ORIGINAL ARTICLE

Evaluation of clinical abdominal scoring system for predicting outcomes of blunt abdominal trauma

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ABSTRACT

BACKGROUND

Trauma has been called the neglected disease of modern society and the most common cause of death under 45 years. Determining the optimal prospective course of action may be aided by the adoption of a scoring system to evaluate urgent laparotomy intervention. A quick and easy technique to identify whether there are any intra-abdominal injuries is to use the clinical abdominal scoring system (CASS). The objective of this study was to evaluate CASS in predicting the outcomes in patients with blunt abdominal trauma (BAT).

METHODS

A retrospective observational study was conducted involving 80 patients with suspected BAT that arrived at the emergency department. All patients with suspected BAT were scored using CASS and radiological investigations that were done in the ED. The decision to proceed with the surgery would be made if the patient had CASS >12 and/or if the radiological investigation showed features of BAT such as air under the diaphragm.

RESULTS

Mean CASS score was 10.28 ± 1.340. The majority of the subjects (75 or 93.5%) had successful laparotomies, whereas only five (6.3%) had unsuccessful ones. Injuries to the spleen (42.6%), and liver (32%), combined injuries to the spleen and liver (2.6%), intestine (16%), pancreas (1.3%), bladder (4%), and kidneys (1.5%) were all found in positive laparotomies. The CASS has specificity of 60%, sensitivity of 80%, PPV 96.7%, and NPV 16.6%.

CONCLUSIONS

According to our data results, The CASS has a poor ability to predict the need for laparotomy in cases of blunt abdominal injuries as it shows low specificity.

Keywords: Blunt abdominal trauma, exploratory laparotomy, scoring system, emergency, trauma management, mortality

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INTRODUCTION

Abdominal blunt trauma continues to be a serious issue that needs more studies, as 15% of all trauma cases seen in emergency rooms throughout Asia, including Qatar, were blunt abdominal trauma cases, according to a previous study.[1] A total of 44 new cases of blunt abdominal trauma were recorded, of which 75% were males, and 79.5% of the CT scans revealed intra-abdominal organ rupture.[2] Determining the optimal choice for the patient's care requires weighing whether or not to do a laparotomy in the event of blunt abdominal injuries. Screening techniques, such the clinical abdominal scoring system (CASS), have been demonstrated to have great validity for patients with suspected intra-abdominal organ injury.[3] The validity of CASS was examined in a number of studies. The CASS is highly effective at determining laparotomy patients with abdominal trauma, according to research comprising 749 abdominal trauma patients. [4] Another study that included 46 patients with only blunt abdominal trauma (BAT) at the Emergency Unit of the Department of General Surgery at Zagazig University Hospitals revealed that CASS has higher sensitivity and specificity in BAT patients than do imaging modalities such as USG of the abdomen and CT scan.[5]

This score has a minimal measurement cost and a high degree of accuracy. With the aid of this score, patients who have suffered blunt abdominal injuries can cut down on the number of follow-up exams and consequently, on the expense of their care. The CASS score is calculated from the Glasgow coma scale (GCS), blood pressure, pulse rate, post-trauma status, and the findings of a clinical abdominal exam.[3] The clinical abdominal scoring system was found to result in considerably higher scores in patients with a positive need for laparotomy than in patients with a negative need, indicating that the CASS score can be used as a reliable index in identifying patients who need laparotomy following acute abdominal injuries.

The clinical abdominal scoring system (CASS) uses a different approach than the blunt abdominal trauma severity score (BATSS), has gained popularity recently, and is thought to be more effective. Additionally, it is considered to be a reliable scoring system because it is affordable and rapid detection results, allowing clinicians to manage more emergency cases. The CASS score system also makes it easier for clinicians to decide which patients require additional procedures like laparotomies by allowing them to make this determination based solely on the total CASS score without the need for additional examinations.[6]

This can be explained as CASS was designed for predicting the need for laparotomy in trauma rather than to predict mortality. However, in our study, CASS was not only used for predicting the need for laparotomy in BAT, but also for predicting the mortality rate. There are various components to our study that could potentially be seen as being more up to date than several other studies. However, the total CASS score acquired can be used to determine whether surgery, particularly exploratory laparotomy, can be performed immediately without anticipating the findings of complementary examinations. However, there were no conclusions in prior investigations about the usage of this CASS score in the therapeutic setting. Furthermore, by initiating prompt action, the CASS score can reduce postoperative problems caused by delayed therapy, as well as the patient's longer length of stay (LOS), which can be avoided, reducing the incidence of in-hospital mortality (IHM). The objective of the present study was to evaluate CASS in predicting the outcomes in patients with BAT.

