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ORIGINAL ARTICLE

Pioneering E-FAST in North Macedonia: A Resource-Efficient Approach to Polytrauma Care (Prospective Cohort Study)

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Abstract

Background/Aim: Polytrauma is a leading cause of morbidity and mortality worldwide, particularly in low- and middle-income countries with limited healthcare resources. The "golden hour" following trauma is critical for effective intervention, yet reliance on computed tomography (CT) for diagnosis often delays treatment due to logistical challenges. Focused assessment with sonography for trauma (FAST) has emerged as a rapid, bedside diagnostic tool, offering a potential solution in resource-limited settings. This study evaluates the utility of FAST in the management of polytrauma patients in North Macedonia, focusing on its impact on diagnostic efficiency, patient outcomes and resource allocation.

Methods: A prospective longitudinal randomised clinical trial was conducted on 80 polytrauma patients, divided into two groups: one receiving FAST followed by CT (FAST/CT) and the other undergoing CT alone. Diagnostic time, accuracy, surgical intervention rates, hospitalisation duration and mortality were compared between the groups. Statistical analysis was performed using descriptive and analytical methods.

Results: A total of 80 polytrauma patients were included and randomly assigned to a FAST/CT group or a CT-only group. FAST significantly reduced diagnostic time compared with CT alone (mean 5.12 vs 23.55 minutes), without delaying subsequent CT imaging or definitive diagnosis. Both FAST and CT demonstrated high accuracy in detecting thoracic (92.5 % vs 97.5 %) and abdominal injuries (85 % vs 86.25 %), with a 97.5 % agreement between methods. No significant differences were observed between groups regarding surgical intervention rates, length of hospital stay, or mortality.

Conclusion: FAST proved to be a cost-effective, non-invasive and efficient diagnostic tool, particularly valuable in resource-limited settings. While its limitations, including false negatives, necessitate complementary CT for stable patients, FAST optimises trauma care by streamlining diagnosis and resource allocation. Challenges such as equipment availability and operator training must be addressed for effective implementation.

Key words: Focused assessment with sonography for trauma; Wounds and injuries; Disease management; Point-of-care systems; Ultrasonography.

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Introduction

One of the biggest problems facing modern medicine is polytrauma, which contributes significantly to morbidity and mortality worldwide. Recent statistics show that trauma is a major cause of death for people under 45 and that it disproportionately affects people in low- and middle-income nations with frequently scarce healthcare facilities. A fundamental idea in trauma management, the "golden hour" notion highlights the vital significance of prompt and effective interventions during the first sixty minutes after an injury. The literature agree that the golden hour is the time frame in which resuscitation techniques can dramatically lower mortality and enhance long-term results for patients with polytrauma.[1-3]

Timely resuscitation is essential for effective management during this critical time, but so are precise and quick diagnostic assessments to inform treatment choices. Computed tomography (CT) has long been the gold standard for imaging in trauma. Clinicians can accurately diagnose life-threatening diseases like internal bleeding, organ damage and fractures thanks to CT scans, which offer comprehensive and trustworthy information regarding injuries. However, there are a lot of practical and logistical issues with depending so heavily on CT imaging. Specialised radiological equipment, skilled workers and the physical transfer of frequently uncooperative patients to radiology suites are necessary for CT scans. Especially in healthcare systems with limited resources, these variables may cause delays in diagnosis and treatment.[4, 5]

A substantial body of evidence has examined the performance of focused assessment with sonography for trauma (FAST) in comparison with CT in the evaluation of trauma patients. Previous studies have demonstrated that FAST is characterised by high specificity in detecting intraperitoneal and thoracic free fluid, while its sensitivity may be variable and influenced by factors such as injury pattern, patient stability and operator experience. Despite these limitations, CT continues to represent the reference imaging modality for comprehensive trauma assessment in haemodynamically stable patients, owing to its detailed anatomical visualisation and overall diagnostic reliability.[2, 5-7]

In light of these drawbacks, point-of-care imaging methods that offer quick, precise and easily available diagnostic data have gained popularity. One in-trauma treatment option that has gained popularity is FAST. The time to diagnosis is greatly shortened by this bedside ultrasonographic approach, which allows doctors to rapidly check for hemoperitoneum, haemothorax/pneumothorax and pericardial effusion. Without the requirement for a radiologist or patient transfer, FAST is non-invasive, low resource consumption and performable by doctors at the patient's bedside. Because of these characteristics, it is especially useful in environments with limited resources, where staff and time are frequently scarce.[6, 7]

The adoption of FAST is a significant development in trauma care in middle-income nations like North Macedonia, where healthcare systems are hindered by a lack of funding and resources. Clinicians can get around some of the inherent drawbacks of conventional imaging techniques by incorporating FAST into current procedures. This method ensures that high-quality treatment is provided even in difficult situations by maximising resource utilisation and speeding up decision-making within the golden hour.[5, 8, 9]

Despite the established role of CT as the reference imaging modality in trauma care, its availability and timely use may be limited in routine emergency settings, particularly in middle-income countries. In North Macedonia, access to CT imaging can be constrained by organisational factors such as staffing availability, patient transport logistics and workflow demands, especially outside peak hours. These limitations highlight the need for reliable bedside diagnostic tools that can support early clinical decision-making while awaiting definitive imaging.

