An Audit of Perioperative VTE Risk Assessment and Prophylactic Anticoagulation

Eman Abdel Azim Elsadek Elhassan
Alamal Hospital
emal.alsadig832@gmail.com

Mohanad Saeed Ahmed Khalifa
Alamal Hospital

Mohamed Rabie Esmail Alnimery
Alamal Hospital

Tagwa Elfatih Salih Ahmed
Alamal Hospital

Rania Ibrahim Elsiddig Ahmed
Alamal Hospital

Huda Babiker Mohamed Ahmed
Alamal Hospital

Nardein John Wadie Danial
Alamal Hospital

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Additional Declarations: No competing interests reported.
Abstract

Background:

Venous thromboembolism (VTE) can arise following significant general surgery. Among hospitalized patients in the U.S, pulmonary embolism has been listed as the most common cause of death. Surgery itself is a risk factor for VTE, In the majority of required quality initiatives, preventing VTE is thought of as a patient safety strategy.

Many approaches have been used in the fight against venous thromboembolism. These devices include pharmaceutical products such as fondaparinux, low-molecular-weight heparin, and unfractionated heparin, as well as mechanical devices such as graded compression stockings (GCS) and intermittent pneumatic compression (IPC) devices. Most of the methods incorporate both of these methods.

Patients undergoing surgery should receive VTE prophylaxis and the level of VTE prophylaxis for surgical patients needs to be in line with the anticipated risk. The total risk category is determined by the type of surgery and VTE risk factors. There are a number of published guidelines for determining VTE risk with widely divergent approaches.

Numerous risk assessment scores exist, such as the Caprini RAM, Khorana score, and Padua score. Of these, the Caprini RAM was chosen for use in this audit because of its greater validity than the other assessment scores. In addition, the caprini score was found to be far more effective than the Khorana prediction score for identifying hospitalized individuals at risk of VTE. Moreover, 40% of patients with a high Caprini score had a non high Padua score, indicating that the Caprini score rather than the Padua score may be more appropriate for assessing VTE in surgical patients.

Methods:

An interview was performed with the surgical staff, consisting of interns and residents, who were responsible for preparing patients for surgery to obtain prospective data. The telephone or in-person interview took place in June or August 2021 and consisted of three questions with one response per question.

Results:

Following the application of the Caprini RAM, 71 (36.6%) of the 194 patients were at risk for deep vein thrombosis (DVT). A total of 123 (63.4%) of the patients did not receive a score evaluation since the doctors in charge of getting the patients ready for the theatre were not aware of the VTE risk assessment. Ten patients (5%) in one unit were given prophylactic heparin before laparoscopic cholecystectomy, based more on personal experience than on a risk evaluation.

Conclusion:
It became clear that staff knowledge was below what was originally expected and more than 90% were not able to apply any VTE risk assessment scoring system.

However, a surprisingly low number of staff said they were aware of the risk assessment scoring system for VTE but they were not applying this system either because they were not aware of the seriousness of the DVT or because they lacked the knowledge that peri-operative measures such as drugs for examples, can be given safely to patients at risks without major bleeding as a complication.

**INTRODUCTION**

**Background:**

Venous thromboembolism (VTE), which comprises pulmonary embolism (PE) and deep vein thrombosis (DVT), is globally connected to a high rate of hospitalized patient mortality and morbidity, making it a critical public health issue. Patients who have had abdominal surgery for benign or malignant illnesses are more likely to experience VTE as it is often a major post surgical event. Twenty percent of patients who undergo general surgery are expected to have VTE. Pulmonary embolism (PE) is the primary cause of preventable hospital mortality and accounts for up to 200,000 deaths annually in the United States. In the majority of legally required quality-improvement programs, postoperative VTE prevention is considered a quality and patient safety intervention.

It is challenging to determine the true incidence of perioperative VTE because most people who experience VTE have no symptoms (1,4).

Recent studies have shown that the risk of postoperative VTE can persist for up to 90 days after surgery, with more than 30% of cases developing during the post discharge period. Clinical trials investigating the use of an extended course of low molecular weight heparin (LMWH) anti coagulation for up to 30 days in patients having abdominal and pelvic procedures have shown significant reductions in VTE rates as much as 60% at 30 days (3, 6).

