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Preoperative risk assessment leadingvenous thromboembolism using The Caprini Risk Assessment Model in elective surgical patients of First Central Hospital of Mongolia

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Abstract

Background: *Venous thromboembolism (VTE) is a leading cause of preventable morbidity and mortality in surgical patients. Despite international recommendations for standardized VTE risk assessment, there is limited implementation in many countries, including Mongolia. This study aimed to assess preoperative VTE risk using the Caprini Risk Assessment Model (Caprini RAM) and to explore its applicability in routine surgical practice.*

Methods: *A total of 3366 adult patients undergoing elective surgery between January 1 and June20, 2025, at the First Central Hospital of Mongolia were evaluated using the Caprini RAM. Patients were stratified into five risk categories: very low (0), low (1–2), moderate (3–4), high (5–8), and very high (≥9) risk. A two-hour training session was provided for anesthesia residents to ensure accurate scoring and data collection. Data were analyzed using SPSS version 26.*

Results: *Of the 3366 patients, 0.39% were classified as very low risk, 33.5%as low risk, 46.1% as moderate risk, 18.2% as high risk, and 1.81% as very high risk. The highestrisk surgerieswere predominantly found joint replacement (15%), liver (14.3%), and kidney transplantation (5%). In contrast, low-risk profiles were mostly observed in ophthalmic, maxillofacial, and ENT surgeries. The preparatory training contributed to consistent data entry and improved awareness of VTE risk assessment among anesthesia residents.*

Conclusions: *The Caprini RAM proved feasible for preoperative VTE risk stratification in a high-volume surgical center in Mongolia. Its use revealed that a substantial proportion of patients were at moderate to high risk, warranting targeted prophylaxis. Incorporating the Caprini RAM into routine surgical care could enhance patient safety and guide evidence-based thromboprophylaxis protocols in Mongolian healthcare settings.*

Keywords: Caprini Risk Assessment Model, Thromboembolism, Surgery Risk, Preoperative Assessment, VTE Guidelines, Surgery Patients

1. Introduction

Venous thromboembolism (VTE), which includes deep vein thrombosis and pulmonary embolism, remains a significant cause of morbidity and mortality among hospitalized patients, particularly in the postoperative period. Often asymptomatic, VTE may lead to delayed diagnosis and life-threatening complications. Early risk assessment and appropriate prophylactic strategies are therefore critical. International guidelines recommend the use of validated tools such as the CapriniRisk Assessment Model (Caprini RAM) to stratify VTE risk and guide preventive interventions [1,2].The Caprini Risk Assessment Model (Caprini - RAM) was developed in the early 1990s by Dr. Joseph A. Caprini, American vascular surgeon and has been internationally adopted since 2005. The model assigns weighted scores to individual risk factors, facilitating categorization of patients into distinct VTE risk groups and guiding appropriate prophylaxis. Its adoption promotes accurate risk prediction, evidence-based decision-making, and standardization of preventive protocols, contributing to a reduction in VTE-related complications and healthcare costs [1-4]. Major international societies-including the American College of Chest Physicians (ACCP), the American Society of Hematology (ASH), the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), and the National Quality Forum (NQF)-have endorsed the Caprini RAM in theirguidelines.Large-scalestudies across the US, Europe, and Asia report that patients with Caprini scores

≥5 have a 5-to 20-fold increased risk of VTE, highlighting the importance of pharmacologic prophylaxis in high-risk groups [5,6,9,10]. In Mongolia, research on preoperative VTE risk assessment using the Caprini RAM remains scarce. Pulmonary embolism is of tenundiagnosed or discovered only in severe or postmortem cases, underscoring the need for systematic, evidence-based approaches. Although the First Central Hospital of Mongolia performs approximately 13,000 major surgeries annually, no standardized VTE risk assessment model is currently in place. Most preventive efforts rely on physician judgments and experience.Thus, this study aims to assess preoperative VTE risk using Caprini RAM and explore the potential for integrating this tool intoclinical practice [3,5].

