

Comparative Efficacy and Economic Impact of Continuous Compartment Pressure Monitoring in Acute Compartment Syndrome Management

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INTRODUCTION: Acute Compartment Syndrome (ACS) is a critical condition marked by elevated pressure within a closed muscle compartment, often following traumatic injuries such as tibial fractures. Delayed or missed diagnosis can lead to severe complications, including permanent muscle and nerve damage, and even amputation. Traditional diagnostic methods for ACS are largely based on clinical signs and symptoms, which can be subjective and inconsistent. Continuous Compartment Pressure Monitoring (CCPM) offers an objective, real-time assessment of intracompartmental pressures, enhancing the accuracy and timeliness of ACS diagnosis. This study aims to rigorously evaluate the clinical and economic impacts of CCPM in ACS management, particularly in cases involving tibial fractures, by comparing it to conventional diagnostic approaches.

METHODS: Employing a sophisticated decision-tree economic model, this research projects the associated costs and Quality-Adjusted Life Years (QALY) over various timeframes, comparing the outcomes of CCPM with traditional, non-continuous monitoring methods. The model specifically targets ACS treatments resulting from tibial shaft and plateau fractures. A thorough analysis of patient records, coupled with a review of relevant clinical guidelines and expert consultations, forms the basis of this model. The study also integrates cost-effectiveness analysis, considering various health system perspectives.

RESULTS: The use of CCPM demonstrated a significant reduction in unnecessary fasciotomies, with a reduction rate of 94%. This intervention correlated with an average cost reduction of \$1,541 per patient (\$4,573 over the lifetime of the patient), alongside an enhancement in QALY, suggestive of improved post-treatment life quality. Over a 60-day time period, the model showed a decrease in length of stay of 2.73 days on average per patient. Long-term benefits were particularly substantial, suggesting that the upfront investment in CCPM could be offset by the reductions in unnecessary surgical interventions and improved patient outcomes.

DISCUSSION AND CONCLUSION:

The findings from this study underscore the substantial benefits of adopting CCPM in diagnosing and managing ACS in patients with tibial fractures. The significant reduction in unnecessary fasciotomies aligns with previous research demonstrating the limitations of clinical judgment alone in accurately diagnosing ACS. By providing continuous, objective data on compartment pressures, CCPM enhances diagnostic accuracy, minimizing risks of both under-treatment and over-treatment.

Economically, CCPM offers notable cost-saving potential. Reducing unnecessary surgical interventions lowers direct medical costs and associated expenses such as extended hospital stays and postoperative care. The average cost reduction of \$1,541 per patient, translating to \$4,573 over a patient's lifetime, represents significant savings for healthcare systems, aligning with value-based healthcare goals of improving patient outcomes while reducing costs.

The improvement in QALY further supports CCPM's clinical value. Enhanced diagnostic accuracy leads to timely and appropriate treatment, improving long-term patient outcomes and quality of life. The average decrease in hospital stay by 2.73 days per patient within 60 days post-injury benefits patients through quicker recoveries and alleviates healthcare resource burdens.

CCPM's adoption also has broader implications for healthcare policy and practice. The initial investments in CCPM technology can be offset by long-term savings and improved patient outcomes, making it a cost-effective strategy for healthcare systems. Integrating CCPM into clinical practice guidelines could standardize ACS management, reducing care variability and ensuring timely, appropriate interventions for all patients.