Cost-Effectiveness of Early Surgical Intervention for Asymptomatic Cervical Spinal Cord Compression: A Markov Analysis

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INTRODUCTION: The purpose of this study was to evaluate the cost-effectiveness of early surgical intervention for asymptomatic cervical spinal cord compression (ACSCC) compared to conservative management, using a Markov model. Additionally, we sought to determine the rate of disease progression at which early decompression becomes a cost-effective strategy.

METHODS:

A state-transition Markov model was developed to simulate the natural history of ACSCC over a lifetime horizon in a cohort of 10,000 patients. The model included seven health states: asymptomatic compression, mild, moderate, and severe myelopathy, post-operative recovery (with and without complications), and death. Transition probabilities, utilities (based on mJOA- and SF-6D-derived QALYs), and healthcare costs (in 2022 USD) were sourced from literature. Strategies compared included early anterior cervical discectomy and fusion (ACDF) versus observation with surgery only upon symptom progression. Monte Carlo simulation and a 3% annual discount rate were used. Sensitivity analysis was conducted to determine the progression rate at which early surgery became cost-effective.

RESULTS:

In the base-case scenario (monthly p12 = 0.0015), conservative management yielded 17.3 QALYs and $36,640 in lifetime cost per patient, while early surgery yielded 15.4 QALYs and $91,760 per patient, with an ICER of –$28,574 per QALY—indicating that early surgery was more costly and less effective. Sensitivity analysis revealed that if the monthly transition rate from asymptomatic to mild myelopathy exceeded 5% (~46% annually), early surgery became cost-effective at a willingness-to-pay threshold of $50,000 per QALY.

DISCUSSION AND CONCLUSION:

Early surgery for ACSCC is not cost-effective under current progression estimates but may be justified in high-risk patients with rapidly progressive disease. These findings support a risk-stratified approach, emphasizing early intervention only for patients with biomarkers or imaging features predictive of deterioration.