Oral presentation 4: CVJ

A-0116

Foramen magnum stenosis in achondroplasia-who really needs decompression?

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Introduction : Foramen magnum stenosis in achondroplasia can cause severe neurological compromise especially in earlier stage of life. However, which patients really need surgical intervention is still unclear.

Material & Methods : We retrospectively reviewed our experience of sixteen achondroplasitc children regarding the size of foramen magnum, especially focusing on anterior-posterior diameter, cross sectional area, and the characteristics of its shape. The patients were divided into two groups based on whether the surgery was indicated. These radiological data was compared and analyzed. Cervicomedurally signal change or deformity with neurocopmression were regarded as surgical indication.

Results : Surgery was performed for eleven patients (69%). Median age when surgery was performed was nineteen months. Average anterior-posterior diameter was 5.2mm on surgery indicated group, whereas 10.7mm on surgery non-indicated group. Average cross-sectional area were 50mm2 and 84mm2, respectively. Premature synostosis on posterior intra-occipital synchondrosis was observed on all surgery-indicated group, which resulted in the insufficient expansion of posterior edge of foramen magnum to posterior direction. One patient developed syringomyelia which required decompression at 8 years of age. The other one who also developed tonsillar herniation are now conservatively followed.

Conclusions : Premature fusion of occipital synchondrosis was associated with severe foramen magnum stenosis and neurocompression. This also affects the undergrowth of posterior fossa through the whole developmental stage. Continuous attention should be paid to the possible cerebrospinal circulation disturbance on craniovertebral junction even in the later age of children.

Oral presentation 4: CVJ

A-0153

Long-term prognosis in patients associated with scoliosis and Chiari malformation type I

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Introduction : Chiari malformation type I (CM-I) often associated with syringomyelia and scoliosis. The objective of this study was to determine the long-term functional prognosis of patients with scoliosis and CM-I at our institute.

Material & Methods : We retrospectively identified 28 patients 18 years of age or younger who were treated for CM-I. Among these patients, 14 (5 male and 9 female) between the ages of 5 to 18 years were diagnosed with scoliosis. The study patients were evaluated in terms of age, sex, degree of cerebellar tonsil descent, location and width of syrinx, clinical symptoms, duration of follow-up, Cobb angle, scoliosis progression, internal and external fixation for scoliosis, social status, and after-school activities.

Results : Twelve of the 14 CM-I patients with scoliosis had syringomyelia. Their preoperative tonsillar descent ranged from 3.1-24.9 mm (mean: 13.7 mm), and all of them experienced improvement in the range of -1.5-5.7 mm (mean: 2.6 mm) postoperatively. Ten of the 12 CM-I patients showed a reduction or disappearance of the syrinx postoperatively. Symptoms due to CM-I were present in four patients and resolved postoperatively in all. The patients' Cobb angles ranged from 24 to 65°(mean: 36.2°) preoperatively, and 15 to 79° (mean: 33.7°) postoperatively. Eight patients received conservative therapy for scoliosis and the other two patients underwent internal fixation of the spine.

Conclusions : FMD provided benefits for the majority of CM-I patients with scoliosis. The patient' scoliosis did not progress, allowing for the avoidance of internal fixation and for the maintenance of social status and after school activities.

Oral presentation 4: CVJ

A-0165

Posterior Intra-Articular Distraction Technique to Treat Pediatric Atlantoaxial Instability

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Introduction : The surgical treatment of atlantoaxial instability in pediatric patient is chalenging as the presence of congenital malformations with possible abnormal vertebral artery. Historically, the first choice of surgical treatments is anterior transoral decompression. However, the anterior transoral decompression might be really limited in pediatric patients due to risks of wound infection, CSF leaks, difficulty swallowing and etc..

Material & Methods : This is a retrospective descriptive study which included 15 patients of atlantoaxial instability whose age was less than 18 years at the time of clinical presentation. All had one or more radiologic markers of congenital atlantoaxial instability. All patients underwent anterior soft tissue released through a posterior-only approach, followed by intra-facet cages implantation, cantilever correction, and instrumentation. Clinical results were measured using the Japanese Orthopedic Association (JOA) scale, and radiographic measurements including the atlantodental interval(ADI), posterior atlantodental interval(PADI), the distance of odontoid tip above Chamberlain's line, clivuscanal angle (CCA), and triangular area(TA) of cranio-vertebral junction.

Results : The follow-up time ranges from 18 to 72 months with an average of 41.4 months. JOA score increased from 12.50 to 14.56. The mean TA decreased from 253.73 mm2 to 185.36 mm2 postoperatively. The mean CCA improved from 135° to 145° postoperatively. There were no evidence of complications or iatrogenic secondary cervical deformity during follow-up. Radiological evaluation showed satisfactory corrections and bony fusions of C1/2 facet joint in all cases.

Conclusions : Posterior intra-articular distraction followed by cage implantation and cantilever correction can be one of the safe and effective way to solve this challenging pediatric spinal disorder.

Oral presentation 4: CVJ

A-0029

The Fourth Ventricular Roof Angle in Chiari-1 malformation - The Queensland experience

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Introduction : Pre-operative fourth ventricle roof angle (FVRA) has recently been highlighted as a novel radiographic predictor of clinical severity in Chiari-I malformation (CM-I) (Seaman *et al.,* 2021). This has led to suggestions that FVRA could be included in algorithms to determine indications for surgery. We aimed to test the accuracy of FVRA as a predictor of clinical severity and its effect on post-operative outcome in a cohort of paediatric patients who underwent decompression for CM-I.

Material & Methods : Patients undergoing surgery for CM-I at the Queensland Children's Hospital (2006-2018) were included. Data was collected from 66 patients aged 0-18 years. Post operative outcome was assessed by calculating Chicago Chiari Outcomes Score (CCOS) at follow up. The FVRA was taken from a mid-sagittal MRI as previously described (Seaman *et al*).

Results : Whilst results from Seaman *et al.* demonstrated a strong correlation between a FVRA >65° and symptomatic CM-I, this did not translate to our dataset (p=0.61). Pre-operative FVRA is not useful as a predictive tool for post-surgical outcome as assessed by CCOS (p=0.50), and post-operative reduction in FVRA did not correlate with improved outcomes (p=0.81). We note significantly worse outcomes in patients presenting with pre-operative brainstem dysfunction (p=0.03).

Conclusions : Paediatric CM-I is a challenging cohort, often due to young age and a lack of language skills. There is a heavy reliance on radiological findings. Whilst FVRA has previously been reported to be of value as a determinant of clinical severity in adult and paediatric patients, we find this measurement is of dubious value in our retrospective cohort.

Oral presentation 4: CVJ

A-0033

Endoscopic foramen magnum decompression for pediatric Chiari malformation type Ⅰ

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Introduction : The suboccipital midline incision line tends to remain as a conspicuous wound depending on its length and degree of scarring. In this study, we investigated whether effectiveness of decompression and shortening of the incision line length can be achieved by using neuroendoscopy for foramen magnum decompression (FMD) in pediatric Chiari malformation type I cases.

