Interrater Variability among Anaesthesiologists Using American Society of Anesthesiologists Physical Status Classification System

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ABSTRACT

Background: The American Society of Anaesthesiologists Physical Status classification is deployed by the anaesthesiologists worldwide to classify operative surgical patients. Many studies have found moderate degree of interrater variability among anaesthesiologists.

The general objective of the study was to find out interrater variability among Nepalese anesthesiologists using this classification system in Nepal. The specific objectives of the study were to find out the correctness of assignment and inter-rater variability among anaesthesiologists based on their experience.

Methods: Ten clinical cases were distributed among 130 registered anaesthesiologist practitioners of Nepal after validation with the experts. Respondents were asked to assign each of ten cases to a specific physical status class. Anaesthesiologists were classified to two classes based on clinical experience as having more or less than five years of experience.

Results: We found substantial agreement among < 5 year's (0.66) and > 5 year's experience group (0.753) and among all raters (0.736). The mean score of the group with less than 5 years of experience was more. There was no significant difference between the mean score ($p = 0.595$). Overall mean score for the both groups was 5.66 with SD 1.66. There was no significant difference between the groups.

Conclusions: The study shows that there is very less variation among registered practising anaesthesiologists of Nepal using American Society of Anesthesiologists Physical Status classification system.

Keywords: ASA-PS; interrater; variability.

INTRODUCTION

In 1941, Sakald M and colleagues devised a classification for the patients undergoing surgery based on their "Physical State", which eventually became the "American Society of Anesthesiologists Physical Status (ASA-PS) classification. It was revised to present modified system and amended in 2020. Being simple, this has been used to make policies, perform audits and resource allocation.[1-4]

Since its inception, it has faced many challenges, among which inter-rater variability is one of the most debated. Owens in 1978 found significant differences among raters. [5] Similar studies have been done in the past only to find weak to moderate inter-rater agreements and significant variation among clinicians working in different settings. [2,6-8]

These discrepancies in accuracy may lead to unnecessary testing and cancellation.[9,10] A limited number of studies have been done to address this issue.[11] Moreover, ASA-PS cannot tell you about individual disease, experience of evaluator and their effect on the perioperative course.[12,13]

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METHODS

An online questionnaire was generated using google tool. The questions were ten fictitious cases created by the researchers and validated by five anaesthesiologists with at least ten years of clinical experiences, peer review and literature review. Respondents were kept anonymous. Mandatory electronic consent was asked for at the beginning of the survey. The total sample size required was 108. We sent email to 130 registered anaesthesiologists adding 20% non-response rate. The respondents were chosen based on computer-based random number. We received a total of 113 responses out of which two respondents did not answer the questionnaire completely hence excluded from the analysis. We classified respondents based on sex, years of experience as less than or more than five years, primary workplace and province.

All the fictitious cases developed were based on ASA-PS classification and examples derived from them.[14] Correct answers were assigned by a panel of five expert anaesthesiologists with at least ten years of experience. The task of the respondents was to assign each case based on ASA-PS classification system into one of the eleven categories I, IE, II, IIE, III, IIIE, IV, IVE, V, VE and VI. To make sure that the respondents do not review ASA-PS classification system before answering questionnaire which would affect the result, all the respondents were explicitly instructed not to review the scoring system before answering the questionnaire.

Those anaesthesiologists who were registered with Society of Anaesthesiologists of Nepal (SAN) and practicing inside the country were included in the random selection for sending the questionnaire. Those who were not registered with SAN, practicing out of Nepal or foreign (honorary) members were excluded for selection.

We aimed to find the inter-rater reliability and variability between anaesthesiologists when classifying patients using American Society of Anaesthesiologists Physical Status (ASA-PS) classification system. We also targeted to find out the association between correctness of the assigned ASA PS and clinical experience.

We designed a quantitative descriptive cross-sectional. Institutional Review Committee (IRC), IOM approval was obtained pretesting.

Simple random sampling method with lottery technique was employed. A list of 350 registration numbers of registered practicing anaesthesiologists was collected and samples were selected randomly by lottery method. We sent an email link to 130 anesthesiologists and received response from 113, among which 2 has answered incompletely, hence excluded from the study.

To increase the reliability of the tool, pretesting was done on 10% of the population (13 anaesthesiologists). The questionnaire was sent in the email in the form of link clicking which would direct the respondents to the consent and questionnaire. Those who would not click consent on the link wouldn't further advance into the questionnaire. The confidentiality was maintained by not mentioning the respondents' name, email or any personal data on the questionnaire. The responses obtained were automatically collected in google response sheet and coding was done for further analysis.