According to data published by the World Health Organisation for the period from 2013 to 2016, Macedonia had a 5.8 % increase in fatal outcomes from traffic accidents per 100,000 inhabitants compared to other countries in the region.[1]

Therefore, the aim of this study was to evaluate the role of FAST as part of the initial diagnostic pathway for polytrauma patients in North Macedonia, a middle-income healthcare setting. The study focuses on the impact of FAST on diagnostic timelines, clinical decision-making, patient management and its implications for workflow and resource utilisation within emergency care.

Methods

The study was a prospective cohort longitudinal randomised clinical trial, conducted with ethical approval from the Clinical Research Ethics Committee at "Ss Cyril and Methodius" University, Skopje and in coordination with the University Clinic for Traumatology, Orthopaedic Diseases, Anaesthesiology, Reanimation, Intensive Care and Emergency Centre. Informed consent was obtained from all participants or their representatives, emphasising their voluntary participation and their right to withdraw at any time. The study sought to encompass all patients with polytrauma admitted to the emergency surgical department. The study's inclusion criteria included all consecutive trauma patients admitted to the Emergency Clinical Centre, irrespective of their injury mechanism and age above 18 years. Excluded were all pregnant patients and those requiring immediate transfer to the intensive care unit or operating theatre.

Upon admission, basic demographic data such as age, gender, BMI, diagnosis and injury mechanism were recorded. Computer software randomly divided patients into two groups:

- Group I: The group underwent a FAST examination in addition to standard diagnostic procedure CT (FAST/CT).
- Group II: Only performed standard diagnostic procedure – CT (CT).

In the FAST/CT group, all included patients underwent an initial FAST examination upon admission, followed by CT imaging as part of the standard diagnostic protocol. CT was performed in all patients in both study groups and no patient was managed based solely on FAST findings without subsequent CT confirmation. Therefore, FAST findings were interpreted in conjunction with CT results, which served as the reference standard for injury assessment and final diagnosis. Patient inclusion, exclusion and group allocation are presented in a flow diagram (Figure 1).

Used protocols

- The initial assessment protocol (A, B, C, D, E) involved evaluating airway, breathing, circulation, disability and exposure.
- The eFAST protocol checked five body parts for free fluid or organ damage: the upper right quadrant, the pericardium, the upper left quadrant, the area above the pubic bone and the thoracic cavity. All investigations with FAST were made by one doctor. In addition, bilateral thoracic ultrasound was performed to evaluate for pneumothorax and haemothorax, using anterior thoracic views. An eFAST examination was considered positive if free fluid was detected in any of the standard abdominal views (right upper quadrant, left up-

