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Usefulness of the Surgical Apgar Score to Predict the Occurrence of Major Complications in the Early Post-Operative Period of Major Surgeries: Experience of Two Second-Category Hospitals in Cameroon

Charles Emmanuel Toussaint Binam Bikoi[1], Francis Ateba Ndongo[2], Serge Vivier Nga Nomo[3], Édouard Léa Mekoui Ze[1], Fidèle Binam[3]

[1]Department of Anesthesia and Intensive Care, University of Ebolowa, Ebolowa, Cameroon
[2]Yaounde Mother and Child Center, Chantal Biya Foundation, University of Garoua, Garoua, Cameroon
[3]Department of Anesthesia and Intensive Care, Catholic University of Central Africa, Yaounde, Cameroon
Email: charlesbinambikoi@gmail.com, binam_04ng@ymail.com, serges771@gmail.com

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Abstract

Objective: The Surgical Apgar Score (SAS) is a tool for intraoperative stratification of the risk of serious complications in the early postoperative period. It varies from 0 to 10 points divided into three risk categories (0 to 4 high, 5 to 7 moderate, 8 to 10 low). The aim of the study was to evaluate its relevance in predicting the appearance of these complications. **Material and methods**: This descriptive and analytical study was carried out at the "Laquintinie" Hospital in Douala and at the Central Hospital in Yaounde, Cameroon. The main data were collected on a population of patients over 18 years old and recorded on a survey form. They consisted of variables of main interest and exposure variables. Univariate and multivariate statistical analysis using top-down logistic regression models made it possible to evaluate the association of each variable of main interest and each exposure variable. The association was significant at $P < 0.05$. The multivariate analysis assessed the strength of the link by concomitantly adjusting for the other exposure variables having a level of significance ≤0.25 in univariate, and in the final model those presenting a significance ≤0.05. The relation was significant at $P < 0.05$. **Results**: Of the 88 patients studied, the SAS was < 4 for 17, 5 - 7 for 66. Univariately, the prevalence of complications was significantly higher in the category of SAS < 4; OR (CI) 0.1 (0.1 - 0.2) as well as for Altemeier classes 3 and 4, ASA 3 and 4, the duration of the intervention > 3 hours. In multivariate, this link persisted only and strongly for the SAS OR (IC) 0.1 (0.1 - 0.2) and p = 000. **Conclusion**:

The study found a specific and powerful link between the SAS score < 4 and the occurrence of complications in the early postoperative period, in favor of its relevance in predicting them.

Keywords

Early Postoperative Complications, Major Surgeries, Surgical Apgar Score

1. Introduction

A major surgery [1] is one in which the surgical procedure itself is responsible for a strong attack that could create imbalances in the patient with significant morbidity and mortality in the early postoperative period, located within 30 days following the surgery [2]. The intervention generally involves an opening of one of the main body cavities (abdomen, thorax and skull), or an extended orthopedic surgery procedure, a long duration, significant bleeding, with serious complications (grade IV and V of the Clavien Dindo classification [3], **Table 1**).

The prediction of surgical risk is then important to provide information allowing the clinician to better guide patient care [4]. Thus, immediate postoperative admission in the intensive care unit for patients at risk has shown its effectiveness in limiting the occurrence and controlling the progression of these complications [5]. Such an anticipatory approach is still only effective for less than 15% of cases concerned, due to the unavailability of reliable and easily accessible post-operative risk stratification criteria [4] [5]. Most of the available exposure criteria, such as socio-anthropomorphic parameters, the ASA and Altemeier scores, do not consider the impact of intraoperative performance on the patient's progress, and taken individually, their reliability remains limited [5] [6]; others such as the "APACHE" system (Acute physiology and chronic evaluation) or the "POSSUM" (The Physiologic and Operative Severity Score for Enumeration of Morbidity and Mortality), are more exhaustive in interpretation but difficult to access and manage in acute contexts [7] [8]. The Surgical Apgar Score (SAS), proposed in 2007 by Gawande *et al*., [7] [9] is a unique evaluation tool that takes into consideration intraoperative performance for the estimation of morbidity and mortality in early postoperative phase. It is made up of three intraoperative parameters which are: the lowest heart rate (HR), the lowest mean arterial pressure (MAP) and the total estimated blood loss [7] [8] [9] [10], sides from 0 to 4 for the first, and 0 to 3 for the last two. The value of the SAS, represented by the sum of the points obtained at the end of the intervention, varies from 0 to 10 (**Table 1**). Gawande's study showed that the lower this score was (<4), the more it was significantly associated with significant morbidity and mortality or a prolonged length ofhospitalization postoperatively [8] [9] (**Table 2**). Its routine use will also depend on the strength of the relationship between the level of the SAS score and the occurrence of complications in current practice [6] [10].