These are the ten cases that were presented in the questionnaire:

Case 1. A 63 years male patient presented for left lower lobe lobectomy for carcinoma lung. He has h/o shortness of breath on and off and is being treated as COPD. The SOB is progressively increasing since last one and half years. It increases on exertion, and he can't walk >5-6min without stopping and can't climb one flight of stairs without stopping. Occasional cough is present with mucoid, scanty sputum. There is no h/o hemoptysis or sore throat. CT guided biopsy of the lesion suggested squamous cell carcinoma. Preanesthetic assessment of the patient also revealed diabetes mellitus. His blood investigations were normal. Chest x-ray had a lesion in left lower zone. PFT shows obstructive disease. Estimated post-operative FEV1 was adequate. ECG showed RBBB. Echocardiograph was normal with EF of 60%.

Case 2. A 26years Female 35 kg with diagnosis of RHD with severe MR is planned for MVR. Her chief complaint was shortness of breath for 1 year. She has no previous anesthetic exposure. She is currently on tab Frusemide 20 mg od, tab Enalapril 2.5 mg PO HS, Penicillin V PO BD. She is non-smoker and does not consume alcohol. She can climb 2 flight of stairs and walk for about 30 minutes.

Her vitals were BP :90/60; Pulse rate: 98/min RR: 16/min. She has no pallor, oedema, lymphadenopathy, anemia, clubbing. Systemic examination revealed pansystolic murmur. Airway examination was insignificant.

Her blood investigations (Blood count, electrolytes, renal function test, liver function test, thyroid function

Table 1. ASA-PS Classification System.

ASA PS Classification	Definition	Adult examples, including but not limited to	Pediatric examples, including but not limited to	Obstetric examples, including but not limited to
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use	Healthy (no acute or chronic disease), normal BMI percentile for age	
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Current smoker, social alcohol drinker, pregnancy, obesity (30<BMI<40), well-controlled DM/HTN, mild lung disease	Asymptomatic congenital cardiac disease, well controlled dysrhythmias, asthma without exacerbation, well controlled epilepsy, non-insulin dependent diabetes mellitus, abnormal BMI percentile for age, mild/moderate OSA, oncologic state in remission, autism with mild limitations	Normal pregnancy*, well controlled gestational HTN, controlled preeclampsia without severe features, diet-controlled gestational DM.
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, history (>3 months) of MI, CVA, TIA, or CAD/stents.	Uncorrected stable congenital cardiac abnormality, asthma with exacerbation, poorly controlled epilepsy, insulin dependent diabetes mellitus, morbid obesity, malnutrition, severe OSA, oncologic state, renal failure, muscular dystrophy, cystic fibrosis, history of organ transplantation, brain/spinal cord malformation, symptomatic hydrocephalus, premature infant PCA <60 weeks, autism with severe limitations, metabolic disease, difficult airway, long term parenteral nutrition. Full term infants <6 weeks of age	Preeclampsia with severe features, gestational DM with complications or high insulin requirements, a thrombophilic disease requiring anticoagulation.
ASA IV	A patient with severe systemic disease that is a constant threat to life.	Recent (<3 months) MI, CVA, TIA or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, shock, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis	Symptomatic congenital cardiac abnormality, congestive heart failure, active sequelae of prematurity, acute hypoxic-ischemic encephalopathy, shock, sepsis, disseminated intravascular coagulation, automatic implantable cardioverter-defibrillator, ventilator dependence, endocrinopathy, severe trauma, severe respiratory distress, advanced oncologic state	Preeclampsia with severe features complicated by HELLP or other adverse event, peripartum cardiomyopathy with EF <40, uncorrected/decompensated heart disease, acquired or congenital.
ASA V	moribund patient who is not expected to survive without the operation	Ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction	Massive trauma, intracranial hemorrhage with mass effect, patient requiring ECMO, respiratory failure or arrest, malignant hypertension, decompensated congestive heart failure, hepatic encephalopathy, ischemic bowel or multiple organ/system dysfunction.	Uterine rupture.
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes			

test) and chest x-ray were normal. ECG showed normal sinus rhythm. Her echocardiography showed severe MR with mild AR, with ejection fraction of 60%.

Case 3. A 29-year-old pregnant lady comes for elective caesarean section for precious baby. She had uneventful antenatal course. Her preoperative evaluation shows haemoglobin of 8.8 gm% and airway examination revealed Mallampatti grading of III.

Case 4. A 52 year old lady, who has been a smoker for last 20 years presents with carcinoma of right breast planned for Modified Radical Mastectomy with Axillary Clearance. She is a known diabetic for last five years under metformin. Her fasting blood sugar level is 5.5 mmol/l and her HbA1c level is 9%.

