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DETERMINANTS OF PATIENTS OUTCOME, ADMITTED IN SURGICAL INTENSIVE CARE UNIT, AN AUDIT OF ONE YEAR

General Surgery

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ABSTRACT

Introduction: A scoring system defines the severity scores of illness that could be used for the prediction of hospital mortality risk by applying logistic regression equations. The SAPS II scoring system has been shown to accurately quantify risk of death in a wide range of clinical settings. While in contrast, SOFA scoring system brings into consideration the various parameters of organ dysfunction as time progresses and depending on that predictions are made that turn out to be more fair and accurate. Since both are age old criteria for prognostication of ICU patients, the idea is worth revisiting each of them and assess their individual merits.

Methods : This prospective study was conducted in SICU, GMCH, Udaipur for a period of 12 months. Findings were added after meticulous history, examinations, investigations and operative procedures and the data collected was put in proper prospective and analysed meticulously. Finally we had score from SAPS and SOFA both and thereafter we proceeded to compare these two system with regards to their "outcome predictability".

Result: The mean age in our study was 55.32 ± 17.88 years. 150 patients had SOFA score <12 showing good prognosis, with 88% prediction accuracy for survival. While remaining 150 patients had SOFA score >12, showing poor prognosis, with 82% prediction accuracy for mortality, died. Patient survived in real time were 159 (53%), while SAPS predicted 147 (49%) patients mortality, which is quite comparable (p >0.05).

CONCLUSION: The good prognostic abilities of SOFA and SAPS in our study suggests that they could be used to identify high risk patients, enabling timely initiation of pro-active measures before irreversible deterioration happens. SOFA and SAPS both are not only reliable but also genuinely effective in prediction of ICU mortality risk identification. Both scoring systems can be used to triage patients into various risk categories for fine tuning the management and resource planning.

KEYWORDS

INTRODUCTION

Intensive care refers to the specialised treatment given to patients who are acutely unwell and require critical medical care. The dynamics of any intensive care unit is manifested by the delicate balancing of illness severity and resource utilization that finally reflects in hospital survival figures as a final outcome.

Intensive care includes all critical cares on which the patient's life depends under supervision of the more experienced and highly qualified physicians and nurses using advanced equipment and gadgetry.[1,2]

The focal point is to calibrate a synchronisation between mortality prediction with illness severity of a patient thereby successfully designing the remedial strategy. The other aspect of the utility of such tools is to evaluate the performance of individual intensive care unit.

A scoring system defines the severity scores of illness that could be used for the prediction of hospital mortality risk by applying logistic regression equations. One of the most widely used scoring system for the general severity of illness and prognosis is the Simplified Acute Physiology Score (SAPS) system. The second version of this scoring system was developed and validated for a large group of ICU patients on the basis of an analysis of a large database of physiologic data from critically ill medical and surgical patients.[3]

Now-a-days, the standard scoring systems determine the severity of illness and the probability of mortality in patients hospitalized in the intensive care units (ICUs).[3,4] Currently, there are different methods to predict patient outcomes, but four of them are more reliably accredited by most references, including Acute Physiology and Chronic Health Evaluation (APACHE II, III, IV), the Simplified Acute Physiology Score (SAPS)[3,4,5], the Mortality Prediction Model (MPM) and the Sequential Organ Failure Assessment (SOFA).[6-10]

Multiple organ dysfunction syndrome (MODS) is the last step in a severely ill patient, which occurs in the following infection, septic shock, tissue damage, excessive hemorrhage, ischemia and severe inflammation.[6,9]

SOFA score (0-4 points) is determined for each one of the six organ systems (neurological, respiratory, cardiovascular, renal, hepatic, and hematologic).[10-12] The advantages of the SOFA compared to the other three above mentioned methods are high discriminatory power and calibration, no need for computer software and operator along with the simplicity of collecting information and low cost.[10] The three APACHE II, MPM and SAPS models are required to investigate a large number of variables[13-15] whereas the SOFA uses only six variables.

The SAPS II scoring system has been shown to accurately quantify risk of death in a wide range of clinical settings.[15-17] This experience has resulted in the widespread use of the SAPS II scoring system as a tool for ICU audit.