Many surgical specialties are particularly interested in examining the occurrence of VTE since it is approximately 70 times more common in surgical inpatients than in the general population. Patients are more vulnerable to VTE following surgery, and the risk is directly correlated with the length of the procedure. Approximately one-third of hospital deaths are estimated to be related to PE, and this condition is thought to be the cause of 10% of all deaths. As a result, it is obvious that patients are at grave danger for VTE. Even after receiving the appropriate anticoagulant treatment and recovering from acute VTE events, patients are prone to develop further problems and complications. Over 20% of patients will experience VTE once more in the future. Apart from the immediate danger of dying, almost half of DVT patients eventually develop post thrombotic syndrome, and approximately 4% of PE patients develop chronic pulmonary hypertension (5).
The multinational, cross-sectional Epidemiologic International Day for the Evaluation of Patients at Risk for Venous Thromboembolism in the Acute Hospital Care Setting (ENDORSE) study was conducted among surgical and medical patients in a significant number of hospitals across the globe. The study's objectives were to determine the proportion of patients who received effective prophylaxis as advised by the American Society for Clinical Pathology (ACCP) recommendations and the total number of patients at risk for VTE. The study showed that more than half of the hospitalized patients were at risk for venous thromboembolism (VTE), with surgical patients having greater risk (64%) than medical patients (5). A number of preventive techniques are available for preventing postoperative VTE. Although studies suggest that intermittent pneumatic compression and early ambulation can help prevent postoperative ventilator-associated VTE, chemoprophylaxis with low molecular weight heparin (LMWH) or unfractionated heparin (UFH) is the most commonly used preventive method. In fact, chemoprophylaxis can reduce the risk of clinical VTE events by 70%–93%. In addition, extended 30-day course of chemoprophylaxis with LMWH significantly reduce the incidence of VTE in patients who are at high risk for this condition (2).

Given the high morbidity and mortality associated with VTE, risk assessment and prevention are essential for patients undergoing surgery. Several thromboprophylaxis techniques are used early and later in the postoperative phase to prevent VTE in surgical patients.

Even so, chemoprophylaxis is still underutilized, and in more than half of at-risk patients, doctors may under prescribe VTE chemoprophylaxis if a systematic risk assessment is not carried out. To optimize patient selection and risk–benefit ratios, standardized risk assessment is essential, as evidenced by the rising frequency of major bleeding episodes associated with drug therapy. Thus, the American College of Surgeons (ACS) and the American College of Chest Physicians (ACCP) have developed detailed guidelines for the use of research-based anti thrombotic therapy as an essential part of perioperative chemo-prophylaxis care. A risk categorization model based on the most recent version was utilized (1,2). Patients at higher risk of VTE were identified using different risk scores. An internationally recognized and validated clinical instrument called the Caprini risk score (CRS) (figure 1) was developed to identify patients who might be at risk of developing DVT perioperatively. The tool is intended to be completed both before and after a patient has surgery, as well as at the time of discharge to evaluate the risk of VTE and choose the best course of action for prophylaxis. Interestingly to note that more variables were added to the CRS since it was first created to enhance risk assessment. Compared to other measures, the Caprini score might be more appropriate for evaluating VTE in surgical patients, re-evaluating the risk score is essential for considering any changes in patient health, such as the presence of a malignancy, the length of the procedure, or other unforeseen events (2).

Several surgical specialties have assessed the Caprini VTE risk assessment model (RAM) as a decision-making tool for selecting the proper chemo-prophylaxis for surgical patients based on the particular Caprini risk score. The five categories of risk were determined by the Caprini score for VTE patients: very low risk (0 points), low risk (1-2 points), moderate risk (3-4 points), high risk (5-9 points), and very high risk (>9 points) (Table 1).
Depending on the risk group, various mechanical and pharmacological prophylaxis regimens, or a combination of both are advised. A patient is considered to be at high risk and may be provided pharmaceutical thromboprophylaxis, mechanical thromboprophylaxis, or both; additionally, they may be eligible for postoperative chemoprophylaxis for a maximum of 30 days. In patients at low or intermediate risk, several varieties of mechanical thromboprophylaxis are suggested. Patients with a score of zero are encouraged to walk around early (3, 6).