Table 1. *SAS* [3].

***SAS parameters* (*Regenbogen et al.*, 2009)**	***SAS rating***
Lowest HR* /min (Rated 0 to 4)	**0**: > 85 **1**: 76 to 85 **2**: 66 to 75 **3**: 56 to 65 **4**: ≤55
Lowest MAP** in mmHg: (Rated 0 to 3)	**0**: <40 **1**: 40 to 54 **2**: 55 to 69 **3**: ≥70
Estimated blood loss in ml Rated from 0 to 3	**0**: >1 000 **1**: 601 - 1 000 **2**: 101 - 600 **3**: ≤100
Risk of post-operative complications	**Score SAS**
High risk	0 - 4
Moderate risk	5 - 7
Low risk	7 - 10
Graduation of post-operative complications according to their severity	
Complications	**Ranks**
Complications requiring only antiemetic, antipyretic, analgesic, diuretic, electrolyte treatments, physiotherapy	**1**: example: Ileus, wall abscess laid flat at the bedside of the patient
Complication requiring pharmacological treatment not authorized at grade 1	**2**: example : Peripheral venous thrombosis, total parenteral nutrition, transfusion
Complication requiring surgical, endoscopic or radiological treatment	IIIa: without AG: ex Radiologically guided puncture IIIb: under AG ex. Surgical revision
	IIIa: without AG: ex Radiologically guided puncture IIIb: under AG ex. Surgical revision
Complication requiring intensive care	IV a: failure of an organ e.g. dialysis IV b: multiple organ failure
Death	V

HR*: Hearth rate; MAP**: Mean arterial pressure.

Table 2. Number of patients according to surgery and prevalence of complications according to surgery and SAS categories.

Variables		Univariate analysis			
			Prevalence of major complications in early postoperative and link with the SAS		
Interventions	SAS	N	n	%	P
Obstetric/gynecology (cervical neoplasia + complicated ovarian cysts, polymyomatous uterus Ruptured ectopic pregnancy, Uterine rupture)	0 - 4	06	06	100.0	0.001
	5 - 7	33	03	9.1	
	8 - 10	03	0	00	
Digestive surgery (Peritonitis, intestinal obstructions, pancreatic neoplasia)	0 - 4	08	05	62.5	0.017
	5 - 7	14	02	14.28	
	8 - 10	02	0	00	

Continued

	0 - 4	03	02	2/3	0.011
Trauma surgery (abdominal trauma, femur fractures)	5 - 7	19	1	5.3	
	8 - 10	0	-	-	-

N: Total number of subjects in the category considered; **n**: Number of subjects in the category considered who developed at least one major early post-operative complication; **%**: Percentage; **p**: Level of significance (Fischer's exact test).

In developing countries, the incidence of postoperative complications and mortality remains high [11] [12] [13]; they often arise unexpectedly with relative unpreparedness for their management. The performance of SAS for better prediction of postoperative risk could help improve the survival rate of patients at risk. The aim of the present study was to evaluate the relevance of the SAS score to predict in current practice the occurrence of these complications in the early postoperative period of major surgical interventions in two second category hospitals in the cities of Yaounde and Douala in Cameroon.