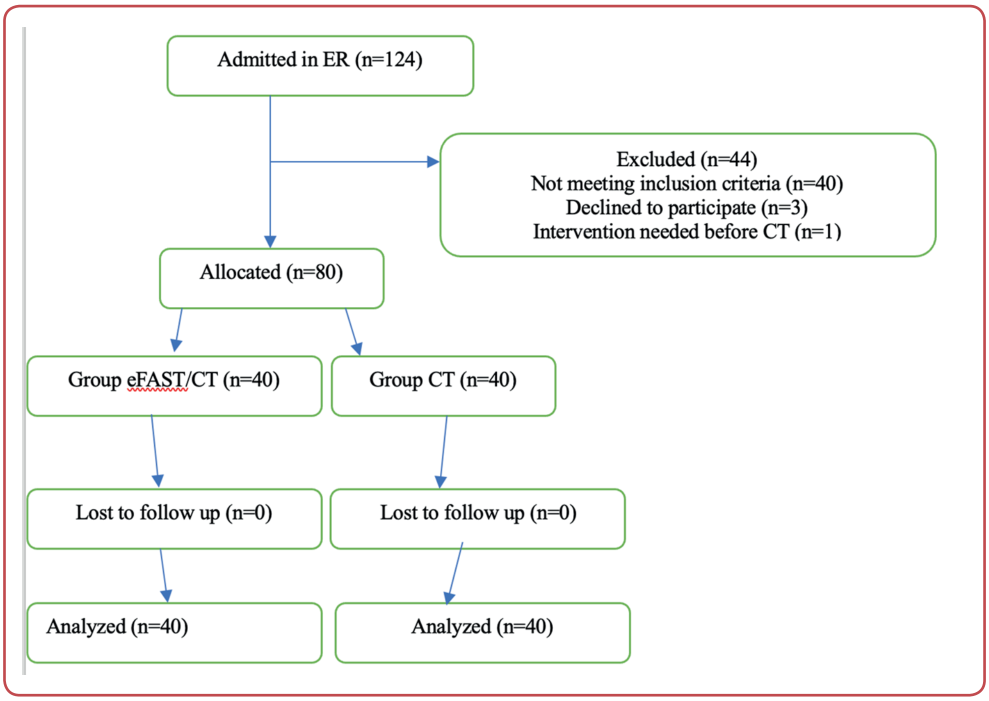

Figure 1: Consort diagram

ER: emergency department; e-FAST: extended focused assessment with sonography for trauma; CT: computed tomography;

per quadrant, or pelvic view), if pericardial effusion was identified on cardiac views, or if sonographic signs of pneumothorax or haemothorax were present on thoracic examination. Thoracic e-FAST findings were considered positive in the presence of absent lung sliding with a barcode (stratosphere) sign on M-mode or visualisation of pleural fluid consistent with haemothorax.

CT protocol

After the eFAST examination, Group I patients and all Group II patients underwent CT imaging for further diagnosis. CT findings were used as the reference standard for injury assessment. CT results were categorised based on the presence or absence of traumatic findings, including thoracic and intra-abdominal injuries. Any CT-detected traumatic lesion relevant to the mechanism of injury was considered a positive CT finding. Injuries were not further classified according to severity or grading systems. A radiologist blind to group allocation independently reviewed all imaging results to minimise bias.

Clinical outcomes were recorded, the presence of free fluid, pleural effusions, pneumothorax, any surgery or intervention and the duration of hospitalisation. The primary outcomes of the study were diagnostic time and agreement between FAST and CT findings. Secondary outcomes included time from admission to intervention, need for surgical or invasive procedures, length of hospital stay and in-hospital mortality.

Statistical analysis

The statistical analyses were conducted using STATISTICA version 10 and IBM SPSS 20.0, employing both descriptive and analytical methods. Categorical data were analysed using proportions, rates and the difference test and assessed numerical data using measures of central tendency, dispersion and Student's t-test; ANOVA with Tukey HSD for multivariable comparisons and evaluated correlations using Spearman's rank-order and Pearson coefficients. Nonparametric tests such as the Mann-Whitney U test and Chi-square or Fisher's exact tests were used to assess dependencies. Trends over time were analysed using a dynamic index, normality was tested with Shapiro-Wilk and significance was set at $p < 0.05$

Results

Patient characteristics and injury mechanism

Study group included 80 patients divided in two groups. Group I were patients that underwent a FAST examination in addition to standard diagnostic procedure CT (FAST/CT). Group II were patients who underwent standard diagnostic procedure CT (CT). The majority of the cohort were men (n = 70, 87.5 %), with an average age of 40.27 years (median: 38.5, range: 19-69 years, standard deviation (SD): 14.78). The two groups did not differ in sex distribution (two-sided Fisher's exact test, p = 0.633), with 90 % (n = 36) of the patients in the FAST-CT group and 85 % (n = 34) of the patients in the CT group being men.

All included patients whose initial admission to the emergency surgical centre was due to trauma. The mechanism of injury (trauma) was diverse. The most common mechanisms of injury were motor vehicle accident (n = 28, 35 %) and pedestrian injury (n = 21, 26.25 %). The two groups did not differ in the mechanism of injury (two-tailed Fisher's exact test, p = 0.541).

Diagnostic time and workflow analysis

The duration of the diagnostic procedures performed were compared. In the FAST-CT group of patients, the FAST was significantly faster than the CT method (Figure 2, two-sided Wilcoxon test, p = 1.4 × 10-14). The FAST method in these patients lasted on average 5.12 minutes (median: 5.08, range: 3.92-6.7, SD: 0.71), compared to the

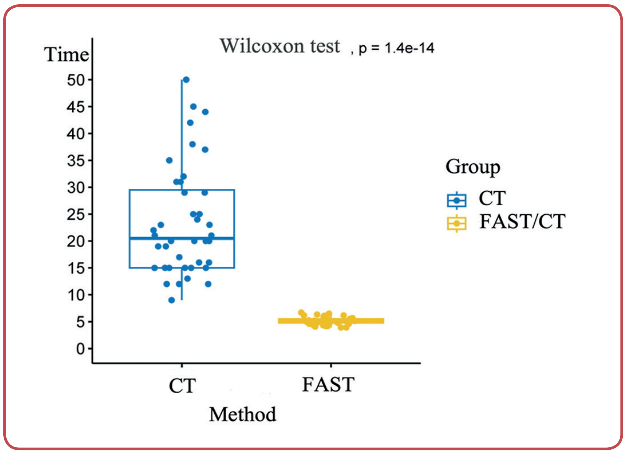

Figure 2: Comparison of diagnostic method duration in patients undergoing CT and FAST in FAST/CT group

FAST: Focused assessment with sonography for trauma; CT: computed tomography;

average duration of the CT method of 23.55 minutes (median: 20.50, range: 9-50, SD: 10.27).