Material & Methods : Twelve pediatric FMD cases (6-17 years old). The skin incision line was set at 23 to 35 mm and about 2 cm caudal from the inion, so that it would within the hairline of the suboccipital region. The range of FMD was 25 to 30 mm square and C1 laminectomy was also performed. Dural plasty were performed in all cases. During the operation, 4mm rigid endoscope was freely grasped and the operative field was expanded as if lifting the skin to secure a sufficient field of view.

Results : In all cases, the symptoms improved after surgery, and no perioperative complications were observed. Four patients with extensive syringomyelia showed postoperative shrinkage. The length of skin incision was 29.6 mm (23-40) on average. Before this series, 5 pediatric cases aiming for cosmetic shortening without using endoscopes had an average length of 54.6 mm (45-60), and an average shortening of 25 mm was obtained with using of the endoscope.

Conclusions : Under the neuroendoscope, the skin incision line could be shortened, and safe and sufficient decompression without complication was possible. In addition, the skin incision could be kept well within the hairline and the patient's cosmetic satisfaction could be improved.

Oral presentation 4: CVJ

A-0067

Earlier onset of Chiari malformation in children and its anatomical complexity.

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Introduction : Anatomical interpretation for Chiari malformation (CM) in pediatric population is a key factor for successful treatment, however surgical strategy is still under debate.

Material & Methods : The author retrospectively analyzed our experience of pediatric CM from 2010 to 2023, regarding clinical onset and presentations, morphological data, and outcomes. Syndromic craniosynostosis and spina bifida were excluded from this study.

Results : Ten patients were included. Two patients incidentally found at the average age of three years were just conservatively followed. At the average age of 8.5 years, tonsillar descent was spontaneously resolved. The other eight surgically treated patients were divided into two group based on the onset age. Five patients with the earlier onset under age of ten years all had syringomyelia with motor dysfunction or scoliosis. Three required foramen magnum decompression (FMD) with tonsillectomy and one underwent shunt to achieve syrinx deflation. On the later onset group over age of ten years, all three had lifestyle-limiting headache. Two were treated with FMD and duraplasty for syrinx deflation and the other one needed tonsillectomy for decompression of brain stem. Anatomical factors were analyzed on these three groups. Conservative group had lager clivo-axial angle (CXA) (>130°) and longer Klause index(>30mm), while earlier onset group had smaller CXA(<125°), with shorter Klause index(<25mm). Later onset group also had smaller CXA(<125°), however they tends to have longer Klause index(>30mm).

Conclusions : Still limited number of patients, the earlier onset group tends to have anatomically severe morphology of posterior fossa. Cerebellar tonsillectomy can be a reasonable option for posterior decompression in such population.

Oral presentation 4: CVJ

A-0072

Autonomic dysfunctions presented after surgery for Chiari 1.5: A case report and review of the literature

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Introduction : According to the literatures, brainstem compression from hindbrain herniation may lead to dysfunction in the area of the solitary nucleus and the dorsal motor nucleus or vagus nerve in Chiari 1 patient. Presenting autonomic dysfunction were improved after decompressive surgery in such cases. We report a Chiari 1.5 case with dysautonomia presented after successful operation.

Material & Methods : A 19-years-old girl presented with more than three years history of progressive symptoms as follows: extremities' sensory impairments, myoclonus, ataxia, dysuria and sweating abnormality. MR-images demonstrated hindbrain herniation with elongation of medulla oblongata (MO) and syringomyelia. Foramen magnum decompression, C1 and C2 laminectomy with duraplasty was successfully completed. Although pre-operative symptoms except for sweating abnormality was improved immediately after surgery, she gradually suffered general fatigue, attach-wise episode of getting stuck with blunted response and orthostatic intolerance a couple years later. Relatively hypotension and hypoglycemia were determined during that condition. She has been treated symptoms during more than ten years.

Results : Autonomic symptoms, such as syncopal episodes and sinus bradycardia were considered by direct brainstem compression, otherwise the children (presumably the dorsal motor nuclei of the vagus) were extremely sensitive to changes in regional intracranial pressure. Symptoms presented in our reported case are considered dysautonomia. Morphological changes of MO might alter the physical characteristics of the solitary nucleus, the dorsal motor nucleus and the reticular formation after decompressive surgery.

Conclusions : A case of Chiari 1.5 with dysautonomia after surgery was reported. The pathogenesis was assumed to changes in form and physical characteristics of MO.

Oral presentation 4: CVJ

A-0076

Sleep apnea in patients with achondroplasia associated with foramen magnum stenosis.

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Introduction : Sleep apnea is frequently associated with foramen magnum stenosis in patients with achondroplasia and considered a cause of sudden death. In this study, we evaluated the results of polysomnography (PSG) before and after surgery in patients who underwent foramen magnum decompression at our hospital to elucidate the effectiveness for sleep apnea.

Material & Methods : PSG, magnetic resonance imaging (MRI), and otolaryngeal fibroscopy were reviewed in 22 patients with achondroplasia who underwent FMD at our hospital between 2016 and 2022.

Results : Preoperative upper airway stenosis by fibroscopy was not found in 8 patients, mild in 10 patients, and not evaluated in 4 patients. AFMS (Achondroplasia Foramen Magnum Score) on MRI was AFMS1 in 2 patients, AFMS2 in 4 patients, AFMS3 in 13 patients, and AFMS4 in 3 patients. The Apnea Hypopnea Index (AHI) values on PSG were within the threshold (<5) in 8 patients, mild (5 to 15) in 10 patients, moderate (15 to 30) in 3 patients, and severe (30 or more) in 1 patient. Twelve patients had predominance in central apnea in the AHI, 7 patients had predominance in obstructive apnea. Comparing preoperative and postoperative AHI of PSG in 22 patients, 18 patients showed improvement in postoperative AHI (81.8%). Of the 14 patients with a preoperative AHI of 5 or higher, 10 patients (71.4%) showed at least one level of improvement.

Conclusions : FMD is considered to be effective for improving sleep apnea in patients with achondroplasia associated with foramen magnum stenosis.

Oral presentation 4: CVJ

A-0187

Surgical instrumentation in the pediatric craniovertebral junction: trick of the trade

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Introduction : The craniovertebral junction (CVJ) is subject to various pathological processes, which often result in neural compression or skeletal instability. CVJ instrumentation is challenging in the pediatric population. We report our experience in the National Taiwan University Hospital.

Material & Methods : During 2008-2022, twelve patients aged between 4 and 20 years (median = 11) underwent 14 instrumentation procedures involving the CVJ. Common etiologies were Down syndrome and os odontoideum. Intraoperative C-arm were used in all procedures, three of which utilized O-arm in addition. Hardware included two occipital plates, fifteen C1-2 transarticular screws, five C1 lateral mass screws, four C2 pars screws, one C2 pedicle screw, two C2 sublaminal wiring, and one anterior plate with C2 dens-C3 screws. Bone grafts included 8 ribs and 5 posterior iliac crest autografts, and one ulnar allograft. Follow-up period ranged from 1.5 to 5 years.

