Interdisciplinary Neurosurgery: Advanced Techniques and Case Management 7 (2017) 64–70

Contents lists available at ScienceDirect

Interdisciplinary Neurosurgery: Advanced Techniques and Case Management

journal homepage: www.inat-journal.com

Neuroanatomical Study

Lateral sinus thrombosis following minor head injury in children

Jun Maruya [a,*], Satoshi Tamura [a], Takaharu Miyauchi [b], Keiichi Nishimaki [a]

[a] Department of Neurosurgery, Akita Red Cross Hospital, Japan
[b] Department of Radiology, Akita Red Cross Hospital, Japan

ARTICLE INFO

Article history:
Received 21 November 2016
Revised 26 November 2016
Accepted 4 December 2016

Keywords:
Lateral sinus thrombosis
Sigmoid sinus thrombosis
Transverse sinus thrombosis
Mild head injury
Child
Anticoagulation

ABSTRACT

Objective: In children, lateral sinus thrombosis (LST) following minor head injury (MHI) has occasionally been reported because of neuroimaging techniques. However, the condition is rare, and its pathophysiology remains unknown. We aimed to identify the factors associated with its etiology and severity to provide information to guide the diagnosis, management, and prognosis.

Methods: We retrospectively reviewed all patients aged 1–15 years with craniofacial trauma presenting to our emergency department between 2011 and 2015. In total, 4 patients with LST following MHI were identified. We also performed a comprehensive literature review to identify relevant cases in studies published between 1990 and 2015, and this yielded 17 studies with 24 patients. We analyzed the data for these 24 patients with our 4 cases (n = 28).

Results: The mean age of the 28 cases was 7.0 years, and the male-to-female ratio was 1.2:1. Nausea/vomiting and headache were the most common symptoms, but signs and symptoms of increased intracranial pressure were present in 5 patients. The sigmoid sinus was most commonly affected. A total of 20 patients were treated conservatively, and the remaining 8 patients received anticoagulation. All patients had good outcomes, with no major complications. Radiological follow up showed complete recanalization in 14 patients and partial recanalization in 3 patients.

Conclusions: Although LST following MHI is still rare in children, our findings indicate that it might be much more common than previously thought. Thankfully, though, most patients appear to have an excellent prognosis. A high degree of suspicion should be maintained when assessing patients with MHI, because the non-specific symptoms make diagnosis difficult. Neuroimaging by magnetic resonance venography or computed tomography venography is crucial for both diagnosis and follow up. Hypercoagulation disorders should be excluded, and anticoagulation therapy should be given to patients with these disorders, or to those with persistent or progressive LST. Conservative therapy is recommended, although anti-edema drugs or intermittent lumbar puncture may be beneficial.

1. Introduction

Lateral sinus thrombosis (LST) in children has mostly been reported as a complication of otitis media [1,2]. However, since the antibiotic era there has been a dramatic reduction in intracranial complications from infectious ear disease [2,3]. Thus, although it can still complicate minor head injury (MHI), LST is now rare in childhood [4]. Whereas the history and clinical presentation are more likely to lead to a diagnosis of LST in adults, the clinical signs and symptoms are less specific in children [1,5]. Therefore, the diagnosis of pediatric LST following MHI is not easy [6]. Early diagnosis has latterly become possible courtesy of the widespread use of neuroimaging, with occasional cases of pediatric LST following MHI being reported in the literature [3,4,6–20]. However, the pathophysiology of this rare complication is still unknown.

The safety of anticoagulation therapy has been established in pediatric cases of cerebral sinus thrombosis [21,22]. But, intracranial hemorrhage frequently occurs in pediatric cases of cerebral sinus thrombosis following head injury, so anticoagulation therapy is often withheld. The role of anticoagulation therapy is therefore still controversial in these cases [4], and management decisions are left to the preference of the treating physician.

We performed a literature review to identify cases of pediatric LST following MHI. This review aimed to identify the factors associated with the etiology and severity of pediatric LST following MHI. Ultimately, we discuss how these can guide the diagnosis, management, and prognosis of this rare entity.