The FAST method was not associated with a difference in the length of the CT method for the FAST-CT group of patients, who had the same length of time for the CT method as the CT group of patients (mean: 24.73, median: 22.5, range: 9–50, SD: 10.5, two-tailed Wilcoxon test, p = 0.52) (Figure 3). Also, using the FAST method before the CT scan did not make the time between admission and getting the CT result longer (two-tailed Wilcoxon test, p = 0.67).

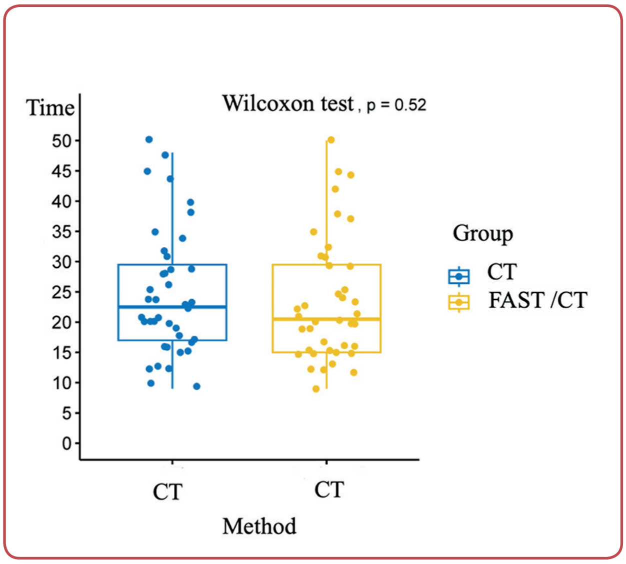

Figure 3: Duration of the CT diagnostic method in the CT group, compared to the duration of CT in the FAST-CT group

FAST: Focused assessment with sonography for trauma; CT: computed tomography;

Statistical analysis of the data showed that the most common diagnosed types of traumas were to the musculoskeletal system (n = 69, 86.25 %) and the thorax (n = 62, 77.5 %). Head trauma (n = 25, 31.25 %) and abdominal trauma (n = 24, 30.00 %) followed, both of which were less common (Figure 4).

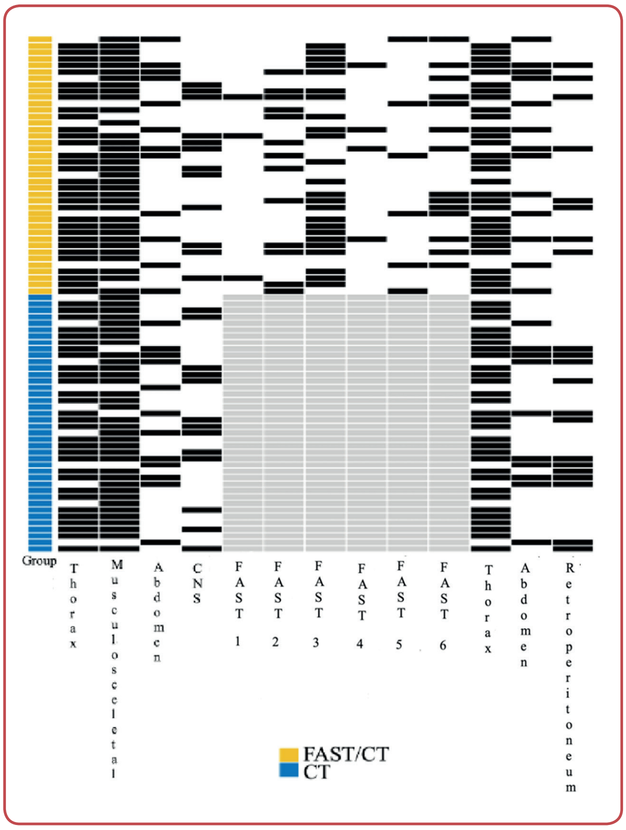

Figure 4: Distribution of trauma by systems in both groups

Distribution of trauma by systems in both groups. Patients are shown as rows and traumas in columns alongside findings from diagnostic methods; quadrant code: black = presence of trauma, white = absence of trauma, grey = patients from Group II CT who were not evaluated with the FAST method. 1 is pericardium in FAST scanning, 2 is the left thoracic quadrant of the FAST, 3 the right thoracic quadrant of FAST, 4 is the upper right quadrant of the abdomen in FAST, 5 the upper left quadrant of the abdomen in FAST and 6 is the suprapubic view in FAST. FAST: Focused assessment with sonography for trauma; CT: computed tomography;

Diagnostic accuracy of eFAST compared with CT

In the eFAST/CT group (n = 40), FAST examination was positive in 20 patients (50 %). Among these patients, CT confirmed traumatic thoracic and/or abdominal injuries in 19 cases, while one patient had no corresponding injury identified on CT. FAST was negative in 20 patients, of whom CT identified traumatic findings in one patient, representing a false-negative FAST result. Overall agreement between FAST and CT findings in the FAST/CT group was 97.5 %.