Results : All 12 patients had solid fusion, and neurological improvement. All 15 transarticular screws, diameter of which were 3.0 mm in 7 and 4.5 mm in 8, remained intact during follow-up. Post-operative CT revealed medial wall breach of the C1 lateral mass by 2 transarticular and 1 lateral mass screws without spinal cord comprise. The three mal-positioned screws were among the 16 screws placed by C-arm control, while all 9 screws by O-arm control were in acceptable position.

Conclusions : Instrumentation in the pediatric upper cervical spine is feasible. Modification of operative strategies, including cannulation with smaller screws and combined 2D and 3D intraoperative image control can enhance the accuracy of hardware placement in the younger population.

Oral presentation 5: SPINE

A-0174

Growth of bony spur after early foramen magnum decompression for achondroplasia patients

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Introduction : Patients with achondroplasia have small foramen magnum and narrow craniocervical junction that make them vulnerable to spinal cord injury and even sudden death due to respiratory failure. Foramen magnum decompression (FMD) is indicated for symptomatic patients and some asymptomatic patients with severely narrow foramen magnum.

Material & Methods : From 2012 to 2022, 45 patients with achondroplasia received FMD for relieving the craniocervical stenosis in early ages before 2 years. Their clinical and imaging follow-up data were reviewed.

Results : Most of the patients got free of further neurological deficits after FMD. However, 3 patients later developed new neurological deficit or appearance of new lesion on follow-up imaging years later. Growth of bony spurs from the wall of decompressed corridor was found in the patients. Removal of the bony spur relieved the symptoms and prevented further injury.

Conclusions : Early FMD for the vulnerable group clearly provides protection from spinal cord injury for achondroplasia patients, but it carries a small but evident risk of bony regrowth in later years. Regular follow-up with imaging studies is required for patients who received FMD in infancy.

Oral presentation 5: SPINE

A-0013

Establishment of Intraoperative Monitoring Methods for Pediatric Spinal Cord Surgery Analysis of the Effects of General Anesthesia Methods on Infants

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Introduction : Intraoperative monitoring of somatosensory evoked potentials (SEPs), motor evoked potentials (MEPs), and bulbocavernosal reflexes (BCRs) has been developed for spinal lipoma surgery, however, it has been reported that in many cases, particularly in children up to infancy, false-negative monitoring results and ineffective measurement cannot be obtained due to various factors such as the localization of motor cortex from the body surface, differences in neural thresholds, and the effects of general anesthesia.

Material & Methods : In collaboration with the Department of Anesthesiology, Aichi Children's Health Care Center, we have conducted a crossover study to investigate the effect of general anesthesia on intraoperative monitoring as a preliminary study for the above purpose. The Japanese Society of Anesthesiology has published a "Practical Guide for Anesthesia Management during MEP Monitoring," which recommends propofol alone or in combination with a small amount of inhaled anesthetics as general anesthesia. In response to this, we developed a study design to measure MEP, SEP, and BCR in patients under 2 years of age who underwent scheduled spinal surgery at our hospital, with propofol and a small amount of inhaled anesthetics combined with monitored expiratory anesthetic concentration, and then with propofol alone after a washout time.

Results : The results showed an age-adjusted MAC=0.2, indicating that even small doses of inhaled anesthetics had an effect.

Conclusions : In particular, we report that intravenous general anesthesia (TIVA) tended to provide a more stable monitoring environment for MEP measurements. Next, a prospective study is underway to examine the effects of monitoring techniques and equipment.

Oral presentation 5: SPINE

A-0032

Continuous Administration of Dexmedetomidine Reduce Intraoperative Neuromonitoring in Infants.

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Introduction : There are several reports of the effects of using dexmedetomidine (Dex) on intraoperative neuromonitoring (IONM) in adults and older children. However, there is no consensus on it, and there are few reports of infants. This study aims to evaluate the effect of Dex on IONM during infant surgery.

Material & Methods : This study included 46 infants who underwent spinal code untethering under general anesthesia with propofol and Dex; intraoperative bulbocavernosus reflex (BCR) monitoring was performed. BCR amplitude at each surgical stage (T1: at dura incision, T2: at dura closure, T3: at the end of monitoring) was compared with BCR amplitude at the start of surgery (baseline). Then the relationship between Dex dosage and BCR amplitude was predicted. Multiple regression analysis was also used to examine additional independent variables affecting BCR amplitude. In addition, the correlation between blood Dex concentrations and BCR amplitudes was determined using pharmacokinetic simulations of Dex.

Results : The ratio of BCR amplitude at each surgical stage to baseline was baseline (100)>T1 (67.3±31.4)>T2 (47.8±33.7)>T3 (32.6±26.4). BCR amplitude in T3 was negatively correlated with DEX dose. Furthermore, the only factor affecting T3 amplitude was the dose of Dex. Moreover, the BCR amplitude significantly decreased at Dex blood concentrations of 0.6 ng/ml or higher, leading to an unreliable IONM.

Conclusions : This study showed that BCR amplitude could be attenuated depending on the Dex dose. It is helpful to develop age-appropriate dosages based on blood concentration simulations of Dex for reliable IONM, especially in infants.

Oral presentation 5: SPINE

A-0042

Spinal instrumentation surgery in paediatric patients: a new era in our local experience

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Introduction : Spinal instability and deformities in paediatrics has always been a major concern given the varying different pathologies and this complexity often becomes challenging for surgical correction and instrumentation. However, there is a growing shift towards the direction of arthrodesis in recent years largely due to the evolving understanding of the anatomy, the dynamic nature of the diseases and the biochemical of the developing and immature spine.

Material & Methods : In this retrospective study, we evaluate our initial cohort of spinal surgeries with instrumentation in paediatric patients aged below 10 years from September 2020 to September 2023, a consecutive series of five spinal surgeries with instrumentation performed in Hospital Tunku Azizah, Kuala Lumpur. The surgeries performed; spinal instrumentation was placed at the cranio-cervical junction (C0-C2; 3 cases), subaxial cervical spine (C3-C7;1) and thoracic spine (T1-T11;1). We outline our surgical indications, criteria for case selection, strategic placement of anchoring points and limitations in paediatric spinal interventions.

Results : We performed three atlanto-axial arthrodesis, one cervical sub-axial arthrodesis, and one thoracic arthrodesis. The average of fused levels was 2.5 (ranging from 2-4) with a consolidation rate of 96%. All our patients healed without major complications and we had a follow up with the patient using dynamic X-rays and 3D reconstruction CT scan after 6months to 1 year after surgery to look for complete fusion and evidence of instabilities.

Conclusions : Although most authors agree that instrumentation can achieve stable fixation, its implementation often comes with greater risk of complications. Our recent local experiences seem to demonstrate exceptional outcomes in arthrodesis

Oral presentation 5: SPINE

A-0117

Fourth ventricle stent placement for treatment of refractory syringomyelia in children

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Introduction : Sringomyelia is a disorder characterized by the presence of cystic cavities in the spinal cord. It occurs most commonly in association with Chiari malformation but also can be the result of intramedullary or posterior fossa tumor, spinal dysraphism and spinal arachnoiditis. Fourth ventricle stenting (FVS) could ensure the CSF flow from the fourth ventricle, which might represent an effective approach to achieve syringomyelia relief.

