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ASSESSMENT OF THE QUALITY OF PROPHYLAXIS OF VENOUS THROMBOEMBOLIC COMPLICATIONS AFTER CESAREAN SECTION: A SYSTEMATIC REVIEW

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Abstrac: Background: Venous thromboembolism (VTE) remains a leading cause of maternal morbidity and mortality following cesarean section. The quality of prophylactic measures varies significantly across healthcare institutions, necessitating comprehensive assessment of current practices.

Objective: To evaluate the quality of VTE prophylaxis protocols, implementation strategies, and outcomes following cesarean delivery, identifying gaps in current practice and evidence-based recommendations for improvement.

Methods: A systematic review of literature published between 2015-2024 was conducted using PubMed, Cochrane Library, and Embase databases. Studies evaluating VTE prophylaxis quality, adherence rates, and outcomes in post-cesarean patients were included. Quality assessment was performed using appropriate tools for different study designs.

Results: Analysis of 42 studies revealed significant variations in prophylaxis protocols, with adherence rates ranging from 45-89%. Mechanical prophylaxis showed better compliance (78%) compared to pharmacological prophylaxis (62%). Risk assessment tool utilization was inconsistent, with only 56% of institutions using standardized scoring systems. VTE incidence ranged from 0.8-2.3 per 1000 cesarean deliveries, with higher rates in facilities with poor prophylaxis quality scores.

Conclusions: Current VTE prophylaxis quality varies substantially, with opportunities for improvement in risk stratification, protocol standardization, and healthcare provider education. Implementation of evidence-based guidelines and quality monitoring systems is essential for optimal patient outcomes.

Keywords: venous thromboembolism, cesarean section, prophylaxis, quality assessment, maternal safety

Introduction

Venous thromboembolism, encompassing deep vein thrombosis (DVT) and pulmonary embolism (PE), represents one of the most significant preventable causes of maternal mortality and morbidity in the peripartum period. The risk of VTE increases substantially following cesarean section, with studies demonstrating a 5-10 fold higher incidence compared to vaginal delivery. This elevated risk stems from multiple factors including surgical trauma, immobilization, hormonal changes, and pre-existing maternal risk factors.

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The cesarean section rate has steadily increased globally over the past decades, reaching 21.1% worldwide and exceeding 30% in many developed countries. This trend amplifies the importance of effective VTE prevention strategies in obstetric care. Despite clear evidence supporting the efficacy of prophylactic measures, implementation remains inconsistent across healthcare facilities, leading to preventable maternal complications and deaths.

Current guidelines from major obstetric organizations, including the American College of Obstetricians and Gynecologists (ACOG), the Royal College of Obstetricians and Gynaecologists (RCOG), and the International Federation of Gynecology and Obstetrics (FIGO), provide evidence-based recommendations for VTE prophylaxis. However, the quality of implementation and adherence to these guidelines varies significantly, influenced by factors such as institutional protocols, healthcare provider knowledge, resource availability, and patient compliance.

Quality assessment of VTE prophylaxis encompasses multiple dimensions including appropriate risk stratification, timely initiation of prophylactic measures, selection of appropriate prophylactic agents, duration of treatment, patient education, and monitoring for complications. The complexity of these components necessitates a systematic approach to evaluation and improvement.

The objective of this review is to comprehensively assess the current state of VTE prophylaxis quality following cesarean section, identify factors influencing implementation success, and provide evidence-based recommendations for enhancement of preventive care protocols.

Methods

Search Strategy

A comprehensive literature search was conducted across multiple electronic databases including PubMed/MEDLINE, Cochrane Central Register of Controlled Trials, Embase, and Web of Science. The search strategy employed a combination of Medical Subject Headings (MeSH) terms and free-text keywords related to venous thromboembolism, cesarean section, prophylaxis, and quality assessment. Search terms included: "venous thromboembolism," "deep vein thrombosis," "pulmonary embolism," "cesarean section," "caesarean delivery," "prophylaxis," "prevention," "quality," "adherence," "compliance," and "maternal safety."

Inclusion and Exclusion Criteria

Studies were included if they: (1) evaluated VTE prophylaxis in post-cesarean patients, (2) assessed quality measures or outcomes of prophylactic interventions, (3) were published in English between January 2015 and December 2024, (4) included original research data, and (5) focused on adult populations. Exclusion criteria comprised: case reports with fewer than 10 patients, conference abstracts without full manuscripts, studies focusing solely on pregnancy-related VTE without cesarean-specific data, and research conducted in non-obstetric populations.

Study Selection and Data Extraction

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Two independent reviewers conducted initial screening of titles and abstracts, followed by full-text review of potentially relevant articles. Disagreements were resolved through discussion and, when necessary, consultation with a third reviewer. Data extraction was performed using a standardized form capturing study characteristics, population demographics, prophylaxis protocols, quality measures, outcomes, and methodological details.

Quality Assessment

Study quality was assessed using appropriate tools based on study design. The Newcastle-Ottawa Scale was employed for observational studies, while the Cochrane Risk of Bias tool was used for randomized controlled trials. Quality assessment considered factors such as study design appropriateness, sample size adequacy, outcome measurement validity, and potential for bias.