If we compare the SAPS and SOFA Scoring system the one thing that stands out is that in SAPS all the variables are taken as face value from the time of landing in the ICU to first 24 hours which gets altered during the period of treatment as the time passes. For example to explain it more clearly a patient of pancreatitis on entering ICU on day 1 may have bad SAPS score, predicting bad prognosis but the scene changes as an effective treatment comes in action and so on day 4 or 5 with improvement the old SAPS scoring might not be truly reflective of patients outcome.

While in contrast, SOFA scoring system brings into consideration the various parameters of organ dysfunction as time progresses and depending on that predictions are made that turn out to be more fair and accurate.

Since both are age old criteria for prognostication of ICU patients, the idea is worth revisiting each of them and assess their individual merits.

AIM AND OBJECTIVE

To compare the prediction accuracy of Simplified Acute Physiology Score2 (SAPS 2) versus Sequential organ - Failure assessment (SOFA) in surgical Intensive care unit (SICU) mortality.

MATERIALS AND METHODS

This prospective study was conducted after obtaining approval from Institutional Ethics Committee at Surgical Intensive Care Unit, GMCH, Udaipur for a period of 12 months.

All the data of 300 patients which were admitted in surgical ICU of

GMCH Udaipur from January 2019 to December 2019, were recorded as per proforma. Findings were added after meticulous history, examinations, investigations and operative procedures and the data collected was put in proper prospective and analysed meticulously.

- Patients of Age > 15 years and admitted to surgical ICU for critical care.
- Patients of Age <15 years, pregnant and/or who were having acute cardiac diseases were excluded.

Procedure

All critically ill suspected multi organ dysfunction patients, and all postoperative patients admitted in surgical ICU under surgery department were chosen for study if they fulfil the inclusion criteria the parameters needed to calculate" SAPS AND SOFA" score were obtained from the patients on admission within 24 hours for SAPS and 24, 48 and 96 hours after admission at the same time of the day subsequently for SOFA.

So once all these varied type of critically ill surgical patients entered the surgical ICU, we detailed them in our 'master chart 'and then compared the panel of investigation that were required. These were carefully charted in various proformas that we had prepared. During our study we meticulously prepared the proformas for both the scoring system viz. the SAPS and the SOFA.

Due diligence was given to the timing of recording of parameters as for SAPS in first 24 hours since admission while for SOFA it was from T0 to T4 (admission till 96 hrs).

Once we accomplished the detailed data posting in these specific charts next was our job to extrapolate and calculate the adversely of the situation in term of "predictable outcome".

In order to not overlook the significance of the impact of various risk factors like "smoker, alcoholics and other tobacco chewing and different co- existing morbidities like hypertension, DM, hypothyroidism etc, a careful effort was made to put them up in our "master chart", thereby accounting for any and every factor that affects the "over all outcome" in critical patients.

This included operated, non-operated and trauma patients (e.g. perforation peritonitis, septicaemia Diabetic ulcer foot with gangrene Necrotizing fasciitis). Patients had to fulfil two or more criteria of systemic inflammation (fever >38.0°C or hypothermia <36.0°C, tachycardia >90 beats/minute, tachypnea >20 breaths/minute, leucocytosis >12x10^9/l or leucopoenia <4x10^9/l)

The score was calculated till discharge from ICU, mortality or day6 of admission to ward whichever was the earliest.

SOFA score	0	1	2	3	4
Respiration					
PaO_2/FIO_2 (mmHg) (kPa)	> 400 (> 5.3)	301–400 (4.1–5.3)	201–300 (2.8–4.0)	101–200 (1.4–2.7)	≤ 100 (≤ 1.3)
Coagulation					
Platelets (x10^3/mm^3)	> 150	101–150	51–100	21–50	≤ 20
Liver					
Bilirubin (mg/dl) (µmol/l)	< 1.2 (< 20)	1.2–1.9 (20–32)	2.0–5.9 (33–101)	6.0–11.9 (102–204)	≥ 12.0 (≥ 204)
Cardiovascular					
Hypotension	No hypotension	MAP < 70 mmHg	Dopamine ≤ 5 or dobutamine (any dose)*	Dopamine > 5	Dopamine > 15
Central nervous system					
Glasgow coma score	15	13–14	10–12	6-9	< 6
Renal					
Creatinine (mg/dl) (µmol/l) or urine output	< 1.2 (< 110)	1.2–1.9 (110–170)	2.0–3.4 (171–299)	3.5–4.9 (300–440) < 500 ml/day	> 5.0 (> 440) < 200 ml/day

* adrenergic agents administered for at least 1 h (doses given are in µg/kg/min)

The SOFA at admission was labelled T0 and at day 2 was labelled as T2 (i.e. at 48 hours) and at day 4 was labelled as T4 (i.e. at 96 hours). The Maximum, Mean and total SOFA were also calculated and compared with outcome of the patient.