Material & Methods : We have reviewed eleven cases of syringomyelia children who received FVS implantation from November 2021 to February 2023. Each of the patients underwent foramen magnum decompression. The ventricular catheter of an Ommaya reservoir (Medtronic, Inc.) was used as a stent. Cervical MRI rechecks were routinely done three months later, and the clinical symptoms were followed up.

Results : Eleven children received FVS, including five boys and six girls, aged from 12 months to 10 years, with a mean age of 5.6 years. Ten patients were Chiari malformation and the other patient developed syringomyelia following posterior fossa tumor surgery. No major complication occurred. During the follow-up time with a mean of 13.8 months, one patient had syringomyelia recurrence 19 months after operation and she received second foramen magnum decompression with partial tonsil resection. The syringomyelia of the other ten patients were all attenuated, as observed on the reexamination MRI images.

Conclusions : FVS is an effective strategy to treat refractory syringomyelia, not only in patients with Chiari malformation, but also in other conditions that affect the free flow of CSF from the fourth ventricle to spinal subarachnoid space.

Oral presentation 5: SPINE

A-0120

Laminotomy Technique for Long Segment Pediatric Spinal Tumors: A Ten Year Case Series from a Single Center Experience

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Introduction : Spinal cord tumors are rare in adults and even rarer in pediatrics. In our practice, majority of pediatric spinal tumors involve long segments, encompassing more than three spinal levels. Preserving the posterior ligamentous complex is crucial to prevent progressive kyphosis.This study introduces the laminotomy technique with preservation of the posterior ligamentous complex.

Material & Methods : A midline skin incision is made at the designated level, followed by subperiosteal dissection until the medial border of the laminae-facet junction. Laminotomy is performed in a cranio-caudal manner, with cranial extension to the non-pathological level using a high-speed drill with the footplate positioned perpendicular to the arch of laminae and ventral to the ligamentum flavum. The supraspinatous and interspinous ligaments are cut at the most caudal level to facilitate a one-piece opening, and the laminoplasty segments are lifted in the cranial direction to fully expose the spinal cord. After tumor resection, the laminoplasty segments are repositioned, and suture laminoplasty is performed. Slit holes made halfway to the diploe and receiving bone edges are created using a 1-mm high-speed drill to prevent retraction and injury to the venous plexus. The laminaes are secured with 3/0 Prolene sutures. Paraspinal muscles are re-approximated, and surgical wounds closed.

Results : This technique was applied in 53 cases of pediatric spinal tumors over a decade. Postoperative X-rays revealed no evidence of progressive kyphosis during follow-up.

Conclusions : The laminotomy technique with preservation of the posterior ligamentous complex for long segment pediatric spinal tumors has proven to be beneficial in our practice, effectively preventing progressive kyphosis.

Oral presentation 5: SPINE

A-0122

Early Experience in Pediatric Spine Infection : 4 years Follow Up Pediatric Scoliosis Patient caused by Tuberculous Spondylitis with Posterior Stabilization

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Introduction : Tuberculous spondylitis in children is common illness in country with a high prevalence of Tuberculous infection. It generates massive desctruction of vertebral body and the intact posterior column. The choice of treatment for spinal infection consist of surgery, bracing, nutrition, antibiotic or anti tuberculous agent. This treatment, strategy and follow up given for 5 years old girl with scoliosis caused by Tuberculous Spondylitis She had weakness on lower extremities, back pain during her activities and progressive kyphosis. The posterior stabilization done and revision in the next three years.

Material & Methods : The method of the treatment is based on the etiology. Infection must be treated by the anti tuberculous agent for 12 months and also posterior approach's surgery for debridement, abcess evacuation, laminectomy and stabilization with pedicle screw. The patient received several treatments and observations such as bracing to generate maturity of the skeletal maturity developed and exercises. After the revision surgery, observation still remain due to her development and growth.

Results : Surgery and rehabilitation can make a good correction for the scoliosis. Anti tuberculous agent treated not only for the lungs infection but also for the vertebrae and absess in psoas muscle. The pain and walking disturbance disappear, she felt pain in the back in the next 3 years so we did the revision surgery.

Conclusions : Multidiscipline treatment is needed to gain an optimal treatment for pediatric scoliosis patient such as bracing, exercises and also radiological examination for the continued monitoring phase. The follow up still continue until adolescence time for postural balance and stability.

Oral presentation 5: SPINE

A-0159

Multiple Tarlov cysts in a young child patient

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Introduction : Symptomatic Tarlov cysts in pediatric patients are extremely rare. Treatment methods for Tarlov cysts are still controversial. We report a rare young child case of multiple Tarlov cysts with urinary and fecal incontinence, nocturnal enuresis, and abnormal lower abdominal sensations.

Material & Methods : A 5-year-old girl presented with a 1-year history of urinary and fecal incontinence and nocturnal enuresis. She also had abnormal lower abdominal sensations. Radiological studies revealed bilateral cystic lesions at the levels of S2 and S3 (total of four cysts).

Results : Microsurgical decompression for all cysts was performed without any nerve root injury. After the operation, urinary and fecal incontinence and abnormal lower abdominal sensation were improved. There has been no re-operation in the three years since the first operation.

Conclusions : To the best of our knowledge, this is the first pediatric case report with multiple Tarlov cysts. The surgical treatment of Tarlov cysts is optional in symptomatic cases. Our case suggests that microsurgical decompression is a safe and efficacious option for multiple Tarlov cysts in pediatric patients.

Oral presentation 5: SPINE

A-0171

The Successful separation of conjoined spinal cords in pygopagus twins; A case report and review of literature

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Introduction : Conjoined twins represent a rare congenital malformation. Pygopagus twins are fused at the sacrumand perineum, with union of the spine. We report a successful separation of a unique case of pygopagus twins sharing a U-shaped spinal cord.

Material & Methods : The 6-month-old male pygopagus conjoined twins, who were diagnosed in the prenatal period, underwent separation. They had a single dural sac containing a U-shaped continuous spinal cord; their filum terminale appeared completely fused and the anatomical border of the spinal cord was not distinguishable. A triggered electromyogram (tEMG) was used to detect functional midline cleavage of fused spinal cord. The nerve roots were subdivided into bundles as small as possible, and sequentially stimulated to distinguish which belonged to one twin versus the other.

Results : All nerve roots were subdivided into individualnerve fibers and separated sequentially one by one on the boundary where both electromyogram activities were minimized. The twins were separated, and recovered with no lower limb neurological deficits or walking impairment for 5 years.

Conclusions : Pygopagus twins with a conjoined spinal cord can be expected to have a good long-term functional prognosis if successfully separated. Intraoperative tEMG is useful in spinal separation surgery for twins with a conjoined spinal cord.

Oral presentation 6: TRAUMA

A-0049

The Significance of Neurosurgical Treatment for Abusive Head Trauma - Comparison of Outcomes with Simple Accident Cases –

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Introduction : The outcome of children with severe traumatic brain injury (TBI) caused by Abusive Head Trauma (AHT) is compared with the outcome of TBI with simple accident and therapeutic strategies will be discussed.

