASA and age, gender, and duration of surgery, bronchopulmonary infection, wound infection and anastomotic leak and urinary tract infection were found in the present study. There were no post-operative cardiac complications and no mortality in the study group patients. The study found an almost perfect inter-rater agreement of the ASA grades assigned at the clinics vs. OTs. In a large single-institution cohort study, the ASA PS scale had a moderate inter-rater reliability in clinical practice. The scale also showed validity, based on its correlation with preoperative characteristics and its prediction of post-operative outcomes. Despite the inherent subjectivity of the ASA PS scale, our findings support its use as a measure of the preoperative health status. There was an almost perfect inter-rater agreement of ASA grades assigned at OPD versus OT. There was the highest correlation with ICU stay.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Seth G S Medical College & KEM Hospital (EC/179/2014 dated 12 January 2015).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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Author Contributions: Concept – P.S., S.D.; Design – P.S., S.D.; Supervision – P.S.; Resources – P.S., S.D.; Materials – P.S., S.D.; Data Collection and/or Processing – P.S., S.D.; Analysis and/or Interpretation – P.S., S.D.; Literature Search – P.S., A.S., S.D.; Writing Manuscript – P.S., A.S., S.D.; Critical Review – P.S., A.S., S.D.; Other – P.S., A.S., S.D.

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