1.1. Objective

To evaluate preoperative VTE risk among surgical patients at the Department of Anesthesiology and Surgery, First Central Hospital of Mongolia, and to promote the adoption of the Caprini Risk Assessment Model in clinical practice.

Aims

- To assess VTE risk levels in surgical patientsbetween January 1 and Jun20,2025, using the Caprini Risk Assessment Model.
- To compare VTE risk level profiles across various surgical departments.

2. Materials and Methods

2.1. Study Design

This observational study was conducted in the Department of Anesthesiology and Surgery at the First Central Hospital of Mongolia. It utilized the Caprini Risk Assessment Model to perform structured preoperative VTE risk evaluations. The study covered the period from January 1 to June20, 2025. Prior to data collection, a two-hour training session was providedto 26 anesthesia residents to ensure accurate use of the Caprini model during preoperative assessments. The training included instructions on evaluating patients, scoring risk factors, and entering data into an Excel spreadsheet. Data quality was regularly monitoredand corrected as needed.

2.2. Study Population

A total of 3366 patients from 11surgical departments were included.

- **Inclusion Criteria**

Patients aged>18 yearsundergoing elective surgery under general or neuraxial anesthesia.

- **Exclusion Criteria**

Patients undergoing emergency surgery, endoscopic or pain management interventions under sedation, or surgeries performed under local anesthesia. Patients with coexistent phatology like: previous VTE, coagulation disorders.

2.3. Risk Assessment Method

The Caprini RAM includes 40 risk factors such as age, medical history, comorbidities, immobility, and surgical type. Each factor was assigned a score based on its VTE risk contribution and total scores were calculated. Based on international guidelines, the Caprini RAM classifies patients into five risk categories: very low (0), low (1–2), moderate (3–4), high (5–8), and very high (≥9). Although the original Caprini model defines high risk as ≥5, we further subclassified patients with a score of ≥9 as 'very high risk' to reflect the significantly elevated VTE risk observed in this group in previous literature and large cohort studies [5,6,10].

2.4. Data Collection and Analysis

Data was entered into Microsoft Excel and analyzed using SPSS version 26. Continuous variables (e.g., age, total risk score) were summarized using mean and standard deviation.Categorical variables (e.g., sex, VTE risk levels) were expressed as frequencies and percentages.

2.5. Ethical Approval

1. This study received ethical approval from the Research and Training Department of the First Central Hospital of Mongolia. Written informed consent was obtained from all participants.

2.The Caprini RAM is a publicly available tool that does not require special permission for use in research or clinical settings.

3. Results

A total of 3366 patients were included in the study. The mean age was 48.5±7.7years, ranging from 21±5.4 years (youngest group) to 81.8±12.51years (oldest group). Of the participants, 1701 (50.53%) were male and 1665 (49.47%) were female (Table 1). Based on the Caprini Risk Assessment Model, the distribution of preoperative VTE risk levels was as follows:

- Very low risk (0 points): 13 patients (0.39%)
- Low risk (1-2 points): 1128 patients (33.5%)
- Moderate risk (3-4 points): 1553 patients (46.1%)
- High risk (5-8 points): 611 patients (18.2%)
- Very high risk (≥9 points):61 patients (1.81%)(Figure 1).