Blood Investigations were taken under aseptic conditions with adequate care and sent to the hospital 24 hours laboratories immediately.

In SAPS2 we took the worst values of 12 physiological variables and observed them within 24 hours of patient admission. For example, heart rate, blood pressure, temperature, GCS, urine output, serum urea and electrolytes etc. These were recorded and analysed and the morbidity and mortality were thusly predicted.

$Logit = -7.7631+0.0737*Score+0.9971*\ln(Score+1)$

$Mortality = e^{logit} / 1+e^{logit}$

Below are the physiological variables which are rated points on the basis of their severity and are included in the scoring of SAPS

1. Age (Years)
- Below 40 (0 points)
- 40-59 (7 points)
- 60-69 (12 points)
- 70-74 (15 points)
- 75-79 (16 points)
- 80 and above (18 points)

2. Type of admission
- Scheduled surgical (0 points)
- Medical (6 points)
- Unscheduled surgical (8 points)

3. Heart rate (bpm)
- Below 50 (11 points)
- 40-69 (2 points)
- 70-119 (0 points)
- 120-159 (4 points)
- 160 and above (7 points)

4. Systolic blood pressure (mmHg)
- Below 70 (13 points)
- 70-99 (5 points)
- 100-199 (0 points)
- 200 and above (2 points)

5. Temperature (C or F)
- Below 39 C (0 points)
- 39 C and above (3 points)
- Below 102.2 F (0 points)
- 102.2 F and above (3 points)

6. Glasgow coma score
- Below 6 (26 points)
- 6-8 (13 points)
- 9-10 (7 points)
- 11-13 (5 points)
- 14-15 (0 points)

7. PaO2 (mmHg)/FiO2 (%) if mechanical ventilation or CPAP
- N/A (0 points)
- Below 100 (11 points)
- 100-199 (9 points)
- 200 and above (6 points)

8. Urine output (L/24h)
- Below 0.5 (11 points)
- 0.5-0.99 (4 points)
- 1 and above (0 points)

9. Serum Urea (g; L) or BUN (mg/dl)
- SU: Below 0.6 (0 points)
- SU: 0.6-1.79 (6 points)
- SU: 1.8 and above (10 points)
- BUN: below 28 (0 points)
- BUN: 28-83 (6 points)
- BUN: 84 and above (10 points)

10. Sodium (mEq/L)
- Below 125 (5 points)
- 125-144 (0 points)
- 145 and above (1 points)

11. Potassium (mEq/L)
- Below 3 (5 points)
- 3-4.9 (0 points)
- 5 and above (3 points)

12. Bicarbonate (mEq/L)
- Below 15 (6 points)
- 15-19 (3 points)
- 20 and above (0 points)

13. Bilirubin (mg/dl)

- Below 4 (0 points)
- 4-5.9 (4 points)
- 6 and above (9 points)

14. White blood cells /mm3
- Less than 1000 (12 points)
- 1000-19000 (0 points)
- 20000 and above (3 points)

15. Chronic disease
- None (0 points)
- Metastatic cancer (9 points)
- Hematologic malignancy (10 points)
- AIDS (17 points)

Total Score:

Mortality	SAPS II Score
10%	29 pts
25%	40 pts
50%	52 pts
75%	64 pts
90%	77 pts

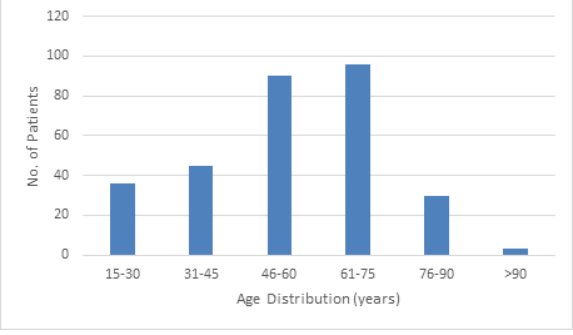
Both SOFA and SAPS2 were calculated simultaneously on admission within 24 hours.

Finally we had score from SAPS and SOFA both and thereafter we proceeded to compare these two system with regards to their "outcome predictability".