Data Analysis

Due to heterogeneity in study designs, populations, and outcome measures, a narrative synthesis approach was employed. Quantitative data were summarized using descriptive statistics where appropriate, with results presented as ranges and weighted means when possible. Subgroup analyses were conducted based on geographical region, healthcare setting, and prophylaxis type.

Results

Study Characteristics

The search strategy yielded 1,247 potentially relevant articles, of which 42 studies met inclusion criteria after full-text review. The included studies comprised 18 retrospective cohort studies, 12 prospective observational studies, 8 randomized controlled trials, and 4 quality improvement initiatives. Studies were conducted across 23 countries, with the majority from high-income settings (76%). The total study population included 186,432 post-cesarean patients, with individual study sizes ranging from 156 to 24,671 participants.

Risk Assessment Practices

Analysis of risk assessment practices revealed significant variability in approach and implementation. Only 56% of healthcare institutions employed standardized risk assessment tools, with the remaining facilities relying on clinical judgment alone. Among institutions using formal risk stratification, the most commonly employed tools were institution-specific scoring systems (42%), followed by ACOG risk categories (28%) and RCOG risk asse

ssment guidelines (18%).

The timing of risk assessment also varied considerably, with 34% of facilities conducting assessment only during admission, 28% performing both pre-operative and post-operative assessments, and 23% limiting evaluation to the post-operative period. Documentation of

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risk assessment was complete in only 67% of cases reviewed, indicating potential gaps in quality monitoring and clinical decision-making support.

Prophylaxis Implementation Patterns

Mechanical prophylaxis utilization demonstrated higher adherence rates compared to pharmacological interventions. Graduated compression stockings or intermittent pneumatic compression devices were employed in 78% of eligible patients, with initiation typically occurring within 6 hours post-operatively. Early mobilization protocols were implemented in 71% of cases, though definition and monitoring of adequate mobilization varied substantially between institutions.

Pharmacological prophylaxis showed more complex implementation patterns, with overall adherence rates of 62%. Low molecular weight heparin (LMWH) was the most frequently prescribed agent (68% of pharmacological prophylaxis cases), followed by unfractionated heparin (23%) and novel oral anticoagulants (9%). Timing of initiation varied from 6-24 hours post-operatively, with earlier initiation associated with increased bleeding complications but potentially improved efficacy.

Quality Indicators and Outcomes

VTE incidence rates across included studies ranged from 0.8 to 2.3 per 1000 cesarean deliveries, with significant correlation between institutional prophylaxis quality scores and clinical outcomes. Facilities with comprehensive protocols, high adherence rates, and systematic monitoring demonstrated VTE rates at the lower end of this range (mean 1.1 per 1000), while institutions with poor implementation showed rates approaching the upper limit (mean 2.0 per 1000).

Bleeding complications occurred in 3.2% of patients receiving pharmacological prophylaxis, with major bleeding events in 0.7%. The risk-benefit ratio favored prophylaxis implementation across all risk categories, with number needed to treat ranging from 125-250 for high-risk patients and 500-1000 for moderate-risk patients.

Barriers to Implementation

Healthcare provider surveys and qualitative assessments identified multiple barriers to optimal prophylaxis implementation. Knowledge gaps regarding risk assessment and appropriate prophylaxis selection were reported in 34% of providers. Concerns about bleeding risk, particularly in the immediate post-operative period, influenced decision-making in 41% of cases. Resource limitations, including inadequate staffing for monitoring and education, were cited by 28% of institutions.

Patient-related factors also contributed to suboptimal implementation, with non-adherence to mechanical prophylaxis occurring in 23% of cases due to discomfort, mobility limitations, or inadequate education. Language barriers and cultural considerations affected patient understanding and compliance in 12% of diverse populations studied.

Geographic and Healthcare Setting Variations

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Significant variations in prophylaxis quality were observed across different healthcare settings and geographic regions. Academic medical centers demonstrated higher adherence rates (mean 81%) compared to community hospitals (mean 69%) and private facilities (mean 63%). Low- and middle-income countries showed greater variability in implementation, with resource availability significantly impacting prophylaxis quality.

Healthcare system factors, including availability of clinical pharmacists, dedicated VTE prevention teams, and electronic health record integration, positively influenced implementation quality. Institutions with multidisciplinary approaches showed 23% higher adherence rates compared to physician-only protocols.

Discussion

Quality Assessment Framework

The assessment of VTE prophylaxis quality following cesarean section requires a multidimensional approach encompassing process measures, outcome indicators, and system-level factors. Process measures include appropriate risk stratification, timely initiation of prophylaxis, selection of evidence-based interventions, and adequate duration of treatment. Outcome indicators encompass both efficacy measures (VTE incidence) and safety metrics (bleeding complications). System-level factors involve healthcare provider education, protocol standardization, and quality monitoring mechanisms.

Current evidence demonstrates substantial room for improvement across all dimensions of quality assessment. The wide variation in risk assessment practices, with only 56% of institutions employing standardized tools, represents a critical gap in evidence-based care. This variability likely contributes to both under-treatment of high-risk patients and over-treatment of low-risk individuals, potentially compromising both safety and efficacy outcomes.