		GS	UroS	CRS	OrtS	NS	VS	Angio	OrganTP		MFS	ENTS	OphS	Mean (±SD)
									Liver	Kidney				
Age	Oldest	102	89	86	93	84	72	92	62	59	80	81	82	**81.8(±12.51)**
	Youngest	20	18	18	18	20	24	21	37	22	18	18	18	**21 (±5.4)**
	Average	52	55.2	46	56.1	51	54	60	50	36	37	42.2	42.4	**48.5 (±7.7)**
Sex	Male	209	289	271	99	57	21	221	11	15	200	262	46	**1701(50.53%)**
	Female	460	144	191	201	67	22	179	10	5	129	225	32	**1665 (49.47%)**
Risk revel (n)	Very low	0	4	0	2	0	0	0	0	0	0	6	1	**13 (0.39%)**
	Low	159	77	186	33	13	2	106	0	1	196	304	51	**1128 (33.5%)**
	Moderate	403	232	238	81	66	14	210	2	5	117	160	25	**1553(46.1%)**
	High	105	115	36	139	45	26	83	16	13	16	16	1	**611 (18.2%)**
	Very high	2	5	2	45	0	1	1	3	1	0	1	0	**61 (1.81%)**
Risk score	Max	9	9	9	14	8	11	10	10	10	8	9	6	**9.4 (±1.92)**
	Min	1	0	1	0	1	2	1	3	2	1	0	0	**1 (±0.9)**
	Average	3.43	3.9	2.8	5.8	4.2	4.8	3.4	6.4	5	2.3	2.2	2	**3.9(±1.43)**
Total surgery		**669**	**433**	**462**	**300**	**124**	**43**	**400**	**21**	**20**	**329**	**487**	**78**	**3366**

Table 1: Preoperative Venous Thromboembolism Risk Evaluation in Elective Surgical Patients Using Caprini Risk Assessment Model

Abbreviation: GS; General surgery, UroS; Urology, CRS; Colorectal surgery, Orth; Orthopedic surgery, NS; Neurosurgery, VS; Vascular surgery, Angio; Angiography, OrganTP; Organ transplantation, MFS; Maxillofacial surgery, ENT; Ear, nose and throat surgery, Oph; Ophthalmic surger

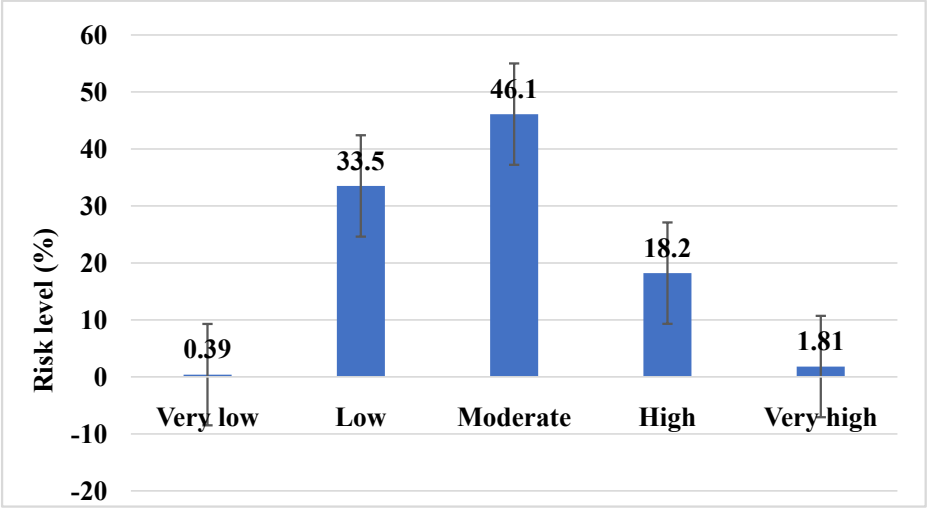


Figure 1:Venous Thromboembolism Risk Level of Total Elective Surgery

Venous thromboembolism risk level of total elective surgery. Distribution of preoperative VTE risk levels was as follows: very low risk (0 points): 13 patients (0.39%), low risk (1-2 points): 1128 patients (33.5%), moderate risk (3-4 points): 1553 patients (46.1%), high risk (5-8 points): 611 patients (18.2%), very high risk (≥9 points):61 patients (1.81%).