Both diagnostic methods had high accuracy in determining thoracic trauma, with FAST having an accuracy of 92.5 % and CT having an accuracy of 97.5 % in determining thoracic trauma. With regard to the eFAST examination, thoracic eFAST identified pneumothorax and/or haemothorax in 29 patients. CT confirmed thoracic injuries in all but one of these cases. One thoracic injury detected on CT was not identified by eFAST, representing a missed case. No false-positive thoracic eFAST findings were recorded. Accuracy was lower in determining abdominal trauma, with FAST accuracy being 85 % and CT accuracy being 86.25 %. In FAST-CT patients, the two methods agreed 97.5 % of the time when it came to identifying thoracic and abdominal trauma. This means that in 29 patients, both methods consistent that there was thoracic trauma and in 16 patients consistent that there was abdominal trauma. The methods had differences in findings in two patients: in one patient, the presence of abdominal trauma was determined by CT that was not visible by FAST, while in the second patient, the presence of thoracic trauma was determined by CT that was not visible by FAST.

When thoracic injuries were analysed separately, FAST demonstrated a sensitivity of 96.7 % (95 % CI: 83.3–99.4 %), specificity of 100 % (95 % CI: 72.2–100 %), positive predictive value of 100 % (95 % CI: 88.3–100 %) and negative predictive value of 90.9 % (95 % CI: 62.3–98.4 %). One thoracic injury detected on CT was not identified by FAST, while no false-positive thoracic FAST examinations were recorded. For abdominal trauma, FAST showed a sensitivity of 94.1 % (95 % CI: 73.0–99.0 %), specificity of 100 % (95 % CI: 85.7–100 %), positive predictive value of 100 % (95 % CI: 80.6–100 %) and negative predictive value of 95.8 % (95 % CI: 79.8–99.3 %). One abdominal injury detected on CT was missed by FAST and no false-positive abdominal FAST findings were observed.

Surgical, interventional and clinical course and outcomes

A total of 37 (46.25 %) of the patients underwent surgery, of which 17 (42.5 %) were from the FAST-CT group and 20 (50 %) were from the CT group, with no difference in the distribution of surgery between the two groups (two-sided Fisher's exact test, p = 0.654). The patients mostly had surgery on their locomotor systems (FAST-CT: n = 9, 22.5 %; CT: n = 7, 17.5 %), then abdominal surgery (FAST-CT: n = 4, 10 %; CT: n = 6, 15 %), abdominal and thoracic surgery (FAST-CT: n = 3, 7.5 %; CT: n = 2, 5 %) and urological surgery (FAST-CT n = 1, 2.5 %; CT: n = 2, 5 %). Only two patients in the CT