Case 5. A 52-year-old man with alcoholic cirrhosis presents as a potential candidate for liver transplant. He has a history of previous three hospital admissions with decompensated cirrhosis. He appears icteric, has pedal oedema and stigmata of chronic liver disease. His labs show Hb% 8.2, platelets 52,000, creatinine 192 µmol/L, Bilirubin 54 µmol/L and albumin 22 gm/L. Airway examination is normal.

Case 6. A 48 year gentleman presents for laparoscopic cholecystectomy with a history of upper abdominal pain on and off for last 1 year. He doesn't have significant systemic comorbidities. His significant surgical history includes fixation of cervical spine for traumatic dislocation and has severe restriction of neck movement.

Case 7. A 72 year old diabetic and hypertensive lady presented in ER with severe abdominal pain and distension with not passing stool for last three days. She had a pulse of 148 bpm, BP 70/34 mmHg, SaO2 84% on room air and appears tachypneic. Her blood gas show respiratory alkalosis with hyperlactemia (lac 4 mmol/l). She is resuscitated with intravenous fluids and started on noradrenaline for pressor support. She had a fall in GCS and was intubated. Her labs show counts of 32,000/mm3, platelets 42,000/mm3, Sodium - 121 mEq/L, Potassium 2.9 mEq/L and creatinine 3.5 mg/dL and she has not passed urine for 24 hours. Her abdominal CT scan shows features of perforation and warrants urgent laparotomy and needful.

Case 8. A twenty-one month old child presents for elective inguinal hernia repair. He doesn't have any significant medical history except for runny nose 15 days ago. His clinical examination doesn't reveal any apparent abnormality.

Case 9. A 42 year old man presents in OR for debridement of necrotising fasciitis of right leg. He doesn't have significant medical illness. His anaesthetic history reveals delayed emergence from anaesthesia two years ago while undergoing laparoscopic cholecystectomy.

Case 10. A 68 year old man presents at the emergency room with a ruptured abdominal aortic aneurysm. He has poorly controlled hypertension, insulin-dependent diabetes mellitus and hypercholesterolemia. His preoperative blood pressure is 78/56 mmHg, hear rate of 120 bpm and oxygen saturation of 90% on room air.

These cases were distributed by email. The tool was adapted from the previously done studies with permission and modified by the researchers. (13)

Questionnaires were divided into two parts.

Part I: Questions related to demographic information

Part II: Questions related to 10 clinical cases

The collected data was analyzed using SPSS v 16

RESULTS

Out of 111 valid responses, 20 (18.01%) were females and 91(81.98%) were males. The majority of the respondents (35.13%) were from university teaching hospitals.

Table 2. Respondents based on primary place of work.

Primary place of work	Frequency	Percentage
University teaching hospital	39	35.13
Government hospital	31	27.92
Private/Corporate hospital	31	27.92
Academy	7	6.3
Community Hospital	3	2.7

Table 3. Distribution based on province.

Province	Frequency	Percentage
Bagmati Province	84	75.67
Province 1	9	8.10
Lumbini Province	8	7.20
Gandaki Province	5	4.50
Madhesh Province	4	3.60
Sudur Paschim Province	1	0.90
Total	111	

Table 4. Inter-rater reliability measures Fleiss' k.

Groups	Reliability Coefficient (k)
All raters	0.73
< 5 years	0.66
> 5 years	0.753

Table 5. Test of significance difference in mean score according to working experience:

Years of experience	N	Minimum	Maximum	Mean Score	Std. Deviation	Mean difference	p value
< 5 years	35	2	10	5.8	1.77	0.18	0.59
> 5 years	76	1	9	5.61	1.61		

Table 6. Responses based on cases.

Case	Years of experience	ASA PS I	ASA PS IE	ASA PS II	ASA PS IIE	ASA PS III	ASA PS IIIE	ASA PS IV	ASA PS IVE	ASA PS V	ASA PS VE	ASA PS VI
Case 1	< 5 years	0	0	1	0	25	1	6	1	1	0	0
	> 5 years	1	0	5	0	53	5	12	0	0	0	0
Case 2	< 5 years	0	0	8	0	16	0	11	0	0	0	0
	> 5 years	3	0	36	1	24	2	8	2	0	0	0
Case 3	< 5 years	1	0	25	5	4	0	0	0	0	0	0
	> 5 years	5	0	63	1	6	1	0	0	0	0	0
Case 4	< 5 years	0	0	11	0	23	1	0	0	0	0	0
	> 5 years	1	0	24	5	45	1	0	0	0	0	0
Case 5	< 5 years	0	0	0	0	11	1	19	0	3	1	0
	> 5 years	1	0	2	2	26	3	33	3	5	0	1
Case 6	< 5 years	24	0	5	1	4	0	1	0	0	0	0
	> 5 years	57	0	14	0	5	0	0	0	0	0	0
Case 7	< 5 years	0	0	0	1	0	0	0	20	1	13	0
	> 5 years	1	0	0	1	1	3	1	40	2	27	0
Case 8	< 5 years	23	3	8	0	0	0	0	0	0	0	1
	> 5 years	54	0	20	0	2	0	0	0	0	0	0
Case 9	< 5 years	4	14	3	7	1	3	0	3	0	0	0
	> 5 years	17	33	3	13	0	3	0	6	0	1	0
Case 10	< 5 years	0	0	0	0	0	3	0	10	2	20	0
	> 5 years	1	0	0	0	1	4	0	29	1	39	1