Analysis of VTE risk levels by the surgical department showed the following trends:

Very lowrisk patients were most frequently seen in ophthalmic(1.28%)andear, nose and throatsurgery (1.23%), lowrisk patients were commonly found in ophthalmic(65.4%), ear, nose and throat surgery(62.4%), maxillofacial (59.6%), moderate risk patients were most frequently in general surgery (60.24%), urology (53.6%),

neurosurgery (53.22%), angiography procedures (52.5%), colorectal surgery (51.5%). Highrisk patients were predominantly observed in liver transplantation(76.2%), kidney transplantation(65%) and vascular surgery (60.5%). Very highrisk patients were most frequently found in joint replacement surgery (15%), liver transplantation surgery (14.3%)(Figure 2.3).

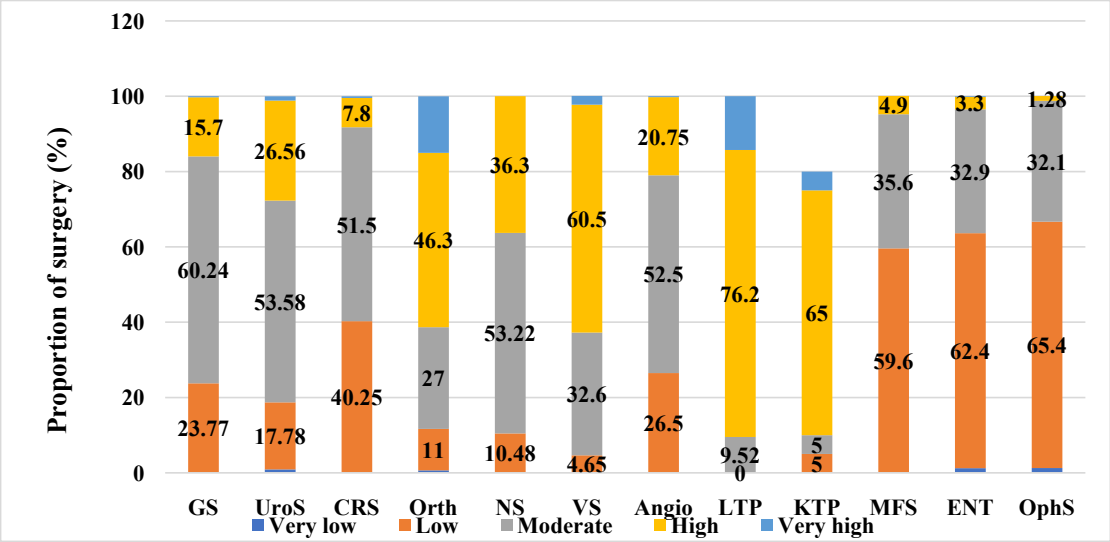


Figure 2: Distribution of VTE Risk Levels Across Different Surgical Types Based on Caprini RAM

Distribution of VTE risk levels across different surgical types based on Caprini RAM: Abbreviation: Oph; Ophthalmic surgery, ENT; Ear, nose and throat surgery, MFS; Maxillofacial surgery, KTP; Kidney transplantation, LTP; Liver transplantation, Angio; Angiography, VS; Vascular surgery, NS; Neurosurgery, Orth; Orthopedic surgery, CRS; Colorectal surgery, UroS; Urology, GS; General surgery