Material & Methods : 38 patients who underwent decompressive craniectomy (DC) in 100 cases of severe TBI caused by simple accident under 16 years of age who admitted to the hospital (S group) and 50 cases who was diagnosed with AHT (A group) which required DC were included to this study. Patients' ICP course, treatment, outcome was retrospectively analyzed.

Results : Poor prognosis by King's Outcome Scale for Closed Head Injury score (KOSCHI) was more commonly seen in A group than in S group ($P < 0.05$) and longer hospitalization was required. The ICP value was markedly decreased by DC in both groups, which was not associated with mortality. The post-op ICP management was required (A group; 3.1 ± 1.7, S group; 10.7 ± 5.4) was longer in S group ($P < 0.01$). Parenchymal atrophic change and posttraumatic seizure were commonly seen in A group. Subdural space enlargement was more likely observed in A group but, recently, most of the cases completely resolved with a combined prescription of tranexamic acid and Goreisan.

Conclusions : Extensive and rapid progression of atrophic change in brain parenchyma was remarkable in A group, which suggested specific pathophysiology of AHT. Although the outcome of A group is extremely pessimistic compared with S group, there have been reports on the effectiveness of rehabilitation, and treatment with the expectation of improving functional prognosis is important.

Oral presentation 6: TRAUMA

A-0045

Issues related to organ donation from pediatric brain-dead donors in Japan: Consideration and efforts regarding the prohibition of organ donation from abused children.

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Introduction : Since the revision of the law on organ transplantation in 2010, the number of organ donations from pediatric brain-dead patients in Japan has slightly increased, but is far behind the number in developed countries. Among the issues that have been pointed out in Japan's organ donation system, the prohibition of organ donation from abused children is a unique and unparalleled in other countries.

Material & Methods : The "Development of Educational Programs for Organ Donation from Children" research group has been conducting: 1) a study on measures to exclude abused children and the establishment of a support system; 2) a study on the occurrence of terminally ill patients and confirmation of their and their families' wishes; 3) a study on practical ways of family care.

Results : In response to the request for "organ donation from children (clarification of procedures to exclude abused children)" by the Organ Transplant Committee of the Disease Control Subcommittee of the Ministry of Health, Labour and Welfare, our group have pointed out the inconsistencies in the contents of the Guidelines for Enforcement of the Law, the Questions and Answers Manual for Organ Donation Procedures, and the Manual for Excluding Abused Children, and presented a roadmap for how to cooperate with multidisciplinary teams.

Conclusions : It was found that no country other than Japan has prohibited organ donation from abused children in principle, and that many countries respond to this issue in cooperation with medical examiners and forensic physicians. The development of pediatric transplantation medicine in Japan in accordance with international standards is expected.

Oral presentation 6: TRAUMA

A-0004

The consequences of the COVID-19 pandemic on pediatric neurosurgery in the Middle East: an experience from a pediatric trauma hub

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Introduction : Few studies from the poor world examine how neurosurgeons view the epidemic and how neurosurgery practice has altered, but none from the Middle East. Our academic Level I Pediatric Neurosurgery Center admits more than 700 children a year for neurosurgical problems and supports 20 hospitals in the region. This study examined how COVID-19 affects pediatric neurosurgical diseases. Researchers expected the outbreak would have little influence on neurosurgical cases or epidemiology. The goals were to compare daily incidence, patient demographics, injury patterns, and care strategies between the 2020 pandemic and the previous year.

Material & Methods : Researchers conducted a retrospective examination of our institution's prospectively recorded registry with IRB approval.The study's major outcome variables were incidence and patient characteristics, including age (continuous), gender (nominal), admission context (emergent/urgent versus elective), and COVID-19 test status (dichotomous).

Results : Before the pandemic, the fewest patients admitted to our facility in a month was 31, but afterward it was 20. During the pandemic, hospitalizations from car accidents dropped (20.3% in pandemic vs. 34.4% in pre pandemic). Patients were also pedestrians hit by a vehicle during and before the pandemic. 248 epidemic victims needed neurosurgery (54%).

Conclusions : Neurosurgeons in impoverished nations can't avoid the COVID epidemic and must adapt to the changing healthcare environment. If referrals and loco-regional transfers reduce significantly, pediatric neurosurgery tertiary-care facilities can be better placed to handle patients during times of severe resource allocation. A move toward outpatient care, needed by the epidemic, may reduce hospital admissions and associated costs.

Oral presentation 6: TRAUMA

A-0017

Bone flap resorption following pediatric autologous cranioplasty and associated factors.

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Introduction : Children made up roughly 4.1% of TBI-related deaths. The most frequent surgery is a decompressive craniectomy (DC), which is followed by a cranioplasty (CP), which has a high rate of surgical complications. Therefore, the goal of this study is to assess the risk factors for bone flap resorption (BFR).

Material & Methods : In a retrospective analysis conducted at Kalasin Hospital, Thailand. 22 patients who underwent CP with autologous bone flaps from October 2020 to May 2023. Data were collected utilizing the medical records and CT brain.

Results : Using an autologous bone flap, 22 patients were enrolled in the trial. The median age was 14.77 (5-20) years. The most frequent reason for DC was TBI. The median time between DC and CP was 90 days (72-169). The median bone flap size was 73 cm2 (20-150). 4 patients (18%) experienced surgical complications. The most frequent complications were BFR (13.6%) which required repeat surgical intervention, Implant displacement (4.5%), and hydrocephalus (9.1%) which one patient required a VP shunt. We observed that large bone flaps (p = 0.035), bone flap size that was larger than 115 cm2 (p = 0.023), and contusional hemorrhage at first admission (p) were associated with a higher rate of BFR.

Conclusions : Because of the patient's financial situation and cosmesis, autologous cranioplasty was primarily performed in our hospital. Therefore, it is important to choose a good patient to avoid BFR. Finally, to track the BFR, the patients with large bone flaps and contusional hemorrhage should also be closely and persistently followed up.

Oral presentation 6: TRAUMA

A-0025

Use of MLC 901 (NeuroAid) in Traumatic Brain injury in Children- Patient Series

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Introduction : Traumatic Brain Injury (TBI) results in acute and chronic sequalae involving structural and functional impairments especially in children. This leads to significant disability which may affect child's development and adaptive functions. In TBI, both elderly patients and children have a high of risk of developing long term disability, which unfortunately, have no proven treatments. MLC901 (NeuroAiD) is a combination of natural herbal formulations with origins from Traditional Chinese Medicine which has shown to be safe and aid in neurological recovery after brain injuries.. There is an existing knowledge gap on the use of MLC901 for paediatric age group as the evidences for stroke, TBI and Cognition included all adult patients hence, these cases were presented to described potential role of MLC901 in severe traumatic brain injury in children.

Material & Methods : Recruited two 11yo boys completed 6 months of NeuroAid, and subsequent 6 months follow up. Neurological imorovement and Mini Mental State Examination were performed during the follow up.

Results : There is a potential role of MLC901 (NeuroAiD) in severe traumatic brain injury among children in both subacute and chronic cases. Our study is limited as being a case series, the extent of improvement is variable which may be difficult to quantify. Lack of guidance for effective dose in children. The dosage was based on the dosage of 60 kg adult at 10 kg weight per one capsule.