METHOD

Research design

A study of observational design, using a retrospective study approach was carried out in the emergency department of Central General

Hospital Professor I.G.N.G. Ngoerah, Denpasar, Bali, Indonesia, between February 2022 and July 2022.

Research subjects

A total of 80 subjects was included in the study. The inclusion criteria in this study were patients with blunt abdominal trauma and aged more than 18 years, who were available from medical records. The exclusion criteria were incomplete medical records, pregnant women with acute abdominal trauma, patients with blunt abdominal trauma who did not undergo a laparotomy, patients with blunt abdominal trauma and laparotomy who were entered in the medical record outside the period of the study, and patients with Glasgow Coma Scale (GCS) = 3. For each participant, the investigators examined the CASS score recorded in the medical record at the moment the patient entered triage.

Data collection

Data collected from medical records included age, sex, pulse rate, systolic blood pressure, Glasgow coma scale, clinical complaints on the abdomen , and laparotomy. All patients who were suspected to have BAT were scored using CASS and radiological investigations that were done in the emergency department of Central General Hospital Professor I.G.N.G. Ngoerah, Denpasar, Bali by the junior resident under the guidance of a consultant. The decision to proceed with the surgery would be done if the patient had CASS of more than 12 and/or if the radiological investigation showed features of BAT.

The CASS is a scoring system that yields a maximum of 15 points based on clinical parameters. Total score range: 5-15 classified into 3 categories: priority one with a score of ≥ 12, in which patients underwent immediate lifesaving laparotomy following an initial phase of resuscitation; priority two with a score of 9-11, in which patients underwent auxiliary investigations in the form of abdomino-pelvic USG, CT scan, and X-ray. Final management was decided

according to the observed findings; and priority three with a score of ≤ 8, in which patients were kept under observation with no auxiliary investigations for an average of 24 hr for the suspected abdominal injury. The score was reevaluated 6 hr after admission and before discharge to avoid any missed injuries.

Statistical analysis

Data analysis was performed with the STATA SE 12.1 program. The Receiver Operating Characteristic (ROC) curve was used to determine the cut-off point of CASS in assessing the need for a laparotomy. Based on the area under the curve (AUC), the ability of CASS to determine the need for a laparotomy was good if the AUC score ≥ 0.7. The best intersection point of the CASS score to determine whether or not a laparotomy is needed is based on the coordinate farthest from the curve to the diagonal line.

Ethical clearance

Under license number 508/ UN14.2.2.VII.14/LT/2022, the Ethics Committee of the Faculty of Medicine at Udayana University in Denpasar granted approval for this research.

RESULT

The mean age of the subjects was 33 (± 15.0) years. The 80 subjects consisted of 59 (73.8%) men and 21 (26.3%) women. There are three categories of trauma onset or time of presentation to the emergency room: 2 hours, 2–6 hours, and >6 hours. Trauma onset was later than 6 hours in 53.8% of participants overall, and followed by 2–6 hours in 28 (35%). The characteristics of the study participants are displayed in Table 1.

After determining the patients' pulse rate, systolic blood pressure, and Glasgow Coma Scale (GCS) score, it was found that their vital signs were generally stable. There were 42 (52.5%) 28 participants with a pulse rate of >110. Forty eight participants (60.0%) had a systolic blood pressure between 90-120 and. 69 (86.3%) of the

Table 1. Distribution of characteristics of the research subjects (n=80)

Variable	
Age (years)	33 ± 15.00
Gender	
Male	59 (73.8)
Female	21 (26.3)
Trauma onset	
<2 hours	9 (11.3)
2-6 hours	28 (35)
>6 hours	43 (53.8)
Pulse rate (beats/minute)	
< 90	28 (35.0)
90-110	10 (12.5)
>110	42 (52.5)
Systolic blood pressure (mmHg)	
<90	19 (23.8)
90-120	48 (60.0)
>120	13 (16.3)
Glasgow coma scale (GCS)	
<9	2 (2.5)
9-12	9 (11.3)
13-15	69 (86.3)
Clinical complaints on the abdomen	
Painful	8 (10.0)
Tenderness	28 (35.0)
Abdominal guarding	44 (55.0)
CASS score	10.28 ± 1.34
Laparotomy	
Positive	75 (93.8)
Negative	5 (6.3)