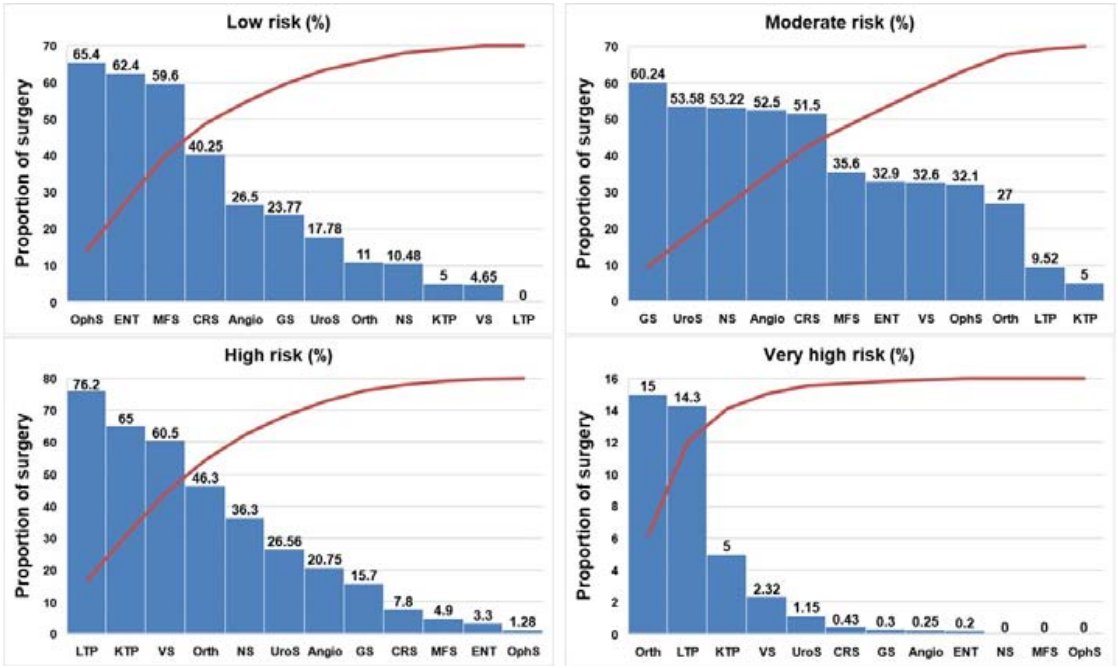


Figure 3: Distribution of Surgical Patients by Caprini RAM Risk Level

Distribution of surgical patients by Caprini RAM risk level: Low risk patients were predominantly observed in ophtalmic surgery (65.4%),moderate risk patients were observed in general surgery (60.24%), high risk patients were predominantly observed inliver transplantation(76.2%), kidney transplantation(65%) andvascular surgery (60.5%). Very highrisk patients were most frequently observed injoint replacement(15%) and liver transplantation surgery (14.3%).

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4. Discussion

This study demonstrates that the Caprini Risk Assessment Model is a clinically practical and easily implementable tool for evaluating venous thromboembolism risk among surgical patients. By assessing 2,670 patients preoperatively, the study facilitated early identification ofindividuals at risk, which is essential for guiding timely and effective prophylactic measures. To better stratify patients with extremely elevated VTE risk, we introduced an additional 'very high risk' category (Caprini score ≥9), which is supported by recent international studies that report a 5- to 20-fold increase in VTE incidence in this subgroup [5,6]. This subclassification helped identify patients undergoing liver and kidney transplantation or joint replacement who require more aggressive prophylactic strategies. To ensure the accuracy and consistency of data collection an esthesia residents were trained in the use of the Caprini RAM prior to data gathering. This training not only enhanced the quality of the study but also served as a formative experience, promoting the model's sustained integration into routine clinical workflow. Despite these strengths, the study has several limitations. Incomplete documentation of patient histories and missing laboratory data may have affected the accuracy of certain risk factors. Additionally, the study was limited to a single tertiary center, which may restrict the generalizability of the findings to other healthcare settings. The absence of comparable domestic research also hindered broader contextual interpretation. Future multicenter, prospective studies are warranted to validate these findings and to inform the development of national guidelines for VTE prevention.

5. Conclusion

Of 3,366 surgical patients stratified using the Carpini model, 33.5% were low risk, 46.1% moderate risk, and 18.2% high risk for VTE. Orthopedic, transplant, and vascular surgeries showed the high risk, whereas general, neurosurgery, urology, angiography, and colorectal surgeries fell mostly into moderate risk. Ophthalmic, maxillofacial, and otolaryngology surgeries carried the lowest risk. Standardizing the Caprini model across surgical departments facilitates targeted, intensified prophylaxis and the establishment of evidence based VTE protocols.

Acknowledgments

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Disclosure of Conflict of Interest

None.

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