2. Methodology

2.1. Study Design

This descriptive and analytical study was conducted during the period from May to November 2022 in 2 second category hospitals in Cameroon (Central Hospital of Yaounde and Laquintinie Hospital of Douala). It enrolled patients aged 18 and above undergoing major surgery who volunteered to participate in the study. Excluded from the study were patients who may have difficulty expressing their signs in event of complications, patients who died during surgery, and those lost from follow-up during the study period.

The estimated minimum sample size (N) was calculated using the following formula: $N = Z^2 \times P(1 - p)/m^2$ [14], where Z = confidence level, the typical value of a confidence level at 95% being 1.96; p = estimated prevalence of the variable studied here, major interventions: 4% from the registers of the operating theaters concerned; m = margin of error = 0.05; *i.e.* $N = (1.9)^2 \times 0.04\ (1 - 0.04)/0.052 = 58{,}358$ (59) patients.

Monitoring of study participants and data collection: The data collected before the surgical intervention included sociodemographic parameters, information on the surgical pathology to be operated on, Altemeier and ASA classes, the chosen anesthesia technique; during the intervention the SAS (**Table 1**) parameters, and at the end of the intervention the duration of the intervention was noted, the SAS calculated and scored as described above [7] [8]. The HR and the MAP were taken from the values automatically displayed on the multiparameter monitor (Mindray MEC-1000), the blood losses quantified from the blood contained in the suction jar and that deduced from the weighing of the gauzes and the surgical linen freshly soaked in blood using a precision balance type S F 400 Light Cameroon; the difference between the weight of the wet laundry and its weight in the dry state being the weight of the blood of which 1g corresponds to

1cc [15]. In the early postoperative period, serious complications and deaths were recorded through regular monitoring of patients during hospitalization and then after returning home by telephone. The following were considered serious complications [10]: respiratory complications including respiratory failure with the need for mechanical ventilation > 48 hours and/or requiring emergency intubation, significant pleural effusions, atelectasis, bronchospasm; infectious complications which included deep infections of the surgical wound or those distant from the surgical site, generalized sepsis; cardiovascular complications, including shock, serious arrhythmia, myocardial ischemia, cardiac arrest; neurological complications including disorders of consciousness and confusional syndromes > 24 hours, strokes; digestive complications including post-operative peritonitis, major hernias, intestinal obstructions, digestive fistulas, stress ulcers; hematological and renal complications with respectively, major bleeding (requiring ≥ 4 units of packed blood cells within 72 hours; venous thromboembolism including pulmonary embolism, acute renal failure; all cases of emergency post-operative re-interventions were also included. The number of serious complications was recorded for each type of surgery and integrated for each SAS category.

2.2. Statistical Analysis

The variables of main interest studied were the major complications recorded early postoperatively. The exposure variables (risk factors) included the main exposure variable which was the SAS (with 3 stages of estimation of the risk of occurrence of major post-operative complications), and the other exposure variables including the other most commonly used post-operative complication risk stratification tools, namely socio-demographic parameters (gender, age), ASA and Altemeier scores, type of surgery (regular or emergency), anesthesia (general or loco-regional), the duration of the surgical intervention (<3 hours, or > 3 hours) [5] [10].

The statistical analysis was carried out in three descriptive, univariate and multivariate sections. The descriptive analysis made it possible to note the extent and distribution of perioperative sociodemographic and clinical characteristics, as well as that of major complications in the early postoperative period, with the use of numbers, proportions or median associated with an interquartile range. Univariate analysis, using logistic regression models, evaluated the association of each variable of main interest retained and each exposure variable. Considering the values of the crude Odds Ratio (OR) and the P, the association was significant for $P < 0.05$.

The strength of the connection observed in univariate was verified by multivariate analysis using logistic regression models; it thus evaluated the association between the SAS and each variable of main interest, while adjusting concomitantly for the other exposure variables. The exposure variables having presented a degree of significance (Wald test) ≤ 0.25 at the level of the univariate analysis were retained for the multivariate analysis, and age which is generally a con-

founding factor a priori in morbidity or mortality studies (clinical research). Only variables presenting a level of significance ≤ 0.05 (Wald test) and age were retained in the final multivariate model obtained by elimination of variables using a top-down approach. The association between the variable of main interest and the exposure variable was measured using the odds ratio (OR) with 95% confidence interval (95% CI).

