Neurological aspects of otogenic lateral sinus thrombosis in children

Doctoral theses

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Budapest

2015

Introduction

The complications of acute otitis media (AOM), acute mastoiditis (AM) are well documented in otolaryngological literature. Before the use of antibiotics septic intracranial complications were life-threatening. However, as a consequence of new drugs and therapeutic methods, the full recovery of patients is a realistic expectation. In spite of these expectations neurological complications can still have an impact on the patients in terms of recovery. In the literature it is not emphasized that optimal care for the patients can only be managed under a multidisciplinary team with pediatric neurologist playing an important role. Since the Heim Pál Children's Hospital's conception working in multidisciplinary teams has been the accepted practice.

It is not well known that the venous drainage is frequently asymmetrical. Serious consequences can result from it. The otorhinolaryngolists carry out research in the field of otology and hearing and while treating and caring for patients they specialize in these fields. The pediatric neurologist has to be mindful of the serious consequences of the complications regarding vision. Palsies and coordination difficulties during the course of disease cannot be ignored. The enormous impact on family life by attention deficits and behaviour changes must be addressed. In my work I have focused on these topics. Based on my 20 years' experience as a pediatric neurologist I have written a summary of my observations, which include some new aspects of areas previously undocumented.

Aim of the study

1. To set a unified diagnostic protocol in pediatric otogenic lateral sinus thrombosis and to define the role of pediatric neurologist in it.
2. To determine new neurological aspects of the disease, which influence care and follow up.
3. To coordinate otorhinolaryngolic, neurologic and opthalmologic aspects in care and follow up. To define the role of physiotherapist, psychologist and education teacher in care and follow up.
4. To set the modality, frequency and length of follow up.

Patients and method

I performed a retrospective chart review of patients, under 18 years of age treated with otogenic lateral sinus thrombosis (LST) in Heim Pál Teaching Children's Hospital in Budapest from January 1998 till June 2014. We have treated 13 patients during this period. This series is the second largest series in the literature in the last 20 years, treated by one center.

After forming the diagnoses children were operated on in the Department of Oto-Rhino-Laryngology. After the operation depending on their clinical conditions they were treated in the Intensive Care Unit or stayed on the Oto-Rhino-Laryngology ward for a few days. Later they moved to the Department of Neurology. I attended all patients at the setting of diagnosis and I was a member of the neurological board, while we treated them. The neurological part of the follow ups was performed by me.

Results

Otogenic LST still remains present in our days despite good access to health care in Hungary. Based on the clinical picture at admission, patients could be divided in two groups, which we defined as Early and Late presenting groups. One presenting early (within one week) and the other late (after 2–6.5 weeks) following AOM. In the Early presenting group we found acute clinical setting, with earache, otorrhea, high spiking fever. All patients suffered from headache, were lethargic and had nausea and vomited. Nuchal rigidity was found in half of them. All patients complained about neck pain and parents reported excessive sleepiness in all. Focal neurological signs were not characteristic. Among patients in the Late presenting group (who were all treated with antibiotics prior to admission, and were thought to be healed) fever was not present. Focal neurologic symptoms (such as abducens nerve palsy, diplopia, ataxia, and facial palsy) dominated the clinical picture besides the signs of elevated intracranial pressure, which manifested as headache, nausea, vomiting and excessive sleepiness. Earache was not so dominant, it manifested just in half of the patients and it was not so profound. Torticollis, gait disturbances were present in both groups.

The clinical practice guideline for AOM has been changed for several times from 1998 to 2014 in Hungary. The last guideline was introduced in 2011. It addresses pain management, initial observation versus antibiotic treatment in children above 2 years of age presenting with unilateral AOM without otorrhea. Despite restrictive antibiotic administration, the number of patient with AM did not increase in our hospital. But we treated more Early presenting cases with otogenic LST after 2011.

Results of diagnostic investigations were group-specific at admission. In the Early presenting group laboratory investigations helped. The mean leukocyte count was 21.5 G/l; the mean value of C reactive protein (CRP) was 221 mg/l. The pitfall of diagnosis setting was that 24-48 hours after administering antibiotics blood CRP level decreased with 53% in average, and leukocyte count decreased with 35% in average. In the Late presenting group neither leukocyte count nor CRP were elevated.