2. Patients and methods

Pediatric LST following MHI was defined as radiologically confirmed LST following a documented MHI in a child aged 1 to 15 years. A child

* Corresponding author at: Department of Neurosurgery, Akita Red Cross Hospital, 222-1 Nawashirosawa, Saruta, Kamikitate, Akita 010-1495, Japan.
E-mail address: jmaruya@archosp-1998.com (J. Maruya).

http://dx.doi.org/10.1016/j.inat.2016.12.002

was determined as having sustained an MHI based on an appropriate history of head trauma and an admission Glasgow Coma Scale (GCS) score of 13–15. We retrospectively reviewed all pediatric patients aged 1–15 years presenting to our emergency department with craniofacial trauma between January 2011 and December 2015, inclusive. From among these 1202 patients, we identified 4 who met the inclusion criteria. We then retrospectively analyzed their clinical records and radiological findings.

Next, we performed a comprehensive literature review to identify relevant studies published between 1990 and 2015 in PubMed, Google Scholar, and Ichushi-Web (for articles written in Japanese). The search terms were as follows: "lateral sinus thrombosis," "transverse sinus thrombosis," "sigmoid sinus thrombosis," "childhood," "children," "minor head trauma," and "minor head injury." The reference lists of relevant publications were also reviewed to identify additional papers that might have been missed by our search terms. We included those papers in which a GCS score had not been mentioned, children did not have obvious disturbance of consciousness, or children were diagnosed as having MHI by the authors. We identified 17 related studies that included medical data for 24 patients.

The data for the 24 patients identified in the literature review were merged with those of our 4 cases, and we analyzed the clinical features, risk factors, follow up, outcomes, and management. We also provide an illustrative case.

3. Results

3.1. An illustrative case

A 7-year-old boy fell off his bike and struck his occiput. He returned home unaided and able to ride his bike; however, he seemed sleepier than normal and complained of a headache, so was taken to the emergency room approximately 3 h after the fall. On initial evaluation, he had stable vital signs, no neurological deficits, and a GCS score of 15. A computed tomography (CT) scan was done following an episode of vomiting in the emergency room, and this demonstrated a very small acute epidural hematoma at the left cerebellar convexity. He was allowed to go home, but neurosurgical follow up was arranged early the following morning. On return, his neurological examination was unremarkable, but a repeat CT scan revealed that he had developed a focal hyperdensity in the left sigmoid sinus (Fig. 1A) and that the acute epidural hematoma had enlarged (Fig. 1B). Meticulous reading of bone window imaging indicated a left lambdoid suture diastasis (Fig. 1C). Subsequently, magnetic resonance (MR) imaging with MR venography was performed, which confirmed that the acute epidural hematoma had not changed in size. Both the T1- and T2-weighted MR images showed an area of isointensity in the left sigmoid sinus that was suggestive of an LST (Fig. 2). There were no other intracranial lesions. MR venography confirmed occlusion of the left transverse and sigmoid sinus, with the development of venous collaterals around the superficial middle cerebral vein (Fig. 3A). The child was managed conservatively, and he made a full recovery. He was discharged home 7 days after the initial trauma, and follow-up MR venography after 2 months showed recanalization of the transverse and sigmoid sinuses (Fig. 3B).

3.2. Literature review

Including our 4 cases, there were 28 reports of pediatric patients with LST following MHI (Table 1). The age range of patients was from 1 to 15 years (mean age 7.0), and there were 15 males and 13 females (male-to-female ratio of 1.2:1). The mechanism of injury was either a fall or a motor vehicle accident. The time from head trauma to admission typically varied from immediately post-trauma to 2 days after the trauma. However, this was not universal, with case 12 being admitted on day 4 and case 24 being admitted on day 5 because of delayed diagnosis and minimal symptoms, respectively. In addition, due to exacerbation after temporary remission, cases 13 and 14 were readmitted on days 10 and 6, respectively. On laboratory investigation, only case 13 had hematological evidence of a prothrombotic disorder (elevated antiphospholipid antibodies).

