Chapter

American Society of Anesthesiologists Physical Status Classification System: History, Development, Reliability, and Its Future

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Abstract

The American Society of Anesthesiologists Physical Status (ASA PS) classification has long been used as a ranking system that quantifies patient health before anaesthesia and surgery. When initially developed, the ASA PS intended application was purely statistical. However, nowadays it is commonly used by surgical specialties to determine a patient's likelihood of developing postoperative complications, despite studies reporting scoring method subjectivity and inconsistencies among anaesthesiologists in assigning these scores. Over the years, the ASA PS classifications have undergone many changes and modifications to address its limitations. There are a few points to be discussed if all shortcomings are to be treated and interobserver variability is to be limited.

Keywords: American, society, anaesthesiologists, physical, status, classification

1. History

A practising anaesthesiologist will understand the fear exhibited by patients receiving anaesthesia, but fortunately, death from anaesthesia has reduced dramatically with the emergence of modern anaesthesia practice [1]. The development of anaesthesia drugs and monitoring and the evolving anaesthesia training have increased anaesthesia safety, especially for patients who are free of comorbidities. This reduction of mortality was first published by the Institute of Medicine (IOM) in the report *To Err Is Human*: they mentioned that death from anaesthesia has decreased from 2 deaths per 10,000 anaesthetics administered in the 1980s to about 1 death per 200,000 to 300,000 anaesthetics administered at the beginning of the twenty-first century [2–4].

Whenever anaesthesia-related death is considered, the American Society of Anesthesiologists Physical Status classification (ASA PS) is mentioned. It is the most commonly used tool by practising anaesthesiologist in the preoperative assessment of patients. This extensive use is owed to its simplicity and seniority. The American Society of Anesthesiologists (ASA) introduced the ASA PS back in 1941 [5]. During that period, the common practice was to classify patients according to their operative risk, but the vision of the ASA committee has helped them to appreciate the complexity of the situation; they admitted that estimating postoperative mortality using preoperative data is a statistically challenging situation, so they have changed

Class	Definition	Examples
I	No organic pathology or patient in whom the pathological process is localised and does not cause any systemic disturbance or abnormality	Fractures without: shock, blood loss, emboli or systemic signs of injury Congenital deformities without systemic disturbance Localised infection without fever Osseous deformities Uncomplicated hernias Any type of operation may fall in this class since only the patient's physical condition is considered
II	A moderate but definite systemic disturbance caused either by the condition that is to be treated by surgical intervention or by other existing pathological processes	Mild diabetes Function capacity I or IIa Psychotic patients unable to care for themselves Mild acidosis Moderate anaemia Septic or acute pharyngitis Acute sinusitis Superficial infection that causes a systemic reaction. Non-toxic thyroid adenoma with all but partial respiratory obstruction Mild thyrotoxicosis
III	Severe systemic disturbance from any cause or causes. It is not possible to state an absolute measure of severity, as this is a matter of clinical judgement	Complicated or severe diabetes Functional capacity IIb Combination of heart and lung diseases that severely impair function Complete intestinal obstruction with serious physiological disturbance Pulmonary tuberculosis causing tachycardia or dyspnoea Prolonged illness with weakness of all or several systems
IV	Extreme systemic disorders which have already become an imminent threat to life regardless of treatment. Due to their duration or nature, there has already been damage to the organism that is irreversible. This class is intended to include only patients who are in extremely poor physical state	Functional capacity III – (cardiac decompensation) Severe trauma with irreparable damage Complete intestinal obstruction in a previously debilitated patient Cardiovascular disease with marked renal impairment Anaesthesia to arrest marked blood loss from secondary haemorrhage in a patient in poor condition
V	Emergencies that would be otherwise graded as Class 1 or 2	
VI	Emergencies that would otherwise be graded as Class 3–4	

Table 1.
ASA PS as described in 1941 [5].

the notion of operative risk into physical status. The purpose of that classification was to create a common platform for doctors to guide the patient classification for further future statistical analysis. There were four classes (**Table 1**), and if there was an emergency surgery, then the class will be five for a patient who was classified as 1–2 and six for a patient who was classified as 3–4. Surgery was considered an emergency whenever the surgeon said so [5]. Clinical scenarios were assigned to each class for easy use. They further added an alphabetic scaling, ranging from A to D according to the objective evidence of cardiovascular decompensation, with A being no evidence and D being severely decompensated (**Table 2**).