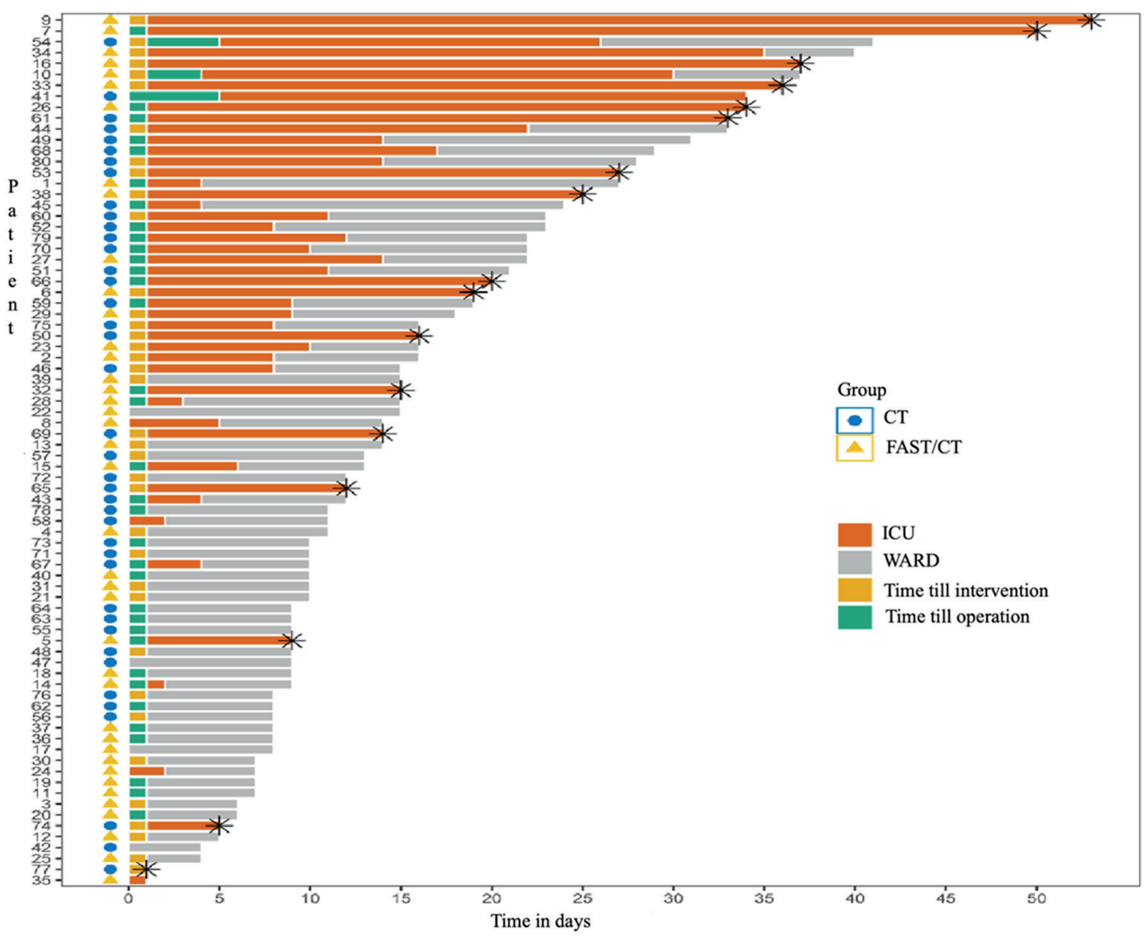

Figure 5: The clinical course of all patients

Legend: The x-axis displays the time in days from admission (0), while the y-axis displays individual patients. The trajectory displays the patient's study group on the left side: circle represents CT and a triangle represents FAST-CT. An asterisk indicates the presence of deceased patients. FAST: Focused assessment with sonography for trauma; CT: computed tomography; ICU: intensive care unit;

group had surgery on their nerves and one patient in the CT group had surgery on their heart. The FAST-CT group had an average of 7.86 hours between admission and surgery (median: 2.42, range: 1–90.6, SD: 21.37), the same as the CT group's average of 14.03 hours (median: 2.05, range: 0.98–107.92, SD: 32.36). There was no difference in the number of invasive non-surgical procedures between the two groups (two-sided Fisher's exact test, $p = 0.646$). Of the 49 patients who had invasive non-surgical procedures, 14 (35 %) were in the FAST-CT group and 17 (42.5 %) were in the CT group. Most of the patients had one-sided thoracic drainage (FAST-CT: n = 15, 37.5 %; CT: n = 13, 32.5 %), then bilateral thoracic drainage (FAST-CT: n = 7, 17.5 %; CT: n = 4, 10 %), thoracic drainage and immobilisation (FAST-CT: n = 1, 2.5 %; CT: n = 5, 12.5 %) and nasal tamponade (FAST-CT: n = 3, 7.5 %; CT: n = 1, 2.5 %). Study found that the time between admission and intervention was the same for both groups. In the FAST-CT group, it took an average of 1.57 hours (median: 1.58, range: 0.87–2.52, SD: 0.41) and it was the same for the CT group, which took an average of 1.50 hours (median: 1.43, range: 0.5–2.5, SD: 0.47).

There were no differences between the FAST-CT and CT groups in the average length of hospital stay (16.82 days for the FAST-CT group, 13.5 days on average, 1–53 days range and SD: 12.85; and 16.77 days for the CT group, 13.5 days on average, 1–41 days range and SD: 9.60).

The clinical course from the time of admission to the final outcome of the patient cohort through the patients' time from admission to hospital discharge or death is shown in Figure 5.