According to certain studies, patients who underwent abdominal surgery and were prescribed perioperative thromboprophylaxis based on their Caprini score had a low incidence of VTE-related adverse events at the 3-month follow-up (4, 6).

The risk of perioperative VTE events varies greatly among surgical patients. The risk/benefit ratio of chemotherapy is unfavorable for all surgical patients.

Patients with Caprini scores greater than 7 clearly and considerably lower their chance of developing VTE, and bleeding does not increase noticeably when chemoprophylaxis is given. A total of 75% of patients had a Caprini score of 6 or who underwent surgery, their risk/benefit relationship was either undesirable or unknown. Regular chemoprophylaxis may not be necessary for these patients. Precision medicine is a suitable tool for assessing and preventing VTE risk in surgical patients (16).

Table 1: Caprini score risk category:

<table>
<thead>
<tr>
<th>Caprini score</th>
<th>Risk category</th>
<th>Recommended prophylaxis</th>
<th>Recommended duration of chemoprophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Lowest</td>
<td>Early frequent ambulation only OR at discretion of surgical team: compression boots OR low dose heparin OR low molecular weight heparin</td>
<td>During hospitalization</td>
</tr>
<tr>
<td>1-2</td>
<td>Low</td>
<td>Compression boots OR low dose heparin OR low molecular weight heparin (Choose 1 item)</td>
<td>During hospitalization</td>
</tr>
<tr>
<td>3-4</td>
<td>Moderate</td>
<td>Compression boots AND low dose heparin OR low molecular weight heparin (choose 1 medication)</td>
<td>During hospitalization</td>
</tr>
<tr>
<td>5-8</td>
<td>High</td>
<td>Compression boots AND low dose heparin OR low molecular weight heparin (choose 1 medication)</td>
<td>7-10 days total</td>
</tr>
<tr>
<td>≥ 9</td>
<td>Highest</td>
<td>Compression boots AND low dose heparin OR low molecular weight heparin (choose 1 medication)</td>
<td>30 days total</td>
</tr>
</tbody>
</table>

Rationale:

Why was the audit undertaken?

After a sad story of a 45-year-old woman with a BMI of 30–34.9 who underwent an abdominoplasty operation that took 3 hours and developed DVT 5 days post operatively with strong family history of DVT
unrecognized pre-operatively, this study aimed to determine whether surgical health providers are applying the risk assessment scoring system of the VTE to all admitted patients whether emergency or elective to quantify and categorize a patient’s risk for venous thromboembolism.

The caprini score was selected because it is widely adopted, incorporated into national screening protocols and relatively easy to use and appears to discriminate reasonably well among patients at low, moderate, and high risk for VTE. When the data are gathered correctly, the Caprini score increases in value to become an expert in peri-operative patient's assessment, risk stratification requires education and experience.

**Objectives**

**Aim:**

The overall aim of the audit is to establish that surgical health providers in Alamal Hospital in all surgery departments have knowledge of the danger of DVT perioperatively and the importance of following and applying the VTE scoring system to all surgical patients to prevent DVT from occurring.

**Objectives:**

1. To ensure that surgical staff are applying the Caprini score for VTE risk assessment in accordance with the national guidelines.
2. To improve the practice of preventing peri-operative DVT development.
3. To assess the effectiveness of the patient's current thromboprophylaxis treatment.

**Criteria and standards:**

Criteria 1: All surgical staff who are in charge of preparing patients for surgery at the theatre must apply the Caprini risk score to all patients undergoing surgery.

Standard: The expected standard is 80%

Criteria 2: All patients at risk should receive proper anticoagulant treatment according to their risk.

Standard: The expected standard is 100%.

**Ethical considerations:**

Clear written consent was received from the hospital manager and the head of general surgery departments.