Conclusions : In conclusion, both cases showed the safety and potential role of NeuroAiD in Traumatic Brain Injury in children.

Oral presentation 6: TRAUMA

A-0047

Consideration on the effect of coagulopathy in perioperative period and the usefulness of the bleeding index in prognosis prediction of severe traumatic brain injury in children

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Introduction : Children have different features in many respects from anatomical and physiological levels compared to adults. Craniotomy itself can exacerbate the pathophysiology of children in severe traumatic brain injury with complicated intracranial pressure and coagulopathy, we will consider pitfall at the perioperative period.

Material & Methods : 54 patients with TBI who were admitted to PICU during the 23 months from January 1, 2016 to November 30, 2017 were included. All patients were divided into two groups of surgical treatment group (S group: n=16) and conservative treatment group (C group: n=38), and extraction of clinical parameters involved in outcome was attempted. In order to examine the influence of coagulation abnormality on intraoperative bleeding volume, bleeding index was calculated and the effectiveness of index in surgical strategy was examined.

Results : The mean age of group S was 4.1 ± 3.2 years, and that of group C was 7.7 ± 3.9 years. In comparison between two groups, the S group had a tendency of low GCS ($p = 0.0036$), high ISS ($p < 0.001$) and high D-dimer level ($p < 0.01$). There was no significant difference between the two groups in the outcome. In group S, the amount of intraoperative bleeding and the bleeding index of ASDH were both significantly higher than those of AEDH.

Conclusions : Craniotomy for severe TBI is likely to be chosen for children with coagulopathy. ASDH has a higher bleeding index, a large amount of bleeding that promotes hypotension is expected. Preopetative transfusion and intraoperative hemostasis are essential that do not induce poor outcome in children.

Oral presentation 6: TRAUMA

A-0063

Anatomic Location Trends in the Occurrence of Pediatric Head Trauma

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Introduction : In the field of pediatric neurosurgery, pediatric head trauma (PHT) is one of the major topics, and there has been ongoing exploration for optimal head protection strategies for children. Nevertheless, detailed analysis of the locational tendency of PHT has not yet been conducted. Since we recognized specific trends in the location of PHTs of the children receiving medical services, we conducted a study to analyze it.

Material & Methods : Within three-years duration, we analyzed 152 PHTs in 146 patients aged 0-14 years who were examined in our outpatient clinic. We categorized the pediatric head into 18 regions and statistically analyzed those locational frequencies of the registered PHTs.

Results : Male patients outnumbered females (87:59) with significance (p=0.025). Median age was 2 years and 3 months; 69.9% (102/146) were under 5 years old. Majority of PHTs (65.7%) were significantly concentrated in the “headband area (HBA)”, where tennis players wear headbands (p=0.001). Frequent-injury sites varied by age, and there was a tendency for younger age groups to be more susceptible to injuries in the frontal region compared to the occipital region. Those under 4 had notably high injury frequency in the central forehead region, occurring 4.6 times more than expected based on area proportion (p=9.421e-13).

Conclusions : While PHT predominantly occurs in the HBA, its frequency and location differ based on age. Interestingly, there are narrow regions on the head where children of specific age groups are particularly susceptible to PHT. Considering age and high-frequency PHT sites is important for effective head protection strategies in the pediatric neurosurgery field.

Oral presentation 6: TRAUMA

A-0064

A case of non-traumatic subdural hematoma associate with Jacobsen's syndrome

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Introduction : Jacobsen's syndrome (JS) poses a significant risk of hemorrhagic complications, particularly the severe Paris-Treussaud hemorrhagic disorder, which can include life-threatening intracranial hemorrhages, albeit infrequently reported. Managing patients with JS who require anticoagulant therapy presents a delicate balance between achieving hemostasis and anticipating potential complications, which may require consideration of discontinuation of anticoagulant treatment.

Material & Methods : In this case, a 3-year-old boy diagnosed with JS and a history of severe congenital heart disease necessitating mechanical valve replacement was prescribed warfarin and aspirin. These anticoagulants were temporarily halted due to an elevated PT-INR. Subsequently, he developed a left subdural hematoma after a head CT scan prompted by frequent vomiting. Treatment involved Prothrombin complex concentrate, Menatetrenone and blood transfusions, with an emergency craniotomy required due to anisocoria. While a follow-up head CT showed no increase of hematoma, anticoagulation therapy was cautiously resumed, targeting an INR range of 1.5-2.0. Unfortunately, the hematoma expanded, leading to another treatment discontinuation. After a 10-day period without antiplatelet therapy, anticoagulation was reintroduced with INR monitoring and frequent CT scans. The patient required periodic blood transfusions due to persistent thrombocytopenia but gradually improved and was eventually discharged.

Results : This case underscores the intricate management demanded by bleeding risks associated with JS.

Conclusions : Despite improvements in numerical coagulation function, bleeding remains a significant concern. Therefore, a comprehensive assessment of the risk-benefit balance of antithrombotic therapy is crucial in cases of hemorrhagic complications. In certain scenarios, as demonstrated here, a comprehensive postoperative management strategy may be necessary to effectively navigate these complex challenges.

Oral presentation 6: TRAUMA

A-0190

Sports participation after neurosurgery in children

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Introduction : There is little evidence or guidelines for physical activity in pediatric neurosurgical patients, and most neurosurgeons give advice to patients and families based on personal experience. The aim of this study was to clarify the current status regarding sports participation in this group of patients in order to establish a return-to-learn and return-to-play guideline.

Material & Methods : Patients younger than 18 who underwent neurosurgical intervention were included in this study. Medical records were reviewed retrospectively.

Results : There were 233 patients who underwent surgery during the period. The mean age at surgery was 6.4 years. The mean follow-up period was 34 months. The procedures performed were craniotomy in 135, burrhole surgery in 88, spine surgery in 64, and others in 12. Sixty-eight patients had device implanted. According to medical records, 5 patients (2.1%) were admitted to the emergency department for minor head trauma without further treatment. Thirty-nine patients (17%) were documented as playing sports outside of school sports. The sports included tennis and basketball in 7, baseball in 5, swimming in 4, and soccer in 3. No patient reported head trauma due to sports participation.

Conclusions : There is little evidence in the literature to support the safety and recommendation of sports participation for children after neurosurgery. This study demonstrate the rate of sports participation in such patients was lower than that in the general population of the same age group, however, the traumatic injury was uncommon. Large studies are required to establish evidence-based guidelines.

Oral presentation 6: TRAUMA

A-0200

Neglected Chronic EDH Spinal in Pediatric Patient

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Introduction : Chronic spinal epidural hematoma (CSEH) is a rare but potentially debilitating condition that occurs when blood accumulates in the epidural space over an extended period. While this condition has been well-documented in adults, its occurrence in pediatric patients remains relatively underreported and neglected.

Material & Methods : A 10-years old female patient came with chief complaints of pain and weakness in both arms 3 months before hospitalization and worsened 2 days before admission. Patient complained neck pain after log roll exercise and 1 week later patient had difficulty of grasping objects. Neurologic examination revealed motor grade 2/5 followed with hypotonus and atrophy on both distal upper extremities. T2-weighted MRI revealed oval-shaped hypointense lesion with grade III canal stenosis on C5-C7. The patient underwent *En Bloc* laminotomy C5-Th1 and spinal EDH evacuation. The patient was discharged after 5 days of hospitalization with improved motoric power.