In the Early presenting group otoscopy revealed red, inflamed tympanic membrane in all patients and otorrhea was present in 6/8. Among patients in the Late presenting group otoscopy revealed only slight retraction of the tympanic membrane in 4/5. Ophthalmoscopy performed within 48 hours after admission revealed papilledema in 5/8 in Early presenting group and 4/5 in Late presenting group. Visual disturbance was not present at admission. Raising the suspicion of otogenic LST imaging was performed in all patients. According to the literature, CT with contrast could detect only 60-84% of LST cases. The gold standard MRI/MRV with no radiation exposure not just visualizes circulation in sinuses, but detects other intracranial complications with high sensitivity. In two children MRI and MR venography (MRV) was performed immediately upon admission. Because of technical reasons the majority of patients (n=11) underwent emergency CT with contrast, which detected an opacification of the mastoid cells and SS thrombosis in all of them. MRI with MRV was performed by all of the patients within one week after surgery. It gave us additional information regarding focal meningeal inflammation in 3 patients and temporal cerebritis and venous infarction was suspected in two. The extension of sinus cavernousus thrombosis to superior ophthalmic vein was also detected only by MRI. This influences both the duration of antibiotic administration and the type of surgery. Follow up examinations were performed

exclusively by MRI and MRV. In 8 cases the thrombosis extended into the lateral sinus and internal jugular vein as well. The length of thrombosed vein was not characteristic for clinical groups. I did not find correlation between the extension of thrombosis and the time length from the beginning of the disease.

I analysed the anatomy of the venous outflow tract in the patients. In 2/13 cases right sided dominance was observed, in 3/13 left sided hypoplasia was detected. In 8/13patients symmetrical venous outflow tract was found.

Bacteriological cultures proved positive for Streptococcus pneumoniae only in those Early presenting cases, who were not pre-treated with antibiotics and in only one case of the Late presenting group.

Each child was treated with intravenous antibiotics. Each patient underwent mastoidectomy. In eight children decompression of the sinus wall was performed as well because cranial CT with contrast suspected perisinosus abscesses or granulation tissue, which were eliminated in seven patients. One epidural abscess was incised and drained with neurosurgical help. Prior to the availability of low molecular weight heparin (LMWH), needle puncture, incision and thrombectomy were performed in two cases. The internal jugular vein was also ligated in one of them. No surgical complications occurred. There was no need for reoperation. LMWH has been available for children in Hungary since 2002. In our practice it was administered to eleven patients in therapeutic doses. Effectivity was monitored by anti-Xa activity measurements. We applied LMWH in average for six months. After six months, anticoagulation was discontinued independently of the degree of recanalization. Neither bleeding complications, nor thrombocytopenia occurred. Laboratory screening for hypercoagulability was carried out in seven subjects. Only in one case we found lupus anticoagulant positivity. Brain abscesses were conservatively managed.

I was the first, who analysed the clinical signs of patients 24-72 hours after mastoidectomy. After surgery, the clinical signs of elevated intracranial pressure transiently worsened in 7/13 patients. They belonged to the group, where the dominant venous outflow was occluded, or to the group where one side of the symmetric venous outflow tract was closed. This manifested as progression of papilledema in seven children, causing severe visual disturbance in two cases, and transient blindness in one.

I was the first who studied the correlation between the anatomy of the venous outflow tract and the persistence of the clinical signs. If one side of symmetrically developed venous outflow tract was occluded (n=8), independently from the extension of the thrombosis, the signs of elevated ICP, visual disturbance persisted on average for 1.4 months after surgery. If the dominant venous outflow tract was occluded (n=3) independently from the length of the thrombus, a more serious clinical picture and a more protracted course was seen between two and five months, on average three month. If the hypoplastic or subdominant side was occluded, clinical signs of elevated intracranial pressure were not present. On average the signs of elevated ICP such as headache, abducens palsy, double vision, persisted for two months, but the most serious case suffered five months long (range 1–5 months) after surgery. Facial palsy, retinal haemorrhages and visual disturbance persisted in average for one month except the most serious case, who presented with permanent unilateral visual deficit of 0.5. Ataxia ceased within one month. Nuchal pain, rigidity and permanent torticollis diminished after surgery, but episodic head tilting could be observed for four months. Altered coordination, slight balance problems lasted on average for three months. In four cases physiotherapy was applied as well. Behaviour changes, hyperactivity were noted in nine patients, regular psychological consultations were added, until the

problems resolved on average within 6 months. Attention deficits were in 6 cases noted, regular psychological and education teacher's consultations helped to resolve this problem. At the one year follow up visit these complaints were no longer present.

After discharge patients were followed up at expanding intervals: weekly in the first month, every second week in the second and third months, and then monthly up to the sixth month, with a last visit at one year At the follow up visit a complete pediatric, neurologic and otologic examination was performed, as well ophthalmoscopy and visual acuity tests were done. Formal audiologic evaluation was carried out at one and three months after discharge. We found conductive hearing loss in two cases. Adenotomy was carried out; normal hearing was verified one month after it.