**Methodology**
This study is designed to evaluate if surgical staff are aware and have the knowledge of the importance of assessing patients scheduled for surgeries regarding their possibility of being at risk for developing VTE as a complication following surgery. Furthermore, it assesses their application of VTE risk assessment scoring system to all patients and provide prophylactic measures accordingly.

**Study Design**

Prospective analytical, observational, cross-sectional study.

**Study location**

Alamal Hospital, Khartoum-Bahry, Sudan. This cross-sectional hospital-based study was conducted at Alamal Teaching Hospital, which is a secondary hospital located in the Khartoum-Bahry locality, which is part of the triangular capital of Sudan. The hospital provides 189 beds and surgical procedures for approximately 2500 patients per year.

**Study Duration**

June–August 2021.

**Sample size**: Total coverage of all patients admitted to all surgical departments during the period of the study, number of patients: 194.

**Inclusion criteria:**

Adult patients who were hospitalized in departments of general surgery's general surgical wards, which included both elective and emergency admissions (the latter of which included trauma patients).

**Exclusion criteria:**

2. Obstetrics and Gynecology Department.
3. Out patients.

**Data collection method**

The prospective data collection, involved interviews conducted with surgical staff, including interns and residents who were responsible for preoperative patient preparation. They were conducted either face-to-face or via telephone between June and August 2021.

Although the audit had been assigned as part of the surgical weekly meeting agenda, there was no prior notice or warning of the audit including the schedule and objectives that were not disclosed to the ward personnel and nurses or treating surgeons to prevent any influence on their behavior.
Staff were asked to answer 3 questions that have been set up in advance with a single response per question; about their patients scheduled for surgery just after they finished preparing them for theater.

**Question 1**

Did the patient have any risk factors for VTE? Yes/No

This question will answer if the treating doctor have the knowledge of scoring system in general and the significance of applying it and if he/she is implementing the scoring system to his/her patients.

**Question 2**

If they did, were they given prophylactic anticoagulant (low molecular weight heparin)? Yes/No

This question will answer if the treating doctor is following the protocol and give prophylactic treatment based on the risk.

**Question 3**

If they were not treated with low molecular weight heparin, was a reason given?

The answer to this question tells us whether the doctor has misconception that giving the patient the prophylaxis -if needed- may lead to bleeding.

**Data collectors:**

The task of data collection during the entire audit period was delegated to a team of five physicians, including 3 general practitioners, a resident of family medicine, and an intern of general surgery. The data collection process took place within the surgical ward and involved direct interviews with doctors or telephone conversations.

**Statistical analysis**

Data were analyzed using SPSS version 23 (SPSS Inc., Chicago, IL), $P < 0.05$ was considered the cutoff value or significance.

**Data validation:**

The data were reviewed and validated by the general surgery specialist in charge of this audit.

**Consent and confidentiality:**

**Informed consent**

was obtained from the hospital and the head department of the general surgery departments.
RESULTS

Demographics:

A total of 194 patients were admitted for surgery during the study period, 105 were females (54.2%), and 89 were males (45.8%). A total of 155 (80%) patients were scheduled for elective surgery, 39 (20%) underwent emergency surgeries and the average age was 44 (range 18–75) years. There were 27 acute surgery emergency admissions and 12 traumatic emergency admissions.

Risk assessment:

With the application of the Caprini RAM, 71 (36.6%) patients were at risk of DVT (Caprini score ≥ 2), 51 (71.8%) were elective and 20 (28.2%) were hospital emergency admissions. A total of 123 (63.4%) patients were not assessed with any score assessment because the doctors in charge of preparing the patients for theater were not aware of the VTE risk assessment (Table 2).

Ten patients (5%) were given prophylactic heparin prior to their laparoscopic cholecystectomy in a single unit as per a personal experience not based on risk assessment.

<table>
<thead>
<tr>
<th>Patients who were assessed using the Caprini score:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Caprini</td>
</tr>
<tr>
<td>NOT Caprini</td>
</tr>
<tr>
<td>Total number</td>
</tr>
</tbody>
</table>

Re audit:

Surgical doctors had received education about the Caprini score and similar data collection tool was used. The audit was repeated between January – March 2022. The key recommendations arising from the results of the audit are all about education and raising awareness of the importance of VTE risk assessment among surgical staff. Some actions such as training and holding regular meetings every three to six months because of the staff rotation; were done to educate doctors about the dangers of DVT and all of its complications, which can range from PE to chronic venous insufficiency.