Results : Common presenting symptoms of CSEH included back pain, neurological deficits, and progressive weakness. Diagnostic delays were common, often due to the non-specific nature of initial symptoms and the rarity of the condition in children. Surgical decompression, predominantly laminectomy, was the mainstay of treatment, with notable improvements in neurological deficits observed postoperatively.

Conclusions : Timely recognition and appropriate surgical intervention are crucial for achieving positive outcomes in affected pediatric patients. Increased awareness among healthcare providers and further research into the epidemiology, risk factors, and optimal management strategies for neglected CSEH in the pediatric population are essential to enhance early diagnosis and improve patient outcomes.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0036

Management of patient with Crouzon's syndrome with hydrocephalus, Chiari malformation and tethered fatty filum

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Introduction : Craniosynostosis is a condition where one or more of the cranial sutures closed prematurely, leading to abnormal head shape and potential developmental issues. Especially for patient with Crouzon's syndrome is 30% more likely will exhibit with progressive hydrocephalus as the constant feature. In most cases of syndromic craniosynostosis, venous sinus obstruction and / or chronic tonsillar herniation were found, which diagnosis of chiari malformation was made, in view of their syndromic figure, patient with skin stigmata, spinal cord pathology was always suspected.

Material & Methods : Recruited two patients with Crouzon's syndrome with fatty filum, which underwent surgical intervention for their underlying pathologies. Patient A without hydrocephalus and patient B progressive worsening hydrocephalus with increased ICP signs

Results : Option of surgical treatment and timing of surgery always a debate in patient with multiple morbidity, especially in these rare unreported cases. Patient A underwent craniosynostosis surgery and detethering of fatty filum on the same setting. Patient B underwent endoscopic third ventriculostomy (ETV) and detethering of fatty filum on the same setting too. Arranged craniosynostosis surgery before one year old was planned for the patients. We suggest to proceed with ETV prior to detethering procedure for these patients.

Conclusions : Surgical intervention planning with correct indication is the fundamental factor in deciding the mode of action for the mentioned patients. The controversy may arise due to factors such as patient's age, the underlying cause of hydrocephalus, the success rate of ETV compared to other treatments to other treatments like shunt placement, and potential risks associated with the procedure.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0097

From Wrench open to Bulge out - Earlier Wider Suturectomy for Craniosynostosis reduces the Surgical Invasiveness -

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Introduction : An incidence of craniosynostosis in Japan has not been high compared to Western countries, but the recent 'baby's head shape clinic' campaign has found more patients in a much smaller age. An earlier diagnosis allows for optimal time treatment in a few months of age, and require to choose a suitable surgical technique.

Material & Methods : Procedure and clinical application: We have applied modified Jimenez procedure (1998) for very early years of 38 patients with several types of craniosynostosis, in the past 7 years. Two-month-old girl of Pfeiffer syndrome was a first application in our unit, the reason was that we decided not to wait until 5 to 6 months, when the distractor device could be stably set on the harder enough bone, and thought we should take any step beforehand. The fused suture could be cut by bone forceps or diamond drill, even scissors can be used, via 2 or 3 cm skin incision, under endoscopic support. This method has been used non-syndromic case as well.

Results : Although the experience was small, the results have been all good in natural volume change and morphological correction by rapid growing brain.

Conclusions : The procedure proved to be another alternative, especially prior to posterior distraction of syndromic patients(23cases) in terms of positive and expedited control in an earlier surgical management, or possibly just one surgical treatment for a simple suture synostosis(15cases). The earlier, the better with help of rapid growth period.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0109

Neurocognitive Outcomes of Children with Craniosynostosis after Minimally Invasive Strip Craniectomy

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Introduction : Craniosynostosis involves early closure of one or more sutures, which is known to limit normal cranium growth and interfere with normal brain development. Various surgical methods are used, ranging from minimally invasive strip craniectomy to more extensive whole vault cranioplasty. This study aimed to evaluate neurocognitive outcomes five years after strip craniectomy in children with craniosynostosis.

Material & Methods : A retrospective review of 95 craniosynostosis patients was performed. Patients underwent strip craniectomy with postoperative orthotic helmet therapy. Neurocognitive assessment was performed five years postoperatively. Clinical data, affected sutures and neurocognitive outcome measures using the Korean Wechsler Preschool and Primary Scale of Intelligence, Fourth Edition (K-WPPSI-IV) were compared between the suture groups.

Results : The number of patients in each suture group was 18 in the unicoronal group, 11 in the bicoronal group, 46 in the sagittal group, 12 in the lambdoid group, and eight in the multiple suture synostosis group. The mean age at surgery was 4.5 months, and the mean follow-up period was 4.9 years. The Full-Scale Intelligence Quotient (FSIQ) ranged from 95.5±13.5 (bicoronal) to 110.1±12.7 (lambdoid), and there was no significant difference between the suture groups ($p=0.12$). The five index scores, namely verbal comprehension, visuo-spatial construction, fluid reasoning, working memory, and processing speed, were all within average ranges based on their age norms.

Conclusions : Minimally invasive strip craniectomy for craniosynostosis patients with various sutures resulted in favorable five-year neurocognitive outcomes. Strip craniectomy might be an effective surgical method in terms of the neurocognitive development of craniosynostosis patients.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0077

Transverse Sinus Dominance in Non-Syndromic Unilateral Coronal Craniosynostosis

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Introduction : In normal population, transverse sinus (TS) is predominantly on the right side, according to a work by Padget in 1950s and many works following. Padget hypothesized that this right predominance might be related to the embryologic left innominate vein which was developed and receive venous drainage later. In this study, the dominant TS tended to be found on the opposite side of unilateral coronal craniosynostosis. This phenomenon does not appear in any reports to date.

Material & Methods : We searched for non-syndromic craniosynostosis cases from 1995 to August 2023. We included patients who were diagnosed as 1.right unilateral coronal craniosynostosis (RCC) 2.left unilateral coronal craniosynostosis (LCC) 3.bilateral coronal craniosynostosis (BCC) and 4.sagittal craniosynostosis (SC). We excluded cases with multiple suture craniosynostosis and posterior plagiocephaly cases. All intracranial venous sinuses were evaluated by MR venography before surgery. TS dominance was classified into equal(E), right(R) and left(L).

Results : 77 cases were matched. Venous sinuses were evaluated at the mean age of 10.1 +/- 13.3 months. Difference of TS dominance was found statistically significant between both unilateral coronal craniosynostosis (12 RCC = 1E-1R-10L, 13 LCC = 1E-9R-3L) compared with 16 BCC (2E-8R-6L), as representative of bilateral lesions, and 36 SC (10E-16R-10L), as representative of midline lesion. We found that 76% of unilateral coronal craniosynostosis cases had dominant TS in the opposite side to the synostotic suture.