To confirm that the observed link was not due to chance, it was necessary to refer to the confidence interval (CI): this link was significant for a CI not including the number 1 and the value of P confirmed the level of significance observed with the CI for $P < 0.05$. The data were analyzed using STATA 12 software.

2.3. Ethical Considerations

Patients were recruited into the study after the informed consent, confidentiality was respected, and appropriate care was provided if necessary. The study presented no conflict of interest.

3. Results

In total, 88 patients were included in the study, 56 (63.6%) of whom were female. The major surgical interventions recorded included 42 cases of gyneco-obstetric surgery (47.7%), 24 of digestive surgery (27.3%) and 22 of trauma surgery (25%) (Table 2).

The median age was 36 years, range 18 to 68 years, with an interquartile range of 29.0 to 47.0. The variables representing the exposure parameters are shown in Tables 3a and 3b. This was about age with 18 (20.45%) patients whose age was > 50 years; ASA class with 41 patients (46.6%) ASA 2 and 47 ASA 3 and 4; of the Altemeier class with 48 (54.54%) Altemeier 2 and 40 Altemeier 3 and 4 patients. Furthermore, surgery was performed urgently for 30 patients (34%), and the duration of the interventions was ≥ 3 hours for 39 patients (44%); the SAS score was < 4 for 17 patients (19.3% of cases), 5 - 7 for 66 (75%) and 8 - 10 for 5 (5.69%). Surgery was performed under general anesthesia (GA) and spinal anesthesia (SA) in 62.5% and 37.5% of cases, respectively. The most frequent complications in the early postoperative period included (Table 3(a) and Table 3(b)): 13 cases of cardiovascular complications (19.1% of patients), consisting of cardiac arrhythmias (57%), and states of shock; 13 cases of septic complications (Sepsis, urinary tract infection, peritonitis, surgical site infection, evisceration) (19.1% of patients); 11 cases presented respiratory complications (acute respiratory distress or respiratory infection) (16.2% of patients). Furthermore, 04 deaths were recorded and 05 cases of hemorrhagic complications (uterine hemorrhage, disseminated intravascular coagulation, digestive hemorrhage) (7.4%).

Association between the SAS and the occurrence of major complications in the immediate post-operative period

The results of the univariate analyzed of the association between the occur-

rence of overall major post-operative complications and the SAS stratified according to the categories of surgical interventions are represented in Table 2. They showed that interventions with a SAS score < 4 were significantly associated with a more frequent occurrence of these complications (Table 2) (p = 0.001, 0.017, 0.011) respectively for gynecological, obstetrical, digestive and trauma surgery interventions. Patients with a SAS of 8-10 did not experience any of these complications.

At the end of the univariate and multivariate analyses, a low SAS was significantly associated with a more frequent occurrence of listed major cardiovascular, respiratory and septic complications: adjusted odds ratio (OR) and 95% confidence interval (95% CI) = 0.1 (0.1 - 0.2); p < 0.001 (Table 3(a) and Table 3(b)). Furthermore, a SAS indicating a high risk of major post-operative complications presented a similar significant association with a more frequent occurrence of all 3 types of major post-operative complications above considered as a whole, at the end of the univariate and multivariate analysis(OR (95% CI) = 0.1 (0.1 - 0.2); p < 0.001) (Table 3(b)).

When we take into consideration the other exposure variables at the end of the multivariate analysis apart from the SAS, contaminated or dirty surgery was significantly associated with a more frequent occurrence of early post-operative major septic complications (OR (95% CI) = 10.8 (1.3 - 92.6); p = 0.030) (Table 3(b)); the ASA score 3 and 4 was strongly associated with a more frequent occurrence of major post-operative respiratory complications (OR (95% CI) = 17.1 (1.6 - 185.3); p = 0.019) (Table 3(a)); age > 50 years was moderately associated with a more frequent occurrence of major septic complications (OR (95% CI) = 7.5 (0.8 - 67.8); p = 0.074) (Table 3(b)). Thus, among the exposure parameters, only the SAS score presented a solid link with all the variables of main interest (complications). The proof of the solidity of this connection was thus confirmed by the results of the multivariate analysis and the adjusted OR.