The circulation of new operating procedures, has taken place and went some way toward addressing the knowledge gaps in these areas; such as presenting lectures and seminars. Furthermore, posters and brochures were printed and disseminated in all departments and to individual teams and discussed at surgical group meetings.

Results of re audit:
A total of 185 patients—90 males and 95 females—were assessed using the Caprini score, except for 12, 8 females and 4 males for whom the Caprini score was not calculated or completed by doctors.

Number of patients who were assessed using the caprini score 173 (93.7%). All patients who were at risk for DVT received an appropriate dose of prophylactic anticoagulant and no patient at risk developed DVT following surgery in the postoperative follow up (Table 3).

As a result, the first criterion was met and even more standards were met.

<table>
<thead>
<tr>
<th>Patients</th>
<th>elective</th>
<th>emergency</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>caprini</td>
<td>124 (67%)</td>
<td>49 (26.7%)</td>
<td>173 (93.7%)</td>
</tr>
<tr>
<td>NOT caprini</td>
<td>8 (4.2%)</td>
<td>4 (2.1%)</td>
<td>12 (6.3%)</td>
</tr>
<tr>
<td>Total number</td>
<td>132 (72%)</td>
<td>53 (28%)</td>
<td>185 (100%)</td>
</tr>
</tbody>
</table>

Table 3
Re audit patients who were assessed using the Caprini score:

Therapy for the total number of at-risk patients:

Doctors in charge were advised to administer chemo-prophylaxis for the proper duration according to the risk. Contraindications for anti-coagulation were demonstrated to all doctors -in charge- and it was written in posters and brochures distributed among surgical staff (Table 4). Medication regimens were examined to evaluate the efficacy of the patient’s existing thromboprophylaxis treatment and to compare it with the ACCP and Caprini RAM guidelines for recommended therapy. All patients who were at risk according to their score had received the correct thromboprophylactic treatment according to their risk factor profile and this achieves favorable outcomes in terms of the second criterion of the audit.

<table>
<thead>
<tr>
<th>Absolute</th>
<th>Relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of hemorrhagic stroke or stroke of unknown origin</td>
<td>Transient ischemic attack in previous 6 months or Infective endocarditis</td>
</tr>
<tr>
<td>Ischemic stroke in previous 6 months</td>
<td>Oral anticoagulation</td>
</tr>
<tr>
<td>CNS neoplasm</td>
<td>Pregnancy or first postpartum week</td>
</tr>
<tr>
<td>Major trauma, surgery, or head injury in previous 3 weeks</td>
<td>Non compressible puncture sites</td>
</tr>
<tr>
<td>Bleeding diathesis</td>
<td>Traumatic resuscitation or Advanced liver disease</td>
</tr>
<tr>
<td>Active bleeding</td>
<td>Refractory hypertension (systolic BP &gt; 180 mmHg) Active peptic ulcer</td>
</tr>
</tbody>
</table>

Table 4
Contraindication to anti-coagulation therapy:
DISCUSSION

By looking at the expenses associated with treating VTE, it is feasible to assess the potential benefits of preventative efforts. According to Henke PK, Kahn SR et al 2020 (8) and according to recent reports, first-year survivors of acute VTE are expected to pay direct medical costs ranging from $12,000 to $15,000 (US dollars) per person. Between 10% and 30% of acute VTE survivors experience recurrent VTE within 5 years, with a peak after anti-coagulation therapy is stopped. Approximately 18% of patients with VTE are readmitted within 30 days at a cost of more than $10,000 per patient.

Surgical interventions are responsible for 20% of all cases of induced VTE in addition to other patient factors that play a major role in increasing post-surgical VTE risk.

CRS is a useful tool for predicting patient risk during surgery and might be at risk of developing DVT postoperatively as a complication; however missing CRS may put patients on unnecessary risks of VTE with all its consequences lasting a lifetime.

