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Original Research Article

ASSOCIATION OF SURGICAL APGAR SCORE WITH POSTOPERATIVE MORBIDITY AND MORTALITY IN HIP FRACTURES: A PROSPECTIVE COHORT

RAFIQ SU*, AHMAD T, MARIAM F, JAMAL S, KHAN MAG, SULAIMAN MA

Department of Orthopedics Surgery, Aga Khan University Hospital Karachi, Pakistan
**Corresponding author`s email address:* syed.umar.rafiq@gmail.com

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Abstract: *Hip fractures are mostly associated with post-operative morbidity and mortality. The Surgical Apgar Score considers the intraoperative parameters for risk estimation of postoperative complications or mortality.* ***Objective:*** *To assess the association of surgical Apgar score with postoperative morbidity and mortality among patients with hip fractures.* ***Methods:*** *Thirty-eight patients of both genders aged≥18 years who underwent hip fracture surgery were included. Surgical Apgar Score (SAS) is based on intra-operative values of lowest heart rate (LHR), lowest mean arterial blood pressure (LMAP), and estimated blood loss (EBL). Mortality within 30 days of surgery was recorded. The normality of data was checked, and the Median (IQR) was reported due to non-normal distribution. Frequencies and percentages were calculated for qualitative variables. Mann Whitney U-test was applied to study the association between SAS and postoperative complications. P-value ≤0.05 was considered as statistically significant.* ***Results:*** *Median age was 71 years [(IQR) 62.25-76.25]. Thirty-seven percent of patients were male, and 63.2% were female. Four patients (10.5%) experienced cellulitis, wound dehiscence, aspiration pneumonia, and the onset of supraventricular tachycardia during the post-operative phase. Four patients (10.5%) required readmission. 11 patients (28.9%) were retained in special care units for one to two days. The median surgical APGAR score was 7[(IQR) 6-8] in relation to the operating parameters. No statistically significant difference was discovered between the complication and the Apgar score (p=0.060).* ***Conclusion:*** *The Surgical Apgar score does not help predict the postoperative risk of complications and 30-day mortality after hip surgeries.*

Keywords: Surgical Apgar Score, Morbidity, Mortality, Hip Fracture Surgeries

Introduction

The femoral neck and trochanteric fractures, including intertrochanteric and subtrochanteric fractures or a combination of both, are commonly termed "Hip Fractures" (1). Hip fracture is a major public health problem in the Asian population, which is usually associated with significant postoperative systemic complications and high mortality due to the burden of major surgery in a morbid patient (2). In 1990, there were reportedly 1.66 million hip fractures globally. Epidemiologic predictions indicate that 2050 this annual global figure will increase to 6.26 million (3). Almost all cases of hip fractures require surgery and are associated with post-operative morbidity and mortality (4).
When patient safety and medical economics are considered, reducing the incidence of perioperative complications and mortality is an important issue (5). While selecting a method for risk assessment, clinicians should consider the predictive accuracy, simplicity, ease of access, and cost. In addition, the parameters associated with perioperative risk should be observable earlier to affect the clinical decision process in optimal time (6). Physicians need predictive tools for postoperative complications to analyze the perioperative risk (1). Several algorithms have been employed for perioperative risk assessment, for example, the American Society of Anesthesiologists Physical Status Classification System (ASA classification)(7,8), the Physiologic and Operative Severity Score for Enumeration of Mortality and Morbidity(9), and Surgical Outcome Risk Tool(10).
A revolutionary 10-point scoring system was introduced in 1953, the Apgar score (11), and graded feedback on the condition of newborns (12). More than five decades later, Gawande et al. published an Apgar score for surgery, a 10-point score to rate surgical outcomes (13). This scoring system is straightforward, with a range of 0 to 10 points that consider the lowest heart rate (LHR), lowest mean arterial pressure (MAP), and estimated blood loss (EBL) during surgery (14). The SAS is a comprehensive tool that provides a detailed assessment of the clinical and biological status of the patient, aiding in predicting mortality (15). However, studies investigating the effectiveness of SAS have yielded conflicting results. While some studies support its value in predicting postoperative outcomes, others focusing on gastric, neurosurgery, and orthopedic patients have been unable to establish a consistent relationship (16).
The Surgical Apgar Score is the most spartan score for predicting postoperative risks (11). According to Pittman et al., the SAS exhibits a modest postoperative morbidity discrimination level and mortality across various surgical specialties (17). According to Sakan et al., the Surgical Apgar Score (SAS) has been shown as a proven independent predictor of major postoperative complications and mortality within 30 days after different types of surgery. Further, in her study on the implementation of SAS on 43 hip fracture patients, it was concluded that the score ≤4 was a significant predictor for major postoperative complications within 30 days of surgery (18). Gawande et al. performed a retrospective study on Apgar Scores for surgery on 303 patients. They concluded that a 10-point score was significantly associated with significant complications or death within 30 days after surgery (19).
Previous literature regarding the utility of SAS in orthopedic surgery is scarce, and most of the studies are

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retrospective; hence, data accuracy may be subpar. Our prospective study aims to assess the reliability of the Surgical Apgar score in patients with hip fractures to predict post-surgery morbidity and mortality so that it can be used to aid in the decision of post-operative care in the future, whether the patient needs close monitoring (special/intensive care) or not.