After 20 years, some authors removed the clinical scenarios, added a fifth class, and added the letter E to indicate emergencies (**Figure 1**). This change was a result of a large study that was aiming to assess the postoperative motility using preoperative physical status [6].

Retrospectives trials to validate ASA scale have then become numerous added to the many prospective trials, and they gave birth to ASA pooled mortality [7]. In

Class	Objective evidence of cardiovascular disease
A	No objective evidence of cardiovascular disease. No symptoms and no limitation in ordinary physical activity
B	Objective evidence of minimal cardiovascular disease. Mild symptoms and slight limitation during ordinary activity. Comfortable at rest
C	Objective evidence of moderately severe cardiovascular disease. Marked limitation in activity due to symptoms, even during less-than-ordinary activity. Comfortable only at rest
D	Objective evidence of severe cardiovascular disease. Severe limitations. Experiences symptoms even while at rest

Table 2.
Additional clinical classification based on cardiovascular state [5].

Class	Definition	Examples
1	Normal health	Healthy, non-smoking, no or minimal alcohol use
2	Mild systemic disease	Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, 30 < BMI < 40, well-controlled DM/HTN, mild lung disease
3	Severe systemic disease	Substantive functional limitations. One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥ 40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction in ejection fraction, ESRD undergoing regularly scheduled dialysis, premature infant PCA < 60 weeks, history (> 3 months) of MI, CVA, TIA or CAD/stents
4	Severe systemic disease that is a constant threat to life	Examples include (but not limited to): recent (< 3 months) MI, CVA, TIA or CAD/stents, ongoing cardiac ischaemia or severe valve dysfunction, severe reduction in ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis
5	Moribund: survival not expected without surgery	Examples include (but not limited to): ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischaemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction
6	Brain-dead organ donor	

Figure 1.
The latest update on ASA [8].

Physiological variables	Operative variables
Chest Hx	Type of surgery
Age	Severity
Cardiovascular Hx	Number of procedures
ECG	Blood loss
BP	Malignancy
HR	
GCS	
WBC	
Hb	
Urea	
Na+	
K+	

Table 3.
POSSUM variables.

1980 another revision (**Table 3**) was carried out, which resulted in the addition of a new class that considers braindead patients [8].

Although ASA PS is widely used, it appears that no much effort or attention was paid by the researcher to improve this tool until recently when some models considered ASA physical status as a part of their risk assessment system.

2. Risk assessment systems

2.1 The surgical risk scale

The Surgical Risk Scale is a simple tool that was created by the combination of ASA scale and the British United Provident Association (BUPA) along with the Confidential Enquiry into Perioperative Death (NCEPOD). It was tested in a prospective study; they used logistic regression analysis and created a scale ranging from 3 to 14, which is simple and accurate [9].

2.2 The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP)

The ACS main idea behind this study was to compare particular risk assessment scores to a universal tool. They provided surgeons with an online application that considers ASA scale. The study results showed that ACS NSQIP variables are significant in ASA scale validation [10].

2.3 The surgical outcome risk tool (SORT)

This risk assessment tool was developed and validated in 2014 in the UK. ASA PS was added along with other six variables: the urgency of surgery, high-risk surgery, severity, age, and the presence of cancer obtained from NCEPOD data analysis [11].

2.4 The National Emergency Laparotomy Audit (NELA) score

As the name implies, it's an audit for more than 50,000 cases. All patients were above 18 years. It was only used to assess mortality inpatient undergoing laparotomy for small bowel obstruction. ASA scale was studied for its association with the patient outcome.