4. Discussion

Serious postoperative complications still constitute a significant problem throughout the world and particularly in developing countries where their incidence has been estimated at one on five patients, with twice as many deaths in Africa than elsewhere [11] [12] [13]. Infectious complications were among the most frequent in the present study, as in the majority of studies in Cameroon and Africa [12] [13] [16] [17]. Cardiovascular complications were just as frequent, more linked to hypovolemic shock, we noted the absence of ischemic attacks, which are still rare in the general population unlike those in developed countries [18]. The rate of serious complications and mortality mentioned above reveals an often unsuitable organization and the difficulties of their management [5] [13]. Predicting these problems is an approach that makes it possible to better guide the choice of the most appropriate care, such as the timely admission of patients at risk to initiate appropriate care within the required time frame [5].

Table 3. (a): Cardiovascular and respiratory complications; (b) Post-operative complications.

(a)

Cardiovascular complications								
Variable	**Univariate analysis Multivariate analysis**							
	***N*1**	***n***	**%**	***Raw OR* (95% *CI*)**	***p***	***adjusted OR* (95% *CI*)**	***p***	**N_2**
SAS								88
0 - 4	17	13	76.0	1	<0.001	1	<0.001	
5 - 10	71	05	07.1	0.1 (0.1 - 0.2)		0.1 (0.1 - 0.2)		
Surgery								
scheduled	58	13	22.4	1	0.431			
emergency	30	04	13.6	0.6 (0.1 - 2.3)				
Duration								
≤3 hours	49	07	14	1	0.206			
>3 hours	39	10	25.6	2.2 (0.7 - 7.7)				
ASA class								
II	41	04	14.8	1	0.016			
III et IV	47	27	57	7.7 (1.5 - 40.4)				
Altemeier								
II	48	04	08.3	1	0.024			
III et IV	40	13	32.3	5.0 (1.2 - 20.2)				
Gender								
Male	32	08	25.0	1	0.429			
Female	56	09	16	0.6 (0.2 - 2.1)				
Age (years)								
≤50	70	10	14.0	1	0.023	1	0.125	
>50	18	08	44.5	5.1 (1.3 - 20.1)		4.4 (0.7 - 29.6)		
Major respiratory complications								
	N_1	***n***	**%**	***Raw OR* (95% *CI*)**	***p***	***Adjusted OR* (95% *CI*)**	***p***	
SAS								
0 - 4	17	11	65	1	<0.001	1	<0.001	
5 - 10	71	04	05.6	0.1 (0.1 - 0.2)		0.1 (0.1 - 0.2)		
Surgery								
Planned	58	09	15.5	1	0.756			
Emergency	30	05	17	1.2 (0.3 - 4.8)				
Duration								
≤3 hours	49	03	06	1	0.017			
>3 hours	39	011	28.2	7.2 (1.4 - 36.3)				

Continued

ASA class								
II	41	04	09.8	1	0.001	1	0.019	
III et IV	47	34	72	22.9 (3.6 144.8)		17.1 (1.6 - 185.3)		
Altemeier								
II	48	02	06	1	0.022			
III et IV	40	11	27.5	6.7(1.3 - 33.7)				
Gender								
Male	32	08	25.0	1	0.210			
Female	56	07	12.5	0.4 (0.1 - 1.6)				
Age (years)								
≤50	70	11	15.8	1	0.367	1	0.125	
>50	18	03	17	1.2 (0.2 - 6.4)				

(b)