Discussion

Presented results showed that the male population is more often affected by trauma (n = 70, 87.5 %). Data from the literature confirm the same that trauma more often affects the male population and younger groups. In this study, the mean age of the patients was (40 ± 14 years). This is in line with previous research, where men are more often affected as victims of trauma, due to the fact that they are often active in outdoor activities, traffic accidents and other injuries, as fewer women experience accidental traumatic injuries. The dominance of younger participants is explained by the fact that younger people spend more time outdoors than older people.[10, 11]

Time is a key factor in reducing mortality in these patients, so it is essential to identify trauma as soon as possible and determine whether any intervention is needed in the shortest possible time. The first sixty minutes after trauma are called the "golden hour" because they are critical for providing timely and effective medical treatment to patients, which increases the chances of survival and reduces the risk of long-term complications. To ensure timely and effective treatment during this hour, rapid assessment, diagnosis and stabilisation are essential.[3, 12-15] In presented study, no data on the time of the prehospital phase was available due to the large number of factors that influence it. From the heterogeneity of the anamnesis, to its non-existence due to the lack of accompaniment with the victim, the time of transport to the tertiary health facility and possible transfer from another facility are some of the possible explanations. But the time to completion of diagnostics and treatment on the other hand were the main driver for conducting this research and its eventual implementation in trauma protocols. As a test that belongs to the group of "point of care" tests that are performed at the patient's bedside, it does not require expensive equipment and is reproducible. This FAST evaluation has been implemented in many trauma protocols around the world.[2, 5-7, 16, 17]

The results of this study showed that the FAST method did not prolong the length of stay in the Emergency Surgical Centre and did not delay the final diagnosis with CT in trauma patients. The average time of the FAST examination was on average 5.12 minutes (median: 5.08, range: 3.92-6.7, SD: 0.71), compared to the average duration of the CT method of 23.55 minutes (median: 20.50, range: 9-50, SD: 10.27). The time to final diagnosis with CT in both groups was statistically insignificant ($p < 0.05$), which means that the implementation of the FAST method did not prolong the time frame and possibly delay the time to final diagnosis and treatment of trauma patients. These results of presented study correlate with the results published in the literature.[18, 19] The mortality rate was not statistically significant between the groups 22.5 % vs 20 % FAST-CT vs CT group (n = 9 vs n = 8).

A positive FAST scan result should be reported and addressed immediately, in accordance with its high positive predictive value and high specificity. However, it is prudent to carefully consider what action to take, given the sensitivity of the method and the fact that one quarter of the results are false negative.[9, 18-24] In the literature, the sensitivity of the FAST method has been reported to be between 85 % and 96 % and the specificity to be greater than 98 %.[18] While in trauma patients, the diagnosis reaches 100 % sensitivity.[19, 25] This diagnostic procedure in the hands of experienced doctors is performed in less than 5 minutes.[19]

In presented study, both diagnostic methods showed high accuracy in determining trauma injuries. In thoracic trauma, FAST had an accuracy of 92.5 %, while CT showed an accuracy of 97.5 % in determining thoracic trauma. In one patient with a life-threatening thoracic injury, immediate therapeutic intervention was initiated based on FAST findings before CT imaging could be performed. As CT was obtained only after the intervention, this patient was not included in the final analysis; however, this case illustrates the potential clinical value of FAST in guiding urgent decision-making in real-world emergency settings. On the other hand, for abdominal trauma, the accuracy was lower. In determining abdominal trauma, the accuracy of FAST was 85 %, while the accuracy of CT was 86.25 % in determining abdominal trauma. In the FAST-CT group of patients, the agreement between the two methods in determining thoracic and abdominal trauma was 97.5 % for both traumas. This is consistent with the results previously published in the literature.[18, 24, 25] And if the method is repeated several times, which is actually one of its greatest advantages, the accuracy reported in the literature can reach up to 100 % (40 %).

Although CT is considered the gold standard for thoracic injuries, this method, at least in resource-limited countries, requires other additional complications such as patient transport, long time to complete the scan, the need for specialist radiologists to obtain the results and exposure to different types of radiation. While in contrast to CT, FAST is increasingly used in emergency departments and trauma centres because it can be easily performed at the bedside. This method plays an important role in the classification and selection of patients, especially critically ill patients who may need additional haemodynamic stabilisation procedures.

The findings of this study confirm that some patients with severe injuries could not be transferred for CT scanning due to lack of time; therefore, it is preferable to transfer them directly to therapeutic or surgical treatment without first undergoing CT diagnostics. In order to provide patients with traumatic abdominal injuries with the best possible treatment, early diagnosis of intra-abdominal injuries is essential. Although CT diagnostics is still the best method for evaluating these patients, it is sometimes not possible to perform it for various reasons, most commonly due to haemodynamic instability but not excluded pregnancy due to the fact that this scan has a high percentage of ionising radiation.[26-29]

The FAST method is easy to perform, requires an ultrasound machine with an appropriate ultrasound probe and therefore has a fairly low cost. On the other hand, it is portable and can be performed at the patient's bedside, without the patient having to be moved to a transportable bed and/or trolley for transport and exposure to radiation. However, it must be emphasised that a negative FAST examination does not always mean that there is no hidden pathology that may later require additional investigation and possible intervention.