Data presented as n (%), except for age and CASS score (mean ± SD);CAS : clincal abdominal scoring system

individuals had GCS 13 to 15. In this study, a CASS score of 10.28 ± 1.340 was considered average. Among those who had a successful laparotomy, injuries to the spleen (42.6%), liver (32%), spleen and liver combined (2.6%), intestine (16%), pancreas (1.3%), bladder (4%), and kidney (1.5%) were all observed. For evaluating the CASS capacity to predict the necessity of a laparotomy in cases of blunt abdominal injuries, the ROC curve was developed (Figure 1). The CASS score has a poor ability to predict the need for laparotomy in cases of blunt abdominal injuries, as shown by the area under the curve (AUC) value, which was reached at 0.687 (0.395 - 0.978). The ROC curve is shown in Figure 1.

The sample was then divided into two groups according to their CASS scores, which were moderate-high (eH10) and low (<10). The CASS score sensitivity, specificity, positive predictive value (NPP), and negative predictive value (NPN) as a predictor of the need for laparotomy in patients with blunt abdominal trauma were measured as part of the validity test. These values were 80.0%, 60.0%, 96.7%, and 16.6%, respectively. Table 2 displays the outcomes of the CASS score validity test.

DISCUSSION

One of the leading causes of death worldwide is trauma. After head and chest trauma, abdominal trauma has the third highest prevalence, with the majority of cases being blunt abdominal trauma.[6] The mean age of the study participants was 33 (± 15.0) years. There were 21 (26.3%) female and 59 (73.8%) male participants. According to research by Kumar et al.,[7] men may sustain blunt abdominal injuries in as much as 81% of cases, while women comprise the remaining 19%. A startling 38.1% of cases of blunt abdominal injuries occurs in

Table 2. CASS score validity test results as predictors of the need for laparotomy in blunt abdominal trauma

CASS	Laparotomy		Total
	Yes	No	
Score ≥10	60	2	62
Score <10	15	3	18
Total	75	5	80

Note: Sensitivity = 80% (95 % CI : 69.1-88.3); Specificity = 60% (95% C.I. 14.4-94.7); Positive Predictive Value (PPV) = 96.7% (85% C.I. 91.0-98.8); Negative Predicitve Value (NPV) =16.7% (95% C.I. 7.9-31.8); CASS: clincal abdominal scoring system
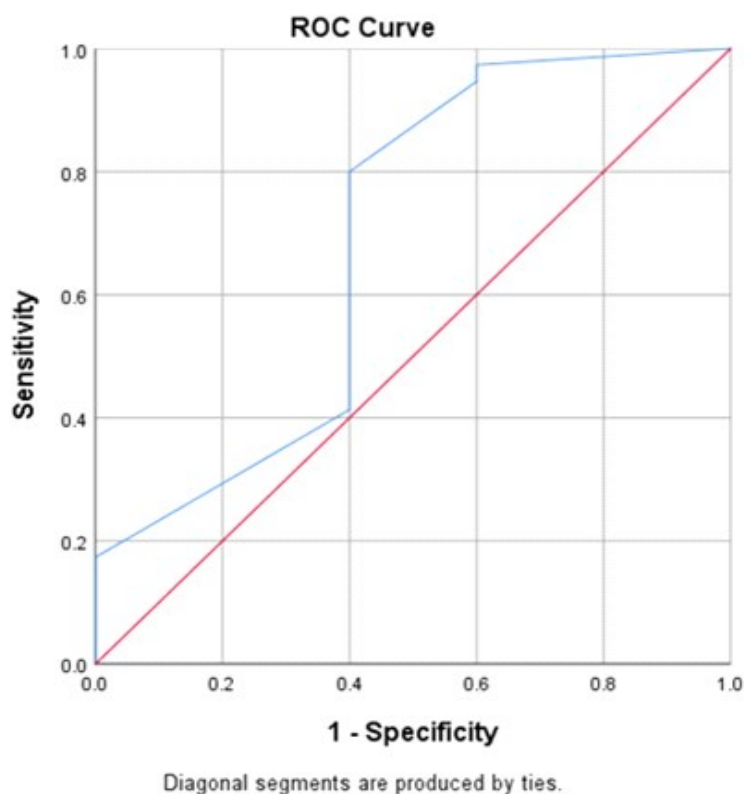
Figure 1. Receiver operating characteristics (ROC) curve of clincal abdominal scoring system as a predictor of the need for laparotomy in patients with blunt abdominal trauma

people between the ages of 21 and 30 years. Furthermore, up to 57.1% of cases presented after 6 hours of trauma, 26.2% after 2–6 hours, and just 16.7% within 2 hours.(In India, research on 100 patients with abdominal trauma demonstrated that 48% of the patients were in the 21–30 year age group, followed by the 31–40 year age group with 25% of patients. The remaining 12 cases involved women, providing a total of 88 cases for men.[8]