RESULTS

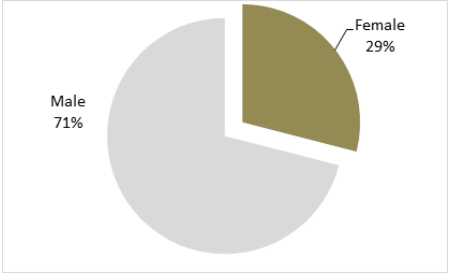
Table 1: Age Distribution of I.C.U Patients

In our study group included patients of different age group ranging from 15-90, years. in which mean age of patients is 55.32 years. Majority of patients are in age group 61-75 years (32%) followed by 46-60 years (30%) age group.



Graph 1: Age Distribution Of I.C.U Patients

In our study group 71% patients are male and 29% patients are female.



Graph 2: Gender Distribution Of I.C.U Patients:

Table 1: Relation Of Sofa And Saps Score Among Smoker And Alcoholic

RISK FACTORS	SOFA SCORE		SAPS SCORE		P
	Mean	SD	Mean	SD	VALUE
Non-Smoker and Non-Alcoholic	55.85	21.22	53.14	27.87	0.18
Smoker	59.61	17.72	64.16	31.55	0.02
Alcoholic	61.76	19.94	63.61	27.26	0.34
Both Smoker and Alcoholic	57.21	16.34	63.7	31.93	0.001

Table 2: Relation Of Sofa And Saps Score With Co-morbidity

Co-morbidity	SOFA SCORE		SAPS SCORE		P
	Mean	SD	Mean	SD	VALUE
Non-Diabetic and Non-Hypertensive	62.58	16.86	57.46	31.02	0.01
Diabetic	64.91	17.02	57.08	29.46	0.0001
Hypertensive	44.81	25.13	59.9	28.8	<0.0001
Both Diabetic and Hypertensive	51.46	18.78	57.4	28.17	0.002

In patients with CO-morbidities morality prediction by SAPs is found to be better than SOFA with significant P value.

Table 3: SAPS Score Distribution Of I.C.U Patients

SAPS SCORE	No. of Patients	Percentage
21-30	9	3
31-40	27	9
41-50	18	6
51-60	138	46
61-70	93	31
71-80	15	5
Total	300	100
MEAN ± SD	57.01± 10.2	

In our study, majority of patients are found in 51-60 score (46%) followed by 31% patients in 61-70 score. Mean SAPS score is 57.01.

Table 4: SOFA Score Distribution Of I.C.U Patients

SOFA SCORE	Day 1		Day 2		Day 3	
	No. of Patients	Percentage	No. of Patients	Percentage	No. of Patients	Percentage
0-5	0	0	3	1	6	2
6-10	135	45	144	48	144	48
11-15	129	43	93	31	69	23
>15	36	12	60	20	81	27
Total	300	100	300	100	300	100
MEAN ± SD	11.29± 3.16		11.53± 3.95		11.78± 4.46	
P-Value	0.3					

Most of the patients in our study population having SOFA scores of 6-10 on admission in ICU approx. (45%), followed by patients 11-15 scores (43%).

Here, patients are distributed according to SOFA score at day 1,2 and 3. The mean SOFA score for day 1 is 11.29 and for day 2 is 11.53 and for day 3 is 11.78. The p-value is 0.3. There is no significant difference between these groups as p-value is <0.05.

Table 5: Predictive Comparison Between Sofa Score <12 And >12.

OUTCOME	SOFA SCORE <12		SOFA SCORE ≥12	
	No. of Patients	Percentage	No. of Patients	Percentage
Survived	132	44	27	9
Non-Survival	18	6	123	41
Prediction Accuracy %	88%		82%	

In our study 150 patients out of 300, had SOFA score less than < 12 showing good prognosis of which 88% were survived.

Rest 150 patients out of 300, had SOFA score more than >12 showing poor prognosis of which 82% died. This signifies good prediction accuracy of SOFA.

Table 6: Predictive Comparison Between Saps Score <60 And >60.

OUTCOME	SAPS SCORE <60		SAPS SCORE ≥60	
	No.	Percentage	No.	Percentage
Survived	129	43	30	10
Non-Survival	18	6	123	41
Prediction Accuracy %	87%		80%	

In our study 147 patients were SAPS score <60 showing good prognosis of which 87% are survived. While in other 153 patients had SAPS score >60 showing poor prognosis of which 80% died. this signifies good prediction accuracy of SAPS.