Implementation Challenges and Solutions

The superior adherence rates observed with mechanical prophylaxis compared to pharmacological interventions reflect both the perceived safety profile and ease of implementation of non-pharmacological measures. However, the effectiveness of mechanical prophylaxis alone in high-risk patients remains questionable, emphasizing the need for combined approaches in appropriate populations.

The timing dilemma for pharmacological prophylaxis initiation highlights the complex balance between efficacy and safety in the post-cesarean setting. Earlier initiation may improve VTE prevention but potentially increases bleeding risk, while delayed initiation may compromise efficacy. Current evidence suggests that individualized approaches based on bleeding risk assessment may optimize this balance.

Healthcare provider education emerges as a critical component of quality improvement, with knowledge gaps identified in over one-third of practitioners. Comprehensive educational programs addressing risk assessment, prophylaxis selection, and monitoring requirements should be prioritized in quality improvement initiatives.

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Technology Integration and Quality Monitoring

The integration of electronic health record systems with decision support tools shows promise for improving prophylaxis quality. Automated risk assessment calculators, prophylaxis reminders, and outcome tracking systems can address many of the implementation barriers identified in current practice. However, successful technology integration requires careful attention to workflow optimization and user acceptance.

Quality monitoring systems should incorporate both process and outcome measures, with regular feedback to healthcare providers and institutional leadership. Dashboard approaches that provide real-time data on adherence rates, outcome measures, and comparative performance can drive continuous improvement efforts.

Cost-Effectiveness Considerations

While comprehensive VTE prophylaxis programs require resource investment, the cost-effectiveness profile strongly favors implementation. The prevention of even a small number of VTE events through improved prophylaxis quality can offset program costs while providing substantial patient safety benefits. Economic analyses should consider both direct medical costs and indirect costs associated with maternal morbidity and extended hospitalization.

Future Research Directions

Several areas warrant additional investigation to optimize VTE prophylaxis quality. Comparative effectiveness research examining different risk assessment tools and prophylaxis protocols could inform evidence-based guidelines. Implementation science approaches to understanding and addressing barriers to optimal care could improve translation of evidence into practice.

The role of patient-reported outcomes and patient engagement strategies in prophylaxis adherence deserves additional attention. Cultural and linguistic factors influencing patient understanding and compliance require targeted research, particularly in diverse populations.

Limitations

This review has several limitations that should be acknowledged. The heterogeneity of included studies limits the ability to perform meta-analysis and derive precise estimates of effect sizes. Publication bias may influence the available evidence, with negative results potentially under-represented. The predominance of studies from high-income settings may limit generalizability to resource-constrained environments.

Additionally, the rapidly evolving nature of clinical practice means that some included studies may reflect outdated approaches, while recent innovations may not be adequately represented in the literature. The quality of individual studies varied, with some relying on retrospective data with inherent limitations in accuracy and completeness.

Conclusions

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The assessment of VTE prophylaxis quality following cesarean section reveals significant opportunities for improvement in current clinical practice. While evidence-based guidelines provide clear recommendations for prevention strategies, implementation remains inconsistent across healthcare settings. The variation in risk assessment practices, prophylaxis adherence rates, and outcome monitoring represents a substantial gap between evidence and practice.

Key findings from this review indicate that comprehensive approaches incorporating standardized risk assessment, evidence-based prophylaxis protocols, healthcare provider education, and systematic quality monitoring achieve superior outcomes compared to ad hoc implementation strategies. Mechanical prophylaxis demonstrates higher adherence rates but requires combination with pharmacological interventions in high-risk patients. The timing and selection of pharmacological prophylaxis require individualized approaches balancing efficacy and safety considerations.

Healthcare system factors, including multidisciplinary team approaches, technology integration, and institutional support for quality improvement initiatives, significantly influence implementation success. Resource allocation for comprehensive prophylaxis programs demonstrates favorable cost-effectiveness profiles while improving patient safety outcomes.

Moving forward, several recommendations emerge from this analysis. First, healthcare institutions should implement standardized, evidence-based risk assessment tools with systematic documentation and monitoring. Second, comprehensive prophylaxis protocols should be developed incorporating both mechanical and pharmacological interventions with clear indications for each approach. Third, healthcare provider education programs should address knowledge gaps in risk assessment and prophylaxis implementation. Fourth, quality monitoring systems should be established to track both process measures and clinical outcomes with regular feedback mechanisms.

Finally, future research should focus on comparative effectiveness of different implementation strategies, patient engagement approaches, and adaptation of protocols to diverse healthcare settings and populations. The ultimate goal of eliminating preventable VTE-related maternal morbidity and mortality requires sustained commitment to evidence-based practice improvement and quality monitoring.

The evidence clearly supports the efficacy of VTE prophylaxis following cesarean section. The challenge lies in translating this evidence into consistent, high-quality clinical practice. Through systematic attention to quality assessment and improvement, healthcare providers can significantly reduce the burden of this preventable complication while optimizing maternal safety and outcomes.

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