The majority of blunt abdominal injuries occurred in women (62.5%), with a mean age of 33.52 (13.84) years. However these findings were not statistically significant. In general, men in the productive age range have a higher frequency of blunt abdominal trauma. Men prefer to be employed in professions that involve more mobility due to culture and traditions, and men additionally suffer more substance and alcohol abuse compared to women.[7] This seems congruent with data showing that 61% of cases of blunt abdominal trauma are from road accidents, while

up to 25% are caused by falls from heights, and the other cases are due to other causes.[9]

In order to determine whether patients with acute abdominal injuries require surgical treatments such as laparotomies, the clinical abdominal scoring system (CASS) has started to be utilized widely.[6,10] This evaluation is essential in helping clinicians choose a course of treatment that is appropriate for the patient's medical condition. The Glasgow coma scale (GCS), clinical abdominal signs, pulse rate, systolic blood pressure, and presentation following an accident or trauma contribute to part of the 15-point total CASS score.[3]

Among the elements that significantly impact a patient's prognosis is the time of the patient's emergency room visit following a traumatic event.[7] Pursuant to our study, the time of presentation or the commencement of trauma was >6 hours in 43 (53.8%) of the subjects, followed by 2–6 hours in 28 (35%), and 2 hours in 9 (11.3) of the individuals. These findings are

reinforced by a study by Kumar et al.,[7] which revealed that only 16.7% of instances occurred within two hours of the trauma, whereas 26.2% occurred between two and six hours after the trauma, and 57.1% occurred within six hours.

The group with the shortest presentation time after trauma (less than 1 hour) had the highest percentage of cases (57.5%), followed by the group with a longer presentation time (1-4 hours), which had the second-highest percentage (36.2%), and the group with the longest presentation time (>4 hours) had the third-highest percentage (6.2%). Patients with negative laparotomy outcomes tended to present to health services more quickly than those with positive laparotomy results. This difference in presentation time after trauma was statistically significant between patients with negative and positive laparotomy results. The potential of the patient's condition and complications due to progressively severe trauma is increased the longer the time elapsing between the beginning of the trauma and arrival at the health center. [11]

A more severe hypovolemic condition is indicated by a greater pulse rate, which is divided into three groups. Stage I hypovolemic shock is a pulse rate of less than 100 beats per minute; stage II is 100 to 120 beats per minute; stage III is 120 to 140 beats per minute; and stage IV is greater than 140 beats per minute.[12] A pulse rate that is less than 90 beats per minute receives a score of 1, a rate between 90 and 110 beats per minute receives a score of 2, and a greater rate than 110 beats per minute receives a score of 3.[6] The results of this study showed that 12.5% of subjects had a pulse rate that was below 90 beats per minute, followed by 52.5% of patients who had a pulse rate between 90 and 110 beats per minute, and 35% of subjects who had a pulse rate that was over 110 beats per minute.

Similar findings were also obtained which showed that the majority of the subjects (16/30) had a pulse rate between 90 and 110 times per minute, followed by a pulse rate below 90 times per minute (10/30 samples), and a pulse rate of over 110 times per minute (4/30 samples).[6]

Systolic blood pressure is another indicator of hypovolemia in a patient. Significant bleeding in intra-abdominal solid organs can lead to hemodynamic imbalances, including reduced cardiac output and contractions. Hypovolemic shock and lowered blood pressure are also effects of this condition. An individual has reached the shock phase when his or her systolic blood pressure is reduced to 90 mmHg.[12] A blood pressure below 90 mmHg in patients with suspected abdominal trauma receives the highest score of 3, while a blood pressure between 90 and 120 mmHg receives a score of 2, and a blood pressure above 120 mmHg receives a score of 1.[6]

In our investigation, systolic blood pressure was 90-12 mmHg, >120 mmHg, and< 90 mmHg in 48 (60.0%), 13 (16.3%), and 19 (23.8%) patients, respectively. This is similar to the results of Kumar et al. [7], where the majority of subjects (22/30) had a systolic blood pressure between 90 and 120 mmHg, followed by >120 mmHg (6/30 subjects), and finally 90 mmHg (2/30 subjects). The Glasgow coma scale (GCS), which assesses the patient's consciousness, is the fourth criterion tested by the CASS. Reduced GCS may arise from the body's hemodynamic instability, and one of the causes is hypovolemic shock. The degree of trauma or bleeding experienced is correlated with the GCS score, which is lower and implies a lesser level of awareness in the patient.[12]