Moreover, practicing the risk score preserves the rights of doctors and patients.

Although surgery itself is a risk factor for developing clots, some other patients experience clots formation if they are not given a prophylactic treatment perioperatively.

One year passed without a VTE event since the first case that occurred in the first month of implementing the Caprini program. This finding suggested that a longer postoperative chemo-prophylaxis program may be linked to a decrease in 60-day VTE incidence, these findings are similar to those of to Helene M. Sterbling et al, who studied VTE incidence in patients published by The Society of Thoracic Surgeons 2018 (4).

There is minimal patient knowledge and awareness of the risk of VTE linked to hospitalization, some patients have a positive family history, yet they forget to tell their treating doctors about this risk.

The Caprini score -in comparison to other type of scores- proved its usefulness in identifying low-risk people who might not need prophylaxis, in addition to identifying high-risk individuals, this approach is similar to that of Spencer Wilson et al (2). In addition, more attention is being given to the potential for VTE occurrence after ambulatory procedures as operations move from inpatient to outpatient settings, and as the list of outpatient procedures grows, as does the chance that patients will have more VTE risk factors. This suggests that risk assessment should be used, and that VTE prophylaxis should be administered following certain outpatient procedures. Despite the fact that laparoscopic surgery in general and laparoscopic cholecystectomy appear to be less traumatic to patients than open surgery is, it is inherently a risk factor for developing DVT, CO2 pneumoperitoneum with reverse Trendelenburg position that causes decreased venous return are factors that can induce venous stasis in the lower extremities, which together leads to a change in coagulation profile. Furthermore, it is possible that the endothelium may be impacted by this venous stasis, leading to detectable alterations in fibrinolysis and
coagulation as described by Garg PK et al. Since Virchow's triad's three components are present, thromboembolic problems may arise.

All these factors make laparoscopic cholecystectomy a potent risk factor for deep venous thrombosis. Several studies have shown a 0% incidence of DVT in laparoscopic cholecystectomy as reported by Garg PK et al (9).

As per Valentina Triolo et al, using the risk assessment and prophylactic thromboprophylaxis protocol, a review comprising 153,832 laparoscopic cholecystectomies revealed that the average percentages of deep vein thrombosis, pulmonary embolism, and fatal pulmonary embolism cases were 0.03%, 0.06%, and 0.02%, respectively. Moreover, within three months of the procedure, the probability of symptomatic thromboembolism was 0.2%, as opposed to 0.5% after open cholecystectomy surgery. Of the 422 patients in the same study who were not given any kind of thromboprophylaxis, only one patient experienced symptoms associated with DVT (14). The majority of the related researches suggest anti-thrombotic medication when significant risk factors are present as shown in Mohammad A Pakaneh et al and Schaepkens Van et al who suggested that laparoscopic cholecystectomy is a low-risk surgery for thrombosis; consequently, routine prophylactic usage is probably not warranted for all patients. One of the most common outcomes of general surgery is coagulation system alteration and laparoscopic procedures are not an exception (12, 14, 15).

In general, the risk of DVT following a minimally invasive surgical treatment such as laparoscopic cholecystectomy is low, as shown by Ntourakis D et al (11).

After laparoscopic cholecystectomy, the incidence of VTE is minimal, and fatal PE is infrequent. PE was 0.15%, DVT was 0.40%, and VTE was 0.53% common in hospitals. Some publications and the current National Institute of Clinical Excellence (NICE) clinical guidelines support the use of pharmaceutical and mechanical DVT prevention for all patients undergoing laparoscopic cholecystectomies based on their risk identified by risk score (11).

The American College of Chest Physicians advised against routinely using thromboprophylaxis for patients who underwent only laparoscopic procedures and had no other thromboembolic risk factors, such as early and frequent ambulation and defined laparoscopic cholecystectomy as “a procedure with a relatively low risk.” (10).