Variables				**Univariate analysis**		**Multivariate analysis**		
				Major post-operative septic complications				
	N_1	*n*	*%*	*Raw OR (95% CI)*	*p*	*Adjusted OR (95% CI)*	*p*	N_2
SAS								88
0 - 4	17	13	76	1	<0.001	1	0.001	
5 - 10	71	05	07.1	0.1 (0.1 - 0.2)		0.1 (0.1 - 0.2)		
Surgery								
Planned	58	13	22.5	1	0.431			
Emergency	30	04	13.3	0.6 (0.1 - 2.3)				
Duration								
≤3 hours	49	03	06	1	0.017			
>3 hours	39	11	28.2	7.2 (1.4 - 36.3)				
ASA								
I ou II	41	07	14.6	1	0.016			
III ou IV	47	24	51	7.7 (1.5 - 40.4)				
Altemeier								
I et II	48	03	6	1	0.007	1	0.030	
III et IV	40	14	35	8.9 (1.8 - 44.2)		10.8 (1.3 - 92.6)		
Gender								
Male	32	10	31	1	0.148			
Female	56	08	14.3	0.4 (0.1 - 1.4)				

Continued

Age (years)								
≤50	70	10	14.28	1	0.023	1	0.074	
>50	18	08	44.5	5.1 (1.3 - 20.8)		7.5 (0.8 - 67.8)		
				Major overall post-operative complications				
	***N*1**	***n***	**%**	***Raw OR* (95% *CI*)**	***p***	***Adjusted OR* (95% *CI*)**	***p***	***N*2**
SAS								88
0 - 4	17	16	94	1	<0.001	1	<0.001	
5 - 10	71	10	14	0.1 (0.1 - 0.2)		0.1 (0.1 - 0.2)		
surgery								
planned	58	16	27.6	1	0.932			
Emergency	30	08	26.7	1.0 (0.3 - 2.3)				
Duration								
≤3 hours	49	09	18.4	1	0.075			
>3 hours	39	15	38.5	2.7 (0.9 - 8.1)				
ASA								
I ou II	41	9	22.0	1	0.017			
III ou IV	47	34	72	8.4 (1.5 - 48.1)				
Altemeier								
I et II	48	07	14.5	1	0.009	1	0.030	
III et IV	40	18	45	4.8 (1.5 - 15.6)		10.8 (1.3 - 92.6)		
Gender								
Male	32	13	40.0	1	0.157			
Female	56	13	23	0.5 (0.2 - 1.4)				
Age (years)								
≤50	70	15	21.4	1	0.008	1	0.074	
>50	18	11	61.7	6.6 (1.7 - 26.2)		7.5 (0.8 - 67.8)		

The implementation of a risk prediction model then strongly contributes to optimizing the survival rate of patients at risk [5] [19]. The SAS turns out to be a unique predictive risk score, due to its easy use with the help of parameters easily accessible intraoperatively. Like the Apgar score described by Virginia for newborns, the primary use of the SAS is to provide the practitioner with a tool within optimal time frames to predict the occurrence of adverse events in the early postoperative period. Until now, these predictions were essentially based on subjective criteria, especially preoperatively [7]. In the present study, the SAS