3. Validity

Something is valid when it can fulfil the objective against which it's being tested, and its reliability depends on consistency. Every reliable tool is valid, but not every valid tool is reliable.

In terms of assessing mortality, the ASA scale is not valid by itself, but this is not a discovery; this was first mentioned in the same original paper by ASA committee itself [12]. Assessing the patient physical status is surely what ASA scale is best used for, but here comes the issue of how reliable it is.

Subjectivity in patient assessment is the source of the variability in the scale use.

Many studies have been investigating ASA scale reliability. They either assessed the consistency of the classification of many patients by a specific number of doctors to evaluate the factors associated with inconsistency if found or evaluated the classification of particular cases among doctors. Effective studies to assess the statistical validity of the scale started to appear 20 years after the original scale was described [6]. Studies to determine the reliability of the scale by assessing its consistency only begun in the late 1970s [13]. In 1978 a questionnaire was developed and was emailed to more than 200 anaesthesiologists to test how consistent is ASA scale in the classification of 10 imaginary clinical scenarios (**Figure 2**). They reported a consistency rate of 5.9, which was affected by whether the anaesthesiologist was doing a private or academic work and with no effect of the region of practice [13]. Age, history of ischemic heart disease, abnormal BMI, and low haemoglobin level appeared to be where conflicts arise. Many years after a study found that there is no significant correlation between expertise in anaesthesia and scale reliability [14]. A more recent study confirmed that result and showed the absence of a relationship between the scale reliability and the age, level of training, or how expert the anaesthesiologist is [15].

The association between the accuracy of scale and whether the user is an anaesthesiologist or not appeared to be significant [16]. Some recent studies claimed that the removal of clinical scenarios affected the scale reliability; they consider it to be a self-correcting tool that empowers the system [17, 12].

Patient 4

A 42-year-old Negro man is scheduled for a lumbar laminectomy for a herniated disc at L2–3. Past history and review of systems reveal a previous diagnosis of sickle-cell trait. The rest of the history is noncontributory. Physical examination shows no abnormality except neurologic findings compatible with the herniated lumbar disc.

Hemoglobin is 11.8 g/100 ml and hematocrit, 36.4 per cent.

Figure 2.
Example of a clinical scenario used for the validation [13].

4. Alternatives

Stop your flow of thoughts for a moment. Now think of this question, what is the main aim of medical care? Many doctors will say that it depends on the specialty. That is partially correct because there is a common place where all doctors meet along the road of patient care, which is to alleviate the patient suffering. So we are not fighting death, and we want to make sure that the patient is not going to die from a preventable cause and is not going to suffer from a bad quality of life. Reducing avoidable mortality along with the people who desire to know their chances of being alive after undergoing surgery has motivated doctors from specialties that are concerned with the preoperative assessment of patients to develop many tools and scales to assess the expected patient mortality.

For us to talk about the possible alternative scores for ASA physical status scale, we need to point out for what reason the scale was created and what variables were included. ASA introduced the classification system back in 1941 to facilitate the statistical calculation of operative patient risk rather than indicating it. They classified the patients according to their physical status to create a common background for patients sorting by surgeons and anaesthesiologists and then assess the association between different classes and patient outcome. The ASA classification itself does not consider many other important factors that may affect the patient outcome (severity of the surgery, the experience of the surgeon, the quality of the hospitals, etc.) [5]. So in terms of patient sorting function, ASA classification is standing on the top if not alone with only a mild problem of subjectivity. But in mortality assessment, it can only be a part of bigger scales, as the pooled mortality for ASA grades obtained using clinical audits was found to be increased with many other factors like intraoperative blood loss, duration of the operation, and in-hospital mortality [7].

There are many scores to predict patient mortality after surgery or in specific conditions. In this chapter, we will only review nonselective scores that predict mortality in surgical patients.