In cases where LST was accompanied by intracranial complications, MRI and MR venography (MRV) were repeated at three weeks, six weeks, and three months and at one year. The results of the early investigations determined the length of antibiotic administration. In cases without intracranial complications, recanalization was followed at three months and one year. At three months only partial recanalization was present in the majority of patients (9/13), while at one year complete recanalization could be detected in 7/12 and partial in two subjects. In two subjects with no recanalization the length of the occlusion decreased with restoration of flow at the internal jugular vein and in transverse sinus, while the sinus sigmoideus remained occluded and the emissarial collateral circulation could be well visualised, suggesting branching of the occluded sinus. In one case, where the internal jugular vein was ligated, there was no hope for recanalization. Non-recanalization, is not an adverse prognostic factor, total clinical cure can be detected without it.

Only one patient experienced permanent sequel with a unilateral impairment of visual of 0.5.

Conclusions

Analysing childhood otogenic sinusthrombosis I set the following conclusions.

1. Regarding clinical presentations after acute otitis media patients can be divided into Early and Late presenting groups. The results of diagnostic investigations at admission are group-specific. In the Early presenting group the pitfall of diagnosis setting is that 24-48 hours after administering antibiotics blood CRP level decreases with 53% on average, and leukocyte count decreases with 35% on average. In this case, if the clinical symptoms do not improve, we need to raise the suspicion of otogenic intracranial complication, despite the improvement in laboratory results.
2. I depicted the role of pediatric neurologist in diagnosis setting. In Early presenting group if nuchal rigidity or torticollis are present, immediate consultation is necessary. It is even recommended in children treated with antibiotics in case of septic otomastoiditis after 48 hours, if their clinical condition does not improve. The majority of Late presenting cases visit pediatric neurologist. If it is not the case consultation at admission is advised.
3. Changing therapeutic strategy in treatment of AOM, applying „watchful waiting" from 2011, the number of Early presenting cases increased.
4. In recent years some authors made suggestions for complete conservative treatment of the disease. Our team's philosophy is that mastoidectomy must be performed in each patient, abscesses must be drained, and

antibiotics must be applied. Regarding the thrombosis, since the availability of LMWH, conservative handling of the thrombosis is advised.

5. I was the first, who studied the clinical signs of patients 24-72 hours after mastoidectomy. I observed first in the literature, that after surgery, the clinical signs of elevated intracranial pressure can transiently worsen in patients where the dominant venous outflow is occluded, or in those, where one side of the symmetric venous outflow tract is closed. This manifested as progression of papilledema, causing severe visual disturbance and even transient blindness in some cases. Children under the age of six do not complain for acute visual disturbance even blindness. I called the attention of the parents for this possibility and introduced a playful bedside visual acuity screening method, which was performed daily by them.
6. Besides the clinical signs treatment of elevated intracranial pressure is determined by papillary prominence. During hospitalisation ophthalmoscopy must be regularly performed two-three times in a week. If visual disturbance is suspected ophthalmologist must test the visual acuity of the patient.
7. I studied first the connection between the anatomy of venous outflow tract and the disease course. I was the first, who observed, that a more protracted clinical course is seen in those patients where the dominant venous outflow is occluded and the signs of elevated intracranial pressure never manifest in the group where the hypoplastic venous outflow is occluded. This fact must be calculated with via planning surgery and in follow up.
8. I depicted the role of pediatric neurologist besides ophthalmologist and otorhinolaryngologist in follow up. I suggested first in the literature, that follow up must be performed by pediatric neurologist. After surgery the

determinant factor regarding long term sequel is management of elevated intracranial pressure.

9. I have analysed clinical and ophthalmologic signs after discharge in details. These are important data to follow up. I recognised first in the literature that after surgery 2/3 of patients suffer from behaviour changes. This is not only the result of elevated intracranial pressure. Long hospitalisation and subcutaneously applied anticoagulant treatment may play a role in it, too. In this case psychologist must consult the patients and therapy must be started. Attention deficit is a frequently reported problem as well. Education teacher's sessions and psychotherapy can help to resolve this problem. Because of the help of these partner professions at the one year follow up visit these problems were not any more present.
10. Though follow up is leaded by pediatric neurologist involving partner professions such as otorhinolaryngologist and ophthalmologist is necessary. I set the time points and modalities of follow up examinations as well the length of it. In the first month weekly consultations are optimal, in the second and third months every second week, and then monthly up to the sixth month, with a last visit at one year. Formal audiologic evaluation has to be carried out at one and three months after discharge. The decision of performing adenotomy or placing a ventilation tube depends on its results, too. Psychologist, education teacher and physiotherapist must check the patients on regular bases. It is advised, that they check the patients at one year follow up visit as well.
11. Imaging follow up is advised by MRI and MRV. In cases where LST is accompanied by intracranial complications, this must be repeated at three weeks and six weeks to check the efficacy of antibiotic treatment. Recanalization must be followed at three month and one year. If at the

three months visit complete recanalization is detected, the dose of LMWH can be reduced to a preventative dosage. At one year follow up visit I found complete recanalization in 7/12 patients. Recanalization in the long term is not a significant factor for outcome. Complete clinical recovery can happen even without it.

Publications

Publications related to the thesis

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