DISCUSSION

The ASA PS classification system was devised to study, examine and experiment and to build a system for collection and tabulation of statistical data to document overall health status of patient prior to the surgery and anaesthesia and allow outcomes to be stratified in terms of illness severity.[1] It was also found to have a strong and independent association with perioperative morbidity and mortality. Along with this, the simplicity of the tool was found to have a great value in prognosticating cases.[15] Apart from this, it can also be used for estimation of cost effectiveness, resource utilisation and as a performance indicator comparison among institutions.[16]

The ASA PS classification system, since its inception has been subjected to various debates regarding its strength in clinical practice. Many studies that have been done across the globe have shown a weak to moderate interobserver reliability. This means that there is a lack of consistency in its usage worldwide. [17]

A systematic review published in 2016 shows that there is a wide range of inter-rater agreement while using ASA

PS classification system. Hence it was suggested that the administrative staff use it carefully for billing purpose and physicians use it carefully while communicating considering its heterogeneity. [18]

Although we do not have billing based on ASA PS in Nepal currently, multitude of health care systems are adopting this for the ease and transparency of billing and prognostication. Despite the wide range of variation amongst users, it has been used widely because of its simplicity and ease of use at the bedside without need for any instrument. Hence, it is slowly entering the domain of specialties other than anaesthesiology. [8]

We designed this study to analyse the inter-rater variability (or acceptance) among the registered anaesthesiologists practising in Nepal. We analysed the inter-rater reliability among the anaesthesiologists with Fleiss' kappa measure. (Table 4) We found substantial agreement among < 5 years' experience group (0.66) and > 5 years' experience group (0.753) and substantial agreement among all raters (0.736). The mean score of the group with less than 5 years of experience is more than those with more than 5 years of experience. (Table 5) However, there is no significant difference between the mean score (p = 0.595). Overall mean score for the both groups is 5.66 with SD 1.66.

This means that although there seems to be better understanding of ASA PS scoring system among those with less than 5 years of experience, the result is not statistically significant.

When considering individual cases assigned to the raters, there was a wide variation of responses seen. For example the case 5, which is a complicated case received a wider response than case 8, which is a relatively uncomplicated straightforward case. Overall analysis, however, did not show any statistically significant variation while assigning ASA PS to the cases presented.

Hence we can conclude that there is substantial agreement among anaesthesiologists while using ASA PS classification system. Although many studies have shown a wide range of variation while assessing the patients with the classification, our study did not show any wide variation among the raters. One of the reasons behind this could be strict adherence to the definitions and examples given in the classification system by all the institutes teaching Anaesthesiology and uniformity in practice among anaesthesiologists throughout the country.

However, looking at the responses received according to the provinces, around 2/3rd of the responses received are from Bagmati Province (Table 3) which may explain why there in not much variation regarding ASA PS rating among anaesthesiologists as it is likely that institutions across the province practice similarly.

We also noted that the maximum number of responses are from tertiary hospitals (university hospitals, corporate hospitals and government sectors). It is likely that academic institutions and corporate sector adhere strictly to the classification system and examples given in the classification. Further study is required to validate this assumption.

In 2014, ASA adopted examples for each ASA PS (ASA-approved examples) to provide additional information to facilitate the clinicians practising anaesthesiology.[19] Likewise, Hurwitz et. al. demonstrated that adding examples to the ASA-Physical Status Classification improves correct assignment to patients.[20]

CONCLUSION

With the results of this study, we can conclude that there is very less variation or alternatively put, substantial agreement among registered practising anaesthesiologists of Nepal using ASA PS classification system. Although there is slight difference in understanding of the classification, there is no statistical significant difference in the two groups. However, more research needs to be done incorporating more anaesthesiologists all over the nation to reduce potential biases and ensure uniform response from all around the country.

CONFLICT OF INTEREST

None.

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