Table 7: Prediction Comparison Of Real Time Outcome And Saps Score Prediction Outcome And Sofa Score Prediction Outcome

Outcome	Real Time Outcome	SAPS Score Predicted Outcome	Sofa Score Predicted Outcome
Survived	159 (53%)	147 (49%)	180 (60%)
Non-Survived	141 (47%)	153 (51%)	120 (40)
P value		0.32	0.08

In our study real survived patients were 159 out of 300, while SOFA predicted 180 patients should survived, P is value 0.08 that is insignificant

DISCUSSION

SAPS and SOFA scoring systems are simple and require non-sophisticated data, unlike APACHE and MPM prognostic score systems. SOFA is mainly used to evaluate the clinical course sequentially and maintain a semiquantitative estimation of mortality. Therefore, it can be observed that SOFA has a disadvantage in failing to show actual clinic state comparing to SAPS. SAPS utilization is claimed to be valid for surgical patients with good discrimination and calibration power, but the SOFA score has not been fairly evaluated in surgical patients in our country.[18]

The mean age in our study was 55.32 ± 17.88 years with majority of patients are in age group 61-75 years (32%) followed by 46-60 years (30%) age group. The Gender distribution in our study were 71% male patients vs 29% female patients. Abelha et al[19] found mean age was 64.11 ± 13.6 with 64% male patients. Tobi et al[20] found male: female ratio of 2.2:1, with males constituting 68.9% of the patients. Sim et al[21] found the median age was 72 years (range, 18-90 years); 94 patients (56%) were male. These studies from developed countries had patients of higher age group as compared to our study but gender distribution is similar.

For SAPS score, in our study majority of patients are found in 51-60 score (46%) followed by 31% patients in 61-70 score. Mean SAPS score of study population is 57.01. In our study 147(49%) patients were having SAPS score <60 showing good prognosis of which 87% have survived. While, the other 153 patients had SAPS score >60 showing poor prognosis of them 80% died. This signifies good prediction accuracy of SAPS. Its p value is <0.0001. In our study 150 patients out of 300, had SOFA score less than < 12 showing good prognosis of which 88% were survived. Rest 150 patients out of 300, had SOFA score more than >12 showing poor prognosis of which 82% died. This signifies good prediction accuracy of SOFA.

Most of the patients in our study population having SOFA scores of 6-10 on admission in ICU approx. (45%), followed by patients 11-15 scores (43%). A study conducted by Hewitt et al[22] showed that out of 800 patients on day 1, day2 and day3 most of the patients had score of between 4-8.

In our study 150 patients out of total 300, had SOFA score less than 12 showing good prognosis, with 88% prediction accuracy for survival. While remaining 150 patients had SOFA score more than 12, showing poor prognosis, with 82% prediction accuracy for mortality, died. In study of Jentzer et al[23] out of 12904 patients the day 1 mortality was highest (>60%) in patients having SOFA score more than 12. This signifies good prediction accuracy of SOFA.

Originally, SOFA score is computed 1 day after ICU admission and every 2 days subsequently. The highest scores are claimed to be most predictive of mortality. In our study, SOFA and SAPS scores were calculated using data derived in the ICU admission day 0 prospectively and the average scores were significantly higher in the non-surviving group.[24] In our study patients survived in real time were 159 (53%) out of 300, while SOFA predicted 180 (60%) patients mortality, which is quite comparable with not significant p value.

In our study patient survived in real time were 159 (53%) out of 300, while SAPS predicted 147 (49%) patients mortality, which is quite comparable with not significant p value.

For any comparative study, it will be unjust if we don't compare obtained deducted values with the real time outcome. In our study, out of a total of 300 patients SAPS score predicted survival for 147 patients but in reality, 159 patients survived (p value -0.32) being not significant. Similarly, out of total 300 patients, SOFA score predicted survival for 180 patients, but in real time, 159 patients survived suggesting that prediction was exaggerated. P value here was 0.08, not significant.

CONCLUSION

The good prognostic abilities of SOFA and SAPS in our study suggests that they could be used to identify high risk patients, enabling timely initiation of pro-active measures before irreversible deterioration happens. SOFA and SAPS both are not only reliable but also genuinely effective in prediction of ICU mortality risk identification. Both scoring systems can be used to triage patients into various risk categories for fine tuning the management and resource planning.

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