A clinical examination needs to be performed because tests solely based on changes in systolic blood pressure and pulse frequency carry the risk of leading to incorrect diagnoses or inefficiencies in treatment.[13,14] Clinical examination of the abdomen will result in a score of 3 for findings of abdominal guarding, a score of 2 for tenderness, and a score of 1 for complaints of pain.[6] Although the remainder of 8 (10.0%) and 28 (35.0) patients complained of discomfort and soreness, a total of 44 (55.0%) subjects displayed clinical abdominal guarding. Although soreness and guarding were more frequent with positive laparotomy findings, abdominal discomfort was more frequent with

negative laparotomy findings (75.5% vs. 64.2%). Once irritation due to peritonitis occurs, the muscles of the abdominal wall will become rigid, which is a sign of abdominal guarding. The presence of organs that have been traumatized or of peritonitis may be indicated by the presence of tenderness and by the location of the tenderness. The presence of peritonitis is one of the signs that a laparotomy is necessary in cases of blunt abdominal injuries.[15] The severity of the patient's trauma is indicated by the CASS score; the higher the score in this abdominal clinical examination, the more serious the trauma.[6] Regarding the predictor of whether or not a laparotomy needed to be performed in cases of blunt abdominal trauma, our study results showed that CASS had a sensitivity of 80%, a specificity of 60%, a positive predictive value (NPV) of 96.77% and a negative predictive value (NPV) of 16.67%.

The mean CASS score was 10.28 (±1.34) was obtained from our study. A higher mean CASS score was found in a different study that was conducted by Vanitha et al. [3] on 100 subjects, where the mean CASS score of 11.56 (±2.02) points was found in the group that had surgery. [3] The study of Sivarajan et al. [8] also found that the mean CASS score was 11.56 with a standard deviation of 2.02 for the operative group and that a CASS value of more than 12 had a specificity of 100%, sensitivity of 83.5%, positive predictive value of 100%, and negative predictive value of 91.3%. According to both studies, in blunt abdominal trauma the calculated CASS score with a cut-off of 12 has a specificity of 100%, a sensitivity of 54%, a positive predictive value of 100%, and a negative predictive value of 78.7% for predicting the necessity for laparotomy. [3,8]

The findings of the present study contrast with those of other studies done in the past. During research conducted by Kumar et al.,[7] specificity, sensitivity, PPV, and NPV were found to be 84.62%, 99.2%, 33.3%, and 100%, respectively. Another study showed the specificity,

sensitivity, PPV, and NPV to be 88%, 100%, 90%, and 100%, respectively.[16] Although in the two preceding investigations of Vanitha et al. and Srivarajan et al. the CASS score had a high specificity of 100%, the current study discovered that it only had a poor specificity of 60%. The sensitivity value has not changed very significantly and remains at 80%.[2] It was discovered in our study that the proportion of subjects with trauma onset of more than six hours was 53.8% and achieved hemodynamic stability (systolic BP > 120 mmHg). This is due to the fact that the study patients had received fluid resuscitation while they were being transported to the hospital.[17–19] The CASS predicted the need for operative intervention with good accuracy. [4,20]

The limitations of the present study were, firstly, that the subjectivity of operators in conducting clinical examinations was very high, resulting in measurement bias. Secondly, the number of subjects in this study was based on the research period, not based on statistical calculations. Finally, this study was based on secondary data (medical records). The CASS score is based on clinical assessment, which is an advantage of this study since it enables measures to be promptly carried out without the need for supporting tests.

CONCLUSION

The CASS is not recommended for assessing the need for laparotomy in cases of blunt abdominal trauma. Further studies in this regard need to be performed on a larger population and in multiple centers to validate the results of the study.

CONFLICT OF INTEREST

None declared.

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AUTHOR CONTRIBUTIONS

NOY: conceptualization, design, writing and reviewing the manuscript, IKW: conceptualization, design, writing, and manuscript revision. NG: manuscript writing and revision. IWS: conceived, designed, wrote, and revised the manuscript. IWN: contributed to the study's conception and design, and critically revised it for key intellectual content. All authors have read and approved the final manuscript . ✚

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