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Case Report
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C2-C3 Pseudo-Subluxation – Importance in Urgent Assessment of Cervical Spine Trauma in Childhood

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Abstract

Cervical spine injury is rare in children. It is mostly seen in people who suffer from severe and significant trauma, occurring in 1% to 2% of these cases. Interpretation of cervical spine radiographs and clinical examination in children can be difficult. In children, the cervical spine presents variations from normality that must be known so that they are not interpreted as pathological, especially in a traumatic context, avoiding exposure to more radiation. The objective of this paper is to report a physiological radiological finding of the cervical spine in childhood that tends to be misjudged as pathological: The pseudo-subluxation of C2-C3.

We report the case of a 30-month-old child who was brought to the emergency room due to traumatic brain injury and cervical trauma, caused by hitting a big object. She reported severe neck pain and headache, the mother denied syncope, nausea or vomiting. She mentioned pain on palpation of the vertebral apophyses of the cervical spine and paravertebral pain, without neurological compromise. On plain radiography, in lateral view, she presented a C2-C3 subluxation, without signs of fracture. She was immobilized with a cervical collar and a computed tomography scan was requested, which showed C2-C3 subluxation, with proper alignment of the posterior wall and rectification of the physiological curvature. She was reassessed early in the consultation; she was asymptomatic, the control radiograph showed normalization of the cervical rectification and confirmed the absence of a lesion.

It is important to know the Swischuk line in the radiographic study, which may be sufficient for the initial assessment. However, given the possibility of an acute injury to the cervical spine, CT should be considered. A multidisciplinary consensus should be established.

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Introduction

In children, the immature cervical spine presents several variations from normality that must be known so that they are not interpreted as pathological, especially in the traumatic context, thus avoiding unnecessary complementary exams [1].

The most frequent variant of normality is the physiological pseudo-subluxation of C2-C3, which can occur in approximately 40% of children under 7 years of age [1,2].

Generally, a rigorous clinical examination associated with the radiological study of the cervical spine is necessary in an emergency context [1]; these can be difficult in pediatric age, requiring additional imaging studies. In the simple radiological study of the child's cervical spine, it is important to know the Swischuk's Line [3], drawn from the anterior cortex of the spinous apophysis of C1 to the anterior cortex of the spinous apophysis of C3. In subluxation, the anterior cortical of the spinous apophysis of C2 must be in continuity with this line at less than 2 mm [1,3].

In this paper, the authors present a review of the literature on the subject, illustrating a case of a child seen in the emergency department for indirect cervical trauma, highlighting the importance of knowing the C2-C3 pseudo-subluxation as a variant of the normality, and not as a pathological entity.

Case Presentation

A 30-month-old child brought to the Emergency Department (ED) for presenting cranial and cervical trauma, approximately 1 h before the appointment, after hitting a big object. She reported severe cervical and occipital pain. The mother denied having lost consciousness, vomiting, agitation

Figure 1: Anteroposterior and lateral projections.

Figure 2: Anteroposterior and front projections.

Figure 3: Cervical spine CT showed mild subluxation of C2-C3.

Figure 4: Absence of the initially suspected lesion was confirmed.

or other associated injuries.

Initially evaluated by a pediatrician in the emergency department, who did not find significant changes or signs of neurological focus in the general physical examination. The Pediatrician requested a simple X-ray of the cervical spine, in the anteroposterior and lateral projections (Figure 1, 2), and referred the child for orthopedic evaluation.

Assessed by orthopedics, the child had severe pain on palpation of the spinous apophyses of the cervical spine, and cervical paravertebral pain, without apparent neurological impairment.

Initial plain radiographs showed no apparent signs of fractures in the cervical spine; the hypothesis of C2-C3 dislocation was raised. A cervical collar was placed and a Computed Tomography (CT) scan of the cervical spine was requested.

Cervical spine CT (Figure 3) showed mild subluxation of C2-C3, but physiological, with adequate alignment of the posterior vertebral wall, and rectification of the physiological curvature.

The child was re-evaluated and referred for review in the orthopedic consultation, with a cervical collar in place.

The time elapsed between the child's admission to the emergency department and hospital discharge was 4 h and 20 min.

Four days after the initial care, in a scheduled orthopedic consultation, the child was re-evaluated. She was asymptomatic, so the cervical collar was removed. Again reassessed four weeks after the trauma, she remained asymptomatic. A radiological study of the cervical spine was performed again, with the normalization of the cervical spine rectification being seen, and the absence of the initially suspected lesion was confirmed (Figure 4), which led to her being discharged from orthopedics.

Discussion

Cervical spine injuries in children occur rarely, accounting for about 0.2% of all fractures and dislocations, and about 1.5% to 3% of all spinal injuries. There are important differences regarding the spine between adults and children, especially up to 10 years of age. Knowledge of the difference between normal, variants of normal and spinal developmental pathology is essential to avoid misinterpretation of radiological exams in pediatric patients. Common examples are misinterpretation of synchondrosis with atlas fractures or C1-C2 or C2-C3 subluxations [4].