Methodology

This prospective cohort study was conducted at the Aga Khan University Hospital, Karachi. ERC exemption was sought from the institution's Ethical Review Committee before the commencement of this study. A total of 38 patients were included in the study. The data was calculated using the non-probability consecutive sampling technique. All consecutive patients above 18 years of age undergoing surgery for hip fractures were included in this study. Patients for whom SAS was not recorded in the post-operative documentation before the patient left the operating room and those who were lost to follow-up were not part of this study. A 10-point scoring system, i.e., Surgical Apgar Score (SAS), based on intra-operative values of lowest heart rate (LHR), lowest mean arterial blood pressure (LMAP), and estimated blood loss (EBL), was used and recorded by the anesthetist intra-operatively. Patient progress was followed post-operatively as an inpatient by the primary orthopedic resident and validated by the principal investigator. Blood transfusion requirement, post-operative special care/intensive care need, or post-operative complications, if any, were recorded. After discharge from the hospital, the patient's medical records were followed for thirty days. Mortality of the patients within 30 days of Surgery was recorded. Any emergency room, orthopedic surgery clinic, or specialty clinic visit was noted and reviewed using the patient records. Any investigation done was also recorded up to 30 days post-surgery. This is a purely observational study, and no intervention was performed.

Data were compiled and analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Mean and standard deviations were calculated for the quantitative variables like age and SAS. The Wilks test checked the normality of the data. Median (IQR) was reported for those variables that were not normally distributed. Frequencies and percentages were calculated for the qualitative variables like gender, co-morbid conditions, postoperative complications, and mortality. A Mann-Whitney U-test was applied to study the association between SAS and postoperative complications. Stratification was also done on age, gender, and co-morbid conditions. Poststratification: Again, the Mann-Whitney U-test was applied to see the association of SAS between stratified variables. P-value ≤0.05 was considered statistically significant in all analyses.

Results

The study comprised 38 patients, with a median age of 71 years [(IQR) 62.25-76.25 years]. 36.8% of the patients were male and 63.2% were female. Most patients (81.6%) had previously experienced concomitant diseases (e.g., diabetes, hypertension, chronic renal disease, etc.). Table 1 illustrates the additional baseline characteristics of the study cohort. Four patients (10.5%) experienced cellulitis, wound dehiscence, aspiration pneumonia, and the onset of supraventricular tachycardia during the post-operative phase. All of these issues were treated appropriately after the relevant subspecialties were involved.

According to Table 2, 4 patients (10.5%) out of 38 patients required readmission because of acute kidney injury, chronic kidney disease, urinary tract infection, and chronic obstructive pulmonary disease exacerbation. Of the 38 patients, 11 (28.9%) were retained in special care units for one to two days until they were clinically and vitally stable; at this point, they were moved to a different ward. ICU stays were not necessary for any of the individuals.

The median surgical APGAR score for operating parameters was 7 [(IQR) 6-8]. The data is not normally distributed; hence, the median has been presented. Table 3 shows that the relationship between the surgical APGAR score and its components and post-operative problems was statistically significant, with p-values less than 0.05. Similarly, no meaningful difference was discovered between complications and the postoperative APGAR score (p=0.060).

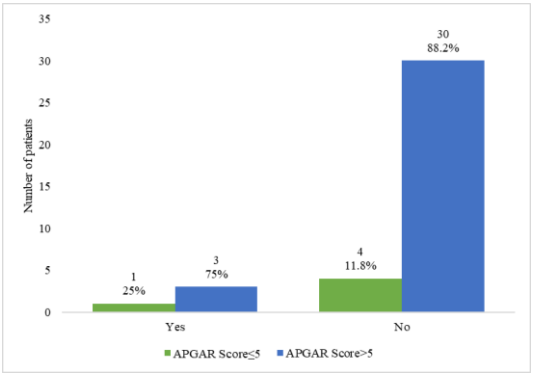

Figure 1: Distribution of surgical APGAR score according to complications

Table 1: Baseline characteristics of the study population

Characteristics	Frequency (%)
Gender	
Male	14 (36.8%)
Female	24 (63.2%)
Comorbid	
Yes	31 (81.6%)
No	7 (18.4%)
Type of injury	
Neck of femur fracture	18 (47.3%)
Intertrochanteric fracture	16 (42.1%)
Subtrochanteric fracture	2 (5.3%)
Implant failure	2 (5.3%)
ASA status	
I	4 (10.5%)
II	21 (55.3%)
III	13 (34.2%)
Post-operative PCV transfusion	
0	23 (60.5%)
1	11 (28.9%)
2	3 (7.9%)
3	1 (2.6%)

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Table 2: Frequency distribution of postoperative outcome