4.1 ASA pooled mortality

After the ASA was being revised into five classes in 1961 [18], many retrospective studies have shown a link between ASA classes and perioperative mortality rate [19–22]. The first prospective study to determine the correlation between ASA classification, perioperative risks, and postoperative outcome with a large number of patients was in 1996. They assigned patients with all types of surgery, and they have taken into account the type of surgery, patient lab results, perioperative risk variables, time of the operation, and the type of anaesthesia. They used univariate analysis and logistic regression analysis to estimate the mortality rate (**Figure 3**) for each ASA class [7].

ASA class	Definition	Pooled mortality (%)
I	Healthy	0–0.3
II	Mild systemic disease with no functional limitation	0.3–1.4
III	Severe systemic disease with functional limitation	1.8–5.4
IV	Severe systemic disease – constant threat to life	7.8–25.0
V	Moribund patient – unlikely to survive 24 h with or without operation	9.4–57.8
E	Suffix added to denote emergency operation	

Figure 3.
ASA pooled mortality.

4.2 Physiological and operative severity score for the enumeration of mortality and morbidity (POSSUM)

This is a risk assessment tool that uses both physiological and operative factors into account (**Table 3**). A prospective study of 10,000 surgical interventions except for paediatric surgery and day-case surgery, applying logistic regression analysis, showed that the POSSUM equation overestimates mortality [23]. A further modification of POSSUM, which was named P-POSSUM, was found to be more accurate in mortality prediction [23].

4.3 Preoperative score to predict postoperative mortality (POSPOM)

A very large cohort study for 1 year was conducted in France. Seventeen variables were used to estimate the mortality risk for 2,717,902 patients. The risk tool was validated by using the logistic model.

4.4 Frailty scores

Assessing frailty in the elderly has become an evolving practice of the twenty-first century. Validated frailty criteria (weakness, fatigue, decreased physical activity, and walking speed), also known as frailty phenotype, were the result of a cohort study that used the cardiovascular health study database. Two cohorts were randomised in 1989, and they were followed for 4 to 7 years [24]. Another model that exists in the literature is the frailty index, which is the impact of frailty detected during geriatric assessment [25]. Notice that each criterion has its particular measurement consideration, and it is not discussed as it is beyond the scope of this chapter. Many studies have used these criteria to assess postoperative mortality in different pathologies [26–28].

5. Comparison of systems

Many studies have explored the issue of which the scale is superior to others, but we have to keep in mind that many variables will be adjusted to make the comparison possible, and this is mainly because of the broad variability between these scores and the different objectives and settings at which each score was introduced.

To understand this in a better way, we must understand the meaning of risk in anaesthesia. Risk indicates the negative impact of a process which may be started in the past, may be happening now, or is probably going to occur in the future. Human survival nature is evident in the efforts that we put on trying to reduce all the risks.

For every patient undergoing surgery, four broad risk categories can be faced:

1. Hospital hazard.

2. Risk of anaesthesia.

3. Surgery.

4. Patient factors.

The ASA PS focuses only on patient status and the risk of anaesthesia; POSPOM, POSSUM, and P-POSSUM have an additional focus on surgical risk. But every score assesses the same variable differently because this is affected by the use of the tool in practice; as ASA is the standard practice for years, then it will have the upper arm in assessing patient factors. None of them considered hospital hazard. The ASA itself varies on its validity between its different versions. The original ASA used to have clinical scenarios that approximate the subjective variations between doctors, which were removed from the updated versions. The authors of the study that introduced and validated POSPOM in 2016 claimed that ASA PS is a deficient tool for assessing mortality risk because it does not take risks apart from patient factors and anaesthesia risk into account [29]. Many retrospective and prospective studies have studied ASA PS correlation with mortality after considering all the other elements, and many other trails have tackled the issue off subjectivity and figured to solve it with a robust statistical methodology many years before 2016 [7, 30].

This risk assessment issue can be solved with a meeting that involves public health, anaesthesia, surgery, and medical statistic expertise to create an assessment tool that considers all these risks and to be statistically applicable and clinically standardised to avoid subjectivity.

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