CT, although to a much lesser extent, can also give false negative results.[30-33] Several factors have been cited as the cause of false negative CT scans in patients with trauma. Subtle injuries, ie injuries that are too small to be detected, especially if they involve small fractures or contusions. The timing of the scan, if performed too soon after the injury, may not be fully developed or visible. Patient motion or artifacts from patient motion during the scan can obscure important anatomical details. There are also technical factors that can contribute to false negative results. Limitations in technology, such as resolution or contrast, can lead to missed injuries. Operator error, such as human error, inexperience or oversight by the radiologist, can result in misinterpretation of images. Overlapping structures, complex anatomy in certain areas can make it difficult to distinguish between normal and injured tissue structures. Operator bias, for example, if a radiologist is looking for specific injuries based on the mechanism of injury, he may overlook others, but on the other hand, what happens much more often is the lack of anamnesis from patients with whom the radiologist does not come into direct contact, which is a major disadvantage for the radiologist to direct attention. The presence of technical artifacts, such as metal objects, surgical hardware, or shrapnel, can create artifacts that obscure the underlying injuries. Basic conditions as pre-existing conditions, surgeries, or variations in anatomy that may complicate scan interpretation. These factors emphasise the importance of clinical correlation and follow-up imaging when necessary.[34-37]

The results of the current study and comparisons with previous studies worldwide indicate the significant role of FAST in the diagnosis of traumatic injuries. However, additional diagnostic CT is recommended after the initial examination with FAST, if the patient is stable and has the technical conditions to perform it, to confirm the injuries and obtain more reliable results.[2, 6, 7, 38]

This study has several limitations that should be acknowledged. First, it was conducted at a single tertiary care centre and the relatively modest sample size may limit the generalisability of the findings to other trauma systems or healthcare settings with different organisational structures or resource availability. Although patients were prospectively randomised into FAST/CT and CT-only groups, the study was not designed as a randomised interventional trial to compare a FAST-first versus CT-first strategy in terms of clinical outcomes. All patients ultimately underwent CT imaging and FAST findings were interpreted in conjunction with CT and clinical assessment. Therefore, while the study demonstrates the diagnostic performance and time efficiency of FAST, causal conclusions regarding its impact on outcomes such as mortality or length of stay cannot be definitively established.

Selection bias may also be present, as patients requiring immediate transfer to the operating room or intensive care unit, as well as pregnant patients, were excluded from the study. Consequently, the results primarily reflect the performance of FAST in haemodynamically stable polytrauma patients. In addition, all FAST examinations were performed by a single experienced operator, which may limit extrapolation of the results to settings with varying levels of ultrasound expertise and does not allow assessment of interobserver variability. Technical limitations of ultrasound, including reduced image quality due to body habitus, bowel gas, or limited acoustic windows, may have contributed to missed injuries in a small number of cases.

Despite these limitations, the study provides clinically relevant evidence supporting the role of FAST as a rapid and resource-efficient diagnostic adjunct in the initial assessment of polytrauma patients.

However, implementing FAST in resource-limited settings poses unique challenges. Ensuring the availability and maintenance of appropriate ultrasound equipment is critical, as is the training and expertise of healthcare professionals. Limited access to specialised education and training programs can preclude the effective use of these tools, requiring ongoing professional development to maintain competency. Furthermore, integrating FAST into clinical workflows presents a logistical challenge in resource-limited settings, where space and inefficient processes can slow down the performance of assessments. Although FAST can be performed quickly at the patient's bedside, the need for dedicated space and proper equipment placement is essential for optimal diagnostic outcomes.

Conclusion

In resource-limited settings, where health systems are often overstretched and underequipped, the ability to perform FAST significantly reduces the diagnostic burden and simplifies patient management. In addition, the use of FAST can optimise the allocation of limited resources. By rapidly excluding or including significant internal injuries, healthcare providers can prioritise the use of advanced imaging techniques and surgical interventions for patients who need them most. This targeted approach not only improves individual patient outcomes but also increases the efficiency of the entire emergency care system. However, the implementation of FAST in resource-limited settings presents unique challenges that need to be overcome to optimise its utility and effectiveness in trauma care.

Ethics

Ethical approval for this study was obtained from Ethics Committee of Faculty of Medicine, "Ss Cyril and Methodius" University, Skopje, The Republic of North Macedonia with approval number 2023-2743/1, dated 13 June 2023. Written Informed consent was obtained from all subjects before the study.

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None.

Conflicts of interest

The authors declare that there is no conflict of interest.

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Data access

The data that support the findings of this study are available from the corresponding author upon reasonable individual request.

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Resources: SA, TN
Data curation: MJS, AGB
Writing - original draft: NB, AGB
Writing - review and editing: AGB, MJS, NB
Visualisation: NB
Supervision: NB, SA
Project administration: NB, AGB
Funding acquisition: NB.

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