Data on the clinical symptoms and signs were available for 23 patients (Table 2). Commonly reported clinical findings included nausea and/or vomiting (23 cases, 100%), headache (16 cases, 69.6%), gait ataxia (5 cases, 21.7%), drowsiness (4 cases, 17.4%), papilledema (4 cases, 17.4%), irritability (4 cases, 17.4%), dizziness, and imbalance (3 cases, 13.0%). In 2 cases each (8.7%), there was evidence of abducens palsy or diplopia, photophobia, hearing disturbance, raccoon eyes (periorbital ecchymosis), Battle's sign (mastoid ecchymosis), or hemotympanum. In addition, 1 patient each (4.3%) had blurred vision, amnesia, nystagmus, otorrhea, pyrexia, or decreased muscle tone. Finally, 5 patients had signs or symptoms of increased intracranial pressure (IICP), including papilledema, abducens palsy, drowsiness, and high opening pressure at lumbar puncture (Table 3). Although the initial symptoms were typically non-specific, some patients did therefore present with diagnostic signs of IICP; these were early symptoms in 2 patients (cases 10 and 17), but were delayed symptoms in 3 patients (cases 12, 13, 23).

Radiological evaluation revealed skull fractures in 18 children (64.3%; vault = 15, base = 5, and diaschisis of lambdoid suture = 5). Pneumocephalus was detected in 8 patients (28.6%), and intracranial hematomas were recognized in 14 patients (50.0%; acute epidural hematoma = 8, acute subdural hematoma = 6, and cerebral contusion = 4). Hematoma expansion did not occur in all patients regardless of the treatment strategy used. Five children (17.9%) had neither skull fractures nor intracranial hematomas. The diagnosis of LST was established by contrast-enhanced CT, MR venography, or CT venography. A single sinus was involved in 13 patients (46.4%), with the transverse sinus involved in 4 cases and the sigmoid sinus in 9 cases. But, there was multiple sinus involvement in 15 patients (53.6%), including the transverse and sigmoid sinuses in 9 cases, the sigmoid sinus and jugular vein in 4 cases, and the transverse-sigmoid sinus and jugular vein in 2 cases.

Conservative therapy was sufficient in 20 patients (71.4%), but 8 patients (28.6%) were treated with anticoagulation therapy (heparin, low molecular weight heparin [LMWH], enoxaparin, warfarin, and/or acenocoumarol). Radiological follow up showed complete and partial recanalization in 14 (duration range: a couple of days to 2 months) and 3 patients (3 days to 5 months), respectively. The median follow-up period was 2 months, with a range from 18 days to 8 months. The outcome was good in all patients, with no major complications reported. However, 2 patients (cases 5 and 9) were still suffering from recurrent headaches for a couple of months.

4. Discussion

4.1. Etiology

LST has been attributed to several etiologies, including: 1) infection (e.g., acute or chronic otitis media), 2) systemic conditions (e.g., coagulation disorders, such as protein C and S deficiency or thrombophilias such as antiphospholipid syndrome and metastatic malignancy), 3) drug induced conditions (e.g., cytotoxic drugs, contraceptive pills, or hormone replace therapy), and 4) trauma (e.g., penetrating severe head injury, closed head injury, or posterior fossa surgery) [1,4,10,23]. Given that LST from infective causes has become a rare presentation in children since the advent of antibiotics [2,3], trauma and hypercoagulable states have emerged as equally significant causes [3]. Outside the neonatal period, the incidence of cerebral sinus thrombosis has been reported to be 0.34 per 100,000 per year [15,20], but the incidence of pediatric LST following MHI is unknown. In our experience, we identified 4 children with LST from 1202 pediatric patients with craniofacial trauma over a 5-year period, and we did not identify any other brain regions with cerebral sinus thrombosis. This is consistent with reports that LST is the most frequent type of cerebral sinus thrombosis, especially