was calculated for each of the interventions carried out using simple means as described above. The SAS category which corresponded to a score < 4 (which would predict the more frequent occurrence of serious and early postoperative complications) included 17 patients; and the univariate analysis showed that there was a link between a SAS < 4 and a higher frequency of occurrence of these complications for all the interventions performed. These results were similar to those of the vast majority of studies carried out, with the aim of answering the clinical question of whether the SAS was an effective assessment tool for the prediction of serious complications in the early postoperative period, as well of course, large series of varied interventions [19] [20], as well as those relating to a specific intervention [21] [22] [23]. They found that low SAS was significantly associated with a greater number of early postoperative complications. Rare studies have found a rather weak connection sometimes for interventions such as those for orthopedic or emergency surgery [19] [23] [24] [25]. The present study also found a similar significant association between a more frequent occurrence of the three types of early postoperative complications recorded considered individually and in their totality and a SAS < 4. Considering the other exposure variables outside the SAS, and in the final multivariate model obtained by eliminating variables using a top-down approach, while a low SAS remained strongly linked to a more frequent occurrence of these complications, these other exposure variables were only weakly and/or partially linked to the more frequent occurrence of these complications; like contaminated or dirty surgery significantly associated only with the more frequent occurrence of early post-operative major septic complications, ASA classification 3 and 4 strongly associated significantly only with a more frequent occurrence of major post-operative respiratory complications; age > 50 years moderately associated with a more frequent occurrence of early post-operative major septic complications. As for the duration of the intervention > 3 hours, it was only in univariate terms that it was significantly linked to a greater occurrence of respiratory and septic complications. The association of the above variables with the SAS has sometimes been proposed to strengthen the reliability of this score [26]. Thus, in order to help alleviate the remaining minor discrepancies on the reliability of the SAS to predict postoperative complications for certain surgeries such as emergency surgery, Yakar *et al.* [26] proposed the use of the modified SAS (mSAS) calculated by adding the operation duration to the data used in the SAS calculation (Operation duration >8 h: 4 points; 7.01 - 8 h: 3 points; 5.01 - 7 h: 2 points; 3.01 - 5 h: 1 point; 0 - 3 h: 0 points added).In relation to previously low SAS, results revealed a statistically significant relationship between mSAS and total number of complications (as operative time [OT] increased): patients with a surgical Apgar score of 4 or less were 3.7 times more likely to experience a major complication ($p = 0.01$) and 24 times more likely to die within 90 days of surgery ($p = 0.0007$). They then suggested that operative time should be event as a simple, objective and practical indication of SAS in major operations. In the present study, among the exposure

parameters, only the low SAS score presented a solid link with all the variables of main interest (complications), which proved the solidity of this connection and confirmed that the observed connection was not the result of chance.

This study is limited in the sample size in that probably a larger sample size could have been more explicit with the findings. A small sample size could also increase the risk of type II errors and reduce the power of the study. The study may have encountered selection bias in the patients who were enrolled in the study. Because the study excluded patients who may have difficulty expressing their signs in the event of complications, patients who died during surgery, and those lost to follow-up during the study period. Further studies should be carried out on large cohorts to consolidate our results.

5. Conclusion

The SAS is an easy score to calculate from intraoperative parameters alone. In the present study, this simple score showed its ability to predict the occurrence of serious complications in the early postoperative period in the various surgical procedures performed. The SAS would then make it possible to better guide the clinician to determine appropriate treatment. Taking into account the above and its easy calculation, the SAS can be used in our health facilities as a simple scoring system to predict the post-operative prognosis and anticipate the most appropriate care. Therefore, a patient with low intraoperative SAS should be considered at risk and subject to meticulous monitoring.

Declarations

Ethics Approval and Consent to Participate

The Ethical Review Board of the school of health sciences of the Catholic University of Central Africa (No. 2022/022609/CEIRSH/ESS/MAR) approved the study protocol. Written informed consent was obtained from patients after providing them with adequate explanations regarding the aims of the study. Also, we have read and complied with the instructions to the authors and in particular the policy of the journal on ethical consent and standards of human health care. The human material and human data were performed in accordance with the Declaration of Helsinki.

Availability of Data and Materials

The datasets generated and/or analyzed during the current study are not publicly available due to patient confidentiality but are available from the corresponding author at a reasonable request.

Authors' Contributions

Binam Bikoi, Mekoui Ze and Binam F conceived and designed the study. Binam Bikoi, Nganomo S and Binam F were responsible for the supervision and coordination of this study. Binam Bikoi, Mekoui Ze conducted the data collection.

Binam Bikoiand Nganomo S led the data analysis with inputs from Ateba Ndongo F and Binam F. The first draft of the manuscript was written by Binam Bikoi, and Binam F. Ateba Ndongo F, Nganomo S and Mekoui Ze contributed to revising and reviewing the manuscript. All authors read and approved the final manuscript before submission.

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Conflicts of Interest

The authors declare no conflict of interest. They are not personally or professionally connected with any commercial enterprise having a direct or indirect relationship with the subject matter covered in this manuscript.

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