With prospective implementation of the CRS, educating the surgical and anesthetic staff periodically and distributing posters in all surgical departments as well as the operating room plus intermittent re audits were vital to guarantee that score was used appropriately and that it was followed. These components of effective quality improvement (QI) programs have been elucidated and serve as additional evidence supporting the need for the multifaceted strategy which is similar to that used by Hachey KJ et al 2016 (6).
Forty percent of patients were determined to be at risk of DVT on the re audit using the Caprini score. This percentage is less than the 77% found in the W D Rocher study (5). Prior to the research 8% of patients routinely received prophylactic medications without risk assessment. The re audit revealed a change in this, with an increase in the proportion of patients who were at risk and received the appropriate dose according to their Caprini RAM. Compared to that in W D Rocher trial, where the overall correct rate and dose of prophylactic prescription in surgical patients was 26%, the incidence of proper VTE prophylaxis was consequently substantially greater.

On the other hand, the rate of hospital-acquired VTE significantly decreased after the implementation of CRS and no reported cases were identified which is similar to the findings of Nazarenko GI 2015 (7). This can emphasize that teaching medical personnel's about the seriousness of VTE and its aftereffects and the importance of preventing it by anticipating it with risk score system is essential.

**CONCLUSION**

In hospitalized patients, venous thromboembolism (VTE) is a dangerous consequence. Significant morbidity and mortality are linked to persistent disease throughout a lifetime and impose a heavy burden on patients, families and health facilities therefore, prevention is crucial as it is better than treatment. A risk assessment scoring system helps to identify patients at risk based on many factors (patients or surgical patients). Even after surgery, VTE remains the primary cause of preventable death. Despite the effectiveness of VTE prophylaxis, its usage is still not as common as it should be. The objective of CRS is to determine each patient's risk for VTE and then provide prophylaxis based on that risk level. According to extensive validation studies undertaken on a range of demographic data, the CRS is capable of identifying patients who require chemo-prophylaxis and are at high risk for postoperative VTE.

**Abbreviations**

DVT     Deep venous thrombosis
ACS     American College of Surgeons
ACCP    American College of Chest Physicians
VTE     Venous thromboembolism
BMI     Body mass index
PE      Pulmonary embolism
GCS     Graduated compression stockings
IPC     Intermittent pneumatic compression
Declarations

Author Contribution

I would like to express my sincere gratitude to all those who contributed to the completion of this clinical audit. First and foremost, I extend my appreciation to my colleagues' authors who dedicated their time, expertise, and insights to this project. Their collaboration and commitment greatly enriched the quality and depth of our findings. EE: Conceptualization, methodology, formal analysis, writing original draft preparation and supervision. MK: Methodology, data analysis and writing: review and editing. MA: Data collector and data analysis. TA: Data collector and data analysis. RA: Data collector. HA: Data collector.

We are also so thankful to the healthcare professionals and staff members who supported the implementation of this audit. Furthermore, we express our heartfelt thanks to Dr. Sami Jalal Eldin, the head department of all surgical departments whose support and encouragement was essential in advancing our work. Finally, we would like to acknowledge Alamal Hospital director for his support throughout the audit process. This audit would not have been possible without the collective effort and collaboration of all those involved, and we are truly grateful for their contributions.

ACKNOWLEDGMENT

I would like to express my sincere gratitude to all those who contributed to the completion of this clinical audit. First and foremost, I extend my appreciation to my colleagues authors who dedicated their time, expertise, and insights to this project. Their collaboration and commitment greatly enriched the quality and depth of our findings.

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This audit would not have been possible without the collective effort and collaboration of all those involved, and we are truly grateful for their contributions.
Conflict of interest: The authors of this paper have no invested interests in products described or used in this paper. The authors have no conflict of interests.

Data availability statement: The data are available at the archives Alamal Hospital, Khartoum-Bahry, Sudan.

Sources of funding: The authors received no financial support for the preparation of this study.

Ethical approval: Ethical clearance obtained from ethical committee of Alamal Hospital, no experiments on humans and/or the use of human tissue samples.

Consent: Informed consent was obtained from the director of Alamal Hospital by clear written permission.

References


Figures
Figure 1

2013 Caprini risk score (CRS) (source: Dr Joseph Caprini and the Illinois Medical Society). COPD, chronic obstructive pulmonary disease; PICC, peripherally inserted central catheter. (The color version of the figure is available online.)