	Frequency (%)
Postoperative complications	**4 (10.5%)**
Cellulitis	1 (2.6%)
Wound dehiscence	1 (2.6%)
Aspiration pneumonia	1 (2.6%)
Supraventricular tachycardia	1 (2.6%)
Readmission	**4 (10.5%)**
Acute Kidney Injury	1 (2.6%)
Urinary Tract Infection	1 (2.6%)
Acute Kidney Injuryon Chronic Kidney Disease	1 (2.6%)
chronic obstructive pulmonary disease exacerbation	1 (2.6%)

Table 3: Association of Surgical APGAR score with post-operative complications and Surgical APGAR score components

	Complications Median (IQR)		P-value
	Yes	No	
Surgical APGAR Score	6.00 (5.25-6.75)	7.00(6.75-8.00)	0.060
Surgical Blood Loss (ml)	3.00(3.00-3.000)	3.00(3.00-4.00)	0.189
Lowest Recorded Intra-Operative Mean Arterial Pressure (mmHg)	3.00(3.00-3.00)	3.00(3.00-3.00)	0.521
Lowest Intra-Operative Heart Rate (bpm)	3.00(2.25-3.75)	4.00(3.00-4.00)	0.249

Table 4: Association of Surgical APGAR score with post-op complications

	Complications Frequency (percent)		P-value
	Yes	No	
APGAR Score≤5	1(25)	4(11.8)	0.446*
APGAR Score>5	3(75)	30(88.2)	
Total	**4**	**34**	
*Fisher exact test was applied. **Insignificant at 0.05 levels.*			

Discussion

Hip fractures are strongly associated with increased mortality rates in different studies worldwide (20). In recent years, predictive models for mortality risk after hip fractures have been developed to identify patients at a higher risk and propose intervention strategies to improve the outcomes of hip fractures (21). The challenge of establishing a pattern among the several variables associated with worsening and mortality outcomes (22) is related to the fact that these associations and the mortality rate assessments reported in different studies involving different populations and methodologies also present regional variations (23).

Haroon F et al. (1) conducted a study to predict postoperative morbidity and mortality among hip fracture patients. As patients with hip fractures usually have a sub-optimal medical condition, comorbidities, and compromised cardiopulmonary reserves, preoperative variables like age and ASA physical status are sometimes not sufficient to predict early and late postoperative course and the need for ICU surveillance. They showed that SAS ≤4 was a significant predictor for developing 30-day major complications. Patients with hip fractures having a score ≤4 should be identified by physicians as alarming cases who need intensive postoperative monitoring. In another, the lowest heart rate and estimated blood loss were associated with higher SAS values and better patient outcomes. Thus, the SAS value would be higher by avoiding higher heart rate and hypotension and applying a surgical technique with better hemostasis. Hence, intraoperative vital signs and hemostasis status significantly predict the patient's outcome (24).

Sakan et al., in their study, concluded that SAS≤4 in posttraumatic hip fracture patients was a significant predictor for the 30-day major postoperative complications. They also suggested that posttraumatic hip fracture patients with SAS≤4 should be under strict surveillance after surgery (18). However, the SAS was not significant in the prediction of 30-day mortality, which is consistent with the current study's findings (1).

Regenbogen et al. concluded that the score could effectively identify patients at higher or lower risk of significant complications and death after surgery than average likelihood and may help evaluate interventions to prevent poor outcomes (25). These results are consistent with the conclusion of the current study. Reynolds et al. conducted a survey in all surgical subspecialties and concluded that lower SAS was associated with an increased risk of death (26). Otherwise, our study did not find SAS as a predictive factor for 30-day mortality.

Thorn et al. concluded that the Surgical Apgar Score may be a reliable predictive tool in general and vascular surgery, but it appears to have a limited role in orthopedic surgery settings (27). Similarly, Urrutia et al., after studying the utility of SAS in general orthopedic surgery, concluded that it remains a weak tool for stratifying the postoperative morbidity and mortality risk (28). The limitations of the current study are that it was conducted in a single institution; second, all data were taken from handwritten anesthesia records, and reliability could not be assessed. Also, blood loss estimation could be questionable.

Conclusion

The results of the current study showed that the surgical

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Apgar score provides reliable information during surgery about patients' postoperative risk of complications and mortality. Hence, we can conclude that the surgical Apgar score can be used as a predictor of postoperative 30-day risk of complications and mortality among patients undergoing Hip surgeries.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (exempted by the institute)
Consent for publication
Approved
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Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

SYED UMAR RAFIQ (Resident)
Study Design, Review of Literature.
Conception of Study, Development of Research Methodology Design, Study Design, manuscript Review, and final approval of manuscript.
TASHFEEN AHMA (Assistant professor)
Coordination of collaborative efforts.
FIZZAH MARIAM (Intern)
Manuscript revisions, critical input.
SHAH JAMAL (Resident)
Conception of Study, Final approval of manuscript.
MUHAMMAD AHMED GHAZNI KHAN (Resident)
Manuscript drafting.
M AHSAN SULAIMAN (Resident)
Data entry and data analysis, as well as drafting the article.

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