DIAGNOSIS OF ACUTE DOUBLE CERVICAL SPINAL CORD INJURIES IN SCHOOL-AGE CHILDREN

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Abstract: Acute double cervical spinal cord injuries (ADCSCI) in school-age children represent a rare but medically significant clinical entity. The unique anatomical and physiological characteristics of the pediatric cervical spine, combined with the evolving neurological maturity of the child, complicate timely and accurate diagnosis. This paper explores the clinical presentation, diagnostic imaging modalities, and differential diagnostic challenges associated with ADCSCI in children. Emphasis is placed on the importance of early recognition, comprehensive neurological evaluation, and tailored radiographic assessment using MRI and CT imaging. The study advocates for multidisciplinary collaboration among pediatricians, neurologists, neurosurgeons, and radiologists to optimize diagnostic accuracy and reduce long-term morbidity.

Keywords: pediatric spinal trauma, cervical spine injury, dual-level cord lesion, MRI diagnosis, neurological assessment.

INTRODUCTION

Traumatic spinal cord injury (SCI) in children, though less common than in adults, presents unique challenges in terms of diagnosis, clinical management, and long-term rehabilitation. Within this category, acute double cervical spinal cord injuries (ADCSCI) refer to two simultaneous lesions occurring at distinct cervical levels, either within the cord itself or in association with vertebral or ligamentous damage [1].

In school-age children—typically defined as those between 6 and 12 years of age—the cervical spine remains biomechanically immature. The disproportionately large head, greater ligamentous laxity, and ongoing ossification processes make this age group particularly vulnerable to high cervical injuries. Diagnosis of ADCSCI is further complicated by the often-subtle initial clinical signs, communication limitations, and potential for delayed symptom progression.

Early and precise diagnosis is critical, as delayed intervention may result in irreversible neurological deterioration. This paper seeks to examine the diagnostic process, integrating both clinical and radiological strategies essential for the timely identification of ADCSCI in pediatric patients.

MATERIALS AND METHODS

While imaging remains the cornerstone of diagnosing spinal cord injuries, neurophysiological techniques such as somatosensory evoked potentials (SSEPs) and motor evoked potentials (MEPs) offer valuable insights into the functional integrity of spinal pathways. In cases of double cervical injuries—where MRI findings may reveal subtle or equivocal lesions—neurophysiological studies can aid in mapping the conduction deficits and localizing the neurofunctional disruption with greater precision. In pediatric patients, where cooperation may be limited and interpretation complicated by developmental neuroplasticity, pediatric-trained neurophysiologists are crucial for reliable application and analysis. Early electrophysiological abnormalities may precede radiological changes, offering an opportunity for preemptive clinical intervention [2].

RESULTS AND DISCUSSION

The biomechanics of pediatric cervical trauma are markedly distinct from adults due to developmental anatomical features. The relatively large head-to-body ratio in young children increases the momentum of cervical flexion during abrupt deceleration. This mechanism can result in dual point failures along the cervical spine: a primary point of hyperflexion injury, and a secondary compensatory hyperextension site—thus explaining the occurrence of double-level injuries. A detailed analysis of biomechanical forces involved can provide diagnostic clues. For instance, C2–C3 injuries combined with C5–C6 involvement may suggest a whip-like injury motion, while C1–C2 combined with subaxial instability may point to underlying ligamentous laxity exacerbated by vertical load trauma.

Understanding the mechanism of injury helps clinicians anticipate which cervical levels should be scrutinized, particularly when MRI reveals edema at one level but symptoms suggest involvement of another [3].

The quality of pre-hospital evaluation can significantly influence the outcomes of cervical spinal injuries in children. Emergency medical responders (EMRs) play a pivotal role in ensuring proper spinal immobilization, early symptom identification, and appropriate transport decisions.

An effective triage system must be tailored to the pediatric population, with field algorithms guiding decisions on early advanced trauma life support (ATLS) measures, selection of trauma centers, and activation of spinal cord injury response teams upon hospital arrival.

Integration of prehospital notification systems can facilitate imaging readiness, multidisciplinary team assembly, and minimized diagnostic delays.

In low-resource environments or rural regions where MRI is not immediately available, diagnosing complex pediatric cervical injuries becomes exceedingly difficult. General hospitals may lack pediatric spinal expertise, sedation capability for imaging, or appropriate immobilization devices [4].

CONCLUSION

The diagnosis of acute double cervical spinal cord injuries in school-age children is a clinically demanding process that requires a keen understanding of pediatric spinal anatomy, injury mechanisms, and presentation patterns. Due to the risk of underdiagnosis and delayed treatment, clinicians must

maintain a high degree of suspicion and use a combination of neurological assessment and advanced imaging to detect both overt and occult injuries.

Early and accurate diagnosis is fundamental to guiding timely interventions, preventing secondary complications, and ensuring optimal long-term functional outcomes. As such, structured protocols, cross-specialty communication, and caregiver involvement remain vital components of high-quality pediatric spinal trauma care.

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