Swischuk [3], in 1977, described the line drawn between the spinous apophyses from C1 to C3, to help differentiate between pathological conditions and physiological alterations of the cervical spine in this infant age group. Subsequently, several authors confirmed its usefulness in several publications [1,5,6]. Swischuk [3]

Figure 5: Swischuk Initial.

Figure 6: Swischuk CT.

considered that in physiological conditions, the posterior cervical line could pass through the posterior arch of C2, could touch the anterior face of the posterior cortex of the posterior arch of C2, or be positioned up to 1mm from the anterior cortex of the posterior arch of C2; in pathological situations, an injury is suspected if the line passes >1.5 mm from the posterior arch of C2, and dislocation is considered if this distance is greater than 2 mm.

It is known that the assessment of the cervical spine is very difficult in children, especially in cases of severe trauma with unique patterns of injury, added to the limitations of exposure to radiation in this age group, as well as unstable cervical injuries, a nosological entity unfamiliar to the emergency physician. In the study by Brockmeyer et al. [7], it was observed that the initial imaging evaluation of the cervical spine in children could be performed with plain radiographs (X-ray) or Computed Tomography (CT), which is more recommended because it demonstrates superior ability to identify critical injuries.

However, other authors such as Hernandez et al. [8], referred to the lower capacity of CT to identify acute cervical lesions in children under 5 years old, and it is comparable to simple radiological examination. Simple radiological studies in flexion and extension are debatable, being unnecessary in situations where the initial simple X-ray is normal [9]. In the study by Eren et al. [10], it was observed that most CT scans did not show changes, with unnecessary exposure to high doses of radiation. Associated with these data, there is the

Figure 7: Swischuk final.

issue of differences in CT interpretation, which should preferably be performed by a pediatric radiologist [11], who is not always available in emergency services.

Currently, there are still no established diagnostic standards or consensual procedures to treat cervical spine trauma in children. Anderson et al. [12] stated in 2006, that the establishment of a cervical spine assessment protocol would be effective in detecting traumatic injuries of the cervical spine in children. This statement was corroborated by other authors [13-15].

Pennell et al. [16], in an attempt to reduce the use of resources and reduce the child's exposure to radiation, established the standardized protocol of the Working Group for the Assessment of the Cervical Spine in Cervical Trauma in Children. They evaluated 359 children, 248 before the application of the protocol and 111 after. They had an adherence of 87.4%, and observed that children evaluated with the protocol were considered discharged mainly by clinical examination (15.3% *vs.* 43.2%), with a smaller number of children undergoing radiological studies (70, 2% against 55%) and TC (14.5% against 5.4%). This reduction in imaging studies resulted in a cost reduction of approximately US $396,476. Similar results were found by Overmann et al. [17], after the creation of a care protocol for cervical trauma for the pediatric group.

Concern about exposure to radiation is related to the carcinogenic effects of X-radiation. In the study by Banerjee and Thomas [18], a 0.37% risk of developing cancer after CT was observed, with a positive correlation between the radiation dose and increased risk of cancer [18]. These authors recommended that children without warning signs for cervical spine injuries should be evaluated by other methods to avoid radiation exposure. Kavuri et al. [19] observed that clinical reassessment after 24 h of trauma reduced radiation exposure without compromising the diagnosis of cervical spine injury.

With this same concern, Lindholm et al. [20] observed that carrying out only one radiological profile study of the child's cervical spine was equivalent to carrying out multiple views. In suspected situations of ligament injuries, they recommended performing magnetic resonance imaging, reducing exposure to radiation.

It is important to emphasize that the study by Swischuk [3] was carried out only with simple profile radiological exams. Based on this literature, the clinical examination of the child described in our case could have been the only one performed, to guide the treatment of this child. This point is corroborated by the tracing of the Swischuck line on the lateral radiograph; the CT scan performed during the patient's urgent episode (Figure 5, 6), confirmed the traced line on

the radiograph taken during the return visit (Figure 7).

Our work intends to emphasize the importance of prior knowledge of the variants of normal in the cervical spine in the pediatric age group. We agree with Easter et al. [21], stressing the importance of training in this area for emergency room physicians, enabling them to identify variants of the normal and to differentiate them from traumatic injuries, allowing us to determine the need for additional studies.

However, at an earlier age, with significant complaints of pain in the cervical spine at initial observation, in view of a possible acute injury to the cervical spine, with potential devastating side effects, the option of performing a CT scan of the cervical spine should be considered by the physician in the emergency service.

Conclusion

Prior knowledge of variations in the normality of the child's cervical spine is extremely important in the initial assessment of cervical spine trauma in pediatric patients.

The lateral radiographic study of the child's cervical spine is sufficient in the initial assessment of trauma.

The establishment of a multidisciplinary consensus between pediatrics, orthopedics and radiology is necessary to standardize procedures for the initial assessment of children in situations of cervical spine trauma, improving the final outcome, reducing expenditure on unnecessary resources and unnecessary exposure of the child to ionizing radiation.

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