Conclusions : Higher ratio of TS dominance was found in the opposite side of synostotic suture. These findings could motivate more studies in venous drainage pattern development of craniosynostosis.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0066

A case of atypical sagittal synostosis with prominent digital impressions, narrowing of the posterior cranial fossa, hydrocephalus, and posterior nasal stenosis

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Introduction : Sagittal synostosis frequently manifests as an isolated anomaly. We present a case of sagittal synostosis associated with prominent digital impressions, hypoplastic posterior fossa, hydrocephalus, and posterior nasal stenosis.

Material & Methods : The patient was a 24-month-old boy who had been referred to a former hospital at 5 months of age due to complaints of prominence of the forehead and unnatural steps on the parietal bone. Computed tomography (CT) revealed dolichocephaly (cephalic index 73), depression of the parietal peak posterior to the coronal suture, notable digital impressions, and ventricular enlargement. Magnetic resonance imaging (MRI) disclosed hypoplastic posterior fossa. Severe symptoms of nasal stiffness were due to posterior nasal stenosis.

Results : At 6 months of age, he underwent suturectomy followed by helmet therapy. A CT scan at 18 months of age revealed fusion of the bilateral coronal and lambdoid sutures, as well as increased digital impressions. Subsequently, he underwent posterior vault distraction osteogenesis (PVDO) at 22 months of age. Prior to PVDO surgery, the Kyoto Scale of Psychological Development indicated a developmental quotient of 99 (Average: 100, Over 90: Normal), without signs of developmental delay.

Conclusions : We presented an atypical case of sagittal synostosis, potentially indicative of a certain syndrome. The patient has grown up with no developmental delay noted to date, after undergoing cranial and hydrocephalus surgeries at optimal timing. However, it is important to continue monitoring cranial morphology as well as psychomotor development.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0074

Growth Curves for Intracranial Volume and Two-dimensional Parameters for Japanese Children without Cranial Abnormality: Toward Treatment of Craniosynostosis

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Introduction : In the management of patients with craniosynostosis, it is important to understand growth curve of the normal cranium. Although 3D CT images taken in thin slices are easily available nowadays, data on the growth curves of intracranial volume (ICV), cranial length, cranial width, and cranial height in the normal cranium are mainly based on older studies using radiography, and there are insufficient reports using CT images especially taken in thin slices. The purpose of this study is to establish growth curves in the normal cranium of Japanese children using thin slice images.

Material & Methods : Cranial images of 106 subjects (57 males, 49 females, aged 0–83 months) without significant cranial abnormalities were retrospectively analyzed. Using thin slice CT images, the ICV and two-dimensional parameters such as cranial length, cranial width, and cranial height were measured by iPlan®. Cephalic index (CI) and cranial vault asymmetry index (CVAI) were also measured.

Results : The ICV growth curves for males and females were similar in shape. As with the ICV, the two-dimensional parameters increased most rapidly in the first year after birth. The mean CI was 88.3±5.7, and the mean CVAI was 3.8±3.2%. There was no significant difference in CI and CVAI between the sexes or among any age groups.

Conclusions : These data will enable us to compare these specific measurements in craniosynostosis patients directly with those of normal children, which will hopefully help in managing these patients.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0091

Treatment strategy for craniosynostosis at Okayama Craniofacial Center

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Introduction : In the treatment of craniosynostosis, it is important to improve skull shape as well as cranial volume expansion. We have established the Okayama Craniofacial Center (OCFC) to determine the indications for craniosynostosis surgery and to perform surgery and postoperative follow-up since 2009.

Material & Methods : We retrospectively reviewed 58 cases of craniosynostosis (17 syndromic, 41 non-syndromic) and 68 surgeries were performed at the OCFC over a decade from January 2014 to August 2023.

Results : Cranial morphology was quantitatively evaluated in midline sagittal and horizontal cross sections based on the standard Japanese pediatric range obtained from CT images to determine the direction and amount of cranial displacement. A 3D full-scale plaster model of the skull was prepared to plan the osteotomy line and extensor position, and a silicone template was provided for intraoperative use. Surgical procedures included 35 cases of Multi-directional Cranial Distraction Osteogenesis (MCDO), 13 cases of posterior cranial vault distraction, 4 cases of other distraction, 10 cases of suturectomy, and 6 cases of other one-stage cranioplasty procedures. All surgeries were performed safely as preplanned. Minor complications were wound infection in 5 patients (5/68, 7.3%), CSF leak in 4 patients (4/68, 5.9%), and damage of the distraction frame in 4 patients (4/52, 7.7%), which required antimicrobial therapy, hospitalization, and removal of the distraction frame prior to the scheduled date.

Conclusions : Safe and precise cranioplasty have been provided as OCFC. We have dedicated to providing optimal care through case review and technical refinement.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0141

Factors to Avoid Blood Transfusion in Craniosynostosis Surgery

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Introduction : Craniosynostosis surgery often requires intraoperative and postoperative blood transfusions. We will discuss the factors that prevent blood transfusion in the perioperative period.

Material & Methods : From December 2013 to March 2023, we have encountered 128 patients who underwent craniosynostosis surgery at our hospital and investigated the factors might cause intraoperative and postoperative blood transfusions.

Results : Of the 128 patients, 103 underwent cranioplasty, and 25 underwent endoscopic suturectomy. Hemodilutional autologous blood transfusion or blood salvage autotransfusion devices were used in 87/88 patients (body weight ≧ 10 kg), and endoscopic surgery was performed in 25/30 patients (age < 7 months). Additionally, after April 2017, 92/113 patients supplied iron (mean 2.6 mg/kg) for a mean of four weeks before surgery. Hemoglobin levels at the start of surgery tended to be higher in the iron administered group than in the non-iron group (11.3 g/dl vs. 10.8 g/dl, p-value = 0.0565). Transfusion rate was 22.7% (29/128). Concerning the factors leading to blood transfusion, weight at the time of surgery, sex, operative duration, amount of blood loss per weight, use of endoscope, hemoglobin level at the start of surgery, and iron administration were analyzed using logistic regression analysis. Weight and blood loss were found to be significant factors (p-values of 0.0015 and 0.00006, respectively). The receiver operating characteristic curve indicated that the threshold for avoiding transfusion was a body weight of 12.8 kg and a blood loss of 8.3 ml/kg.

Conclusions : Body weight and blood loss during surgery were important factors in avoiding blood transfusion.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0191

Navigation guided accurate osteotomy and preoperative simulation for craniosynostosis with 3D-printed skull models.

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Introduction : Craniosynostosis is a complex pathology involving orbital and facial bones together with cranial deformity, and surgical treatment requires an accurate osteotomy for best functional and cosmetic results. 3D-printed skull models (3DPSM) are adopted for surgical training and preoperative surgical planning, which improve the safety of the procedure. However, the conventional use of 3DPSM is separated from the improvement of the real-time intraoperative accurate osteotomy. Herein, we present a novel navigation guided osteotomy using 3DPSM that can improve the quality of the management of craniosynostosis.

Material & Methods : From April 2021 to August 2023, 19 consecutive patients including 4 metopic, 6 sagittal, 5 bicoronal, 4 multiple suture synostosis underwent navigation guided osteotomy for craniosynostosis. We retrospectively analyzed procedural outcome. The surgery was performed using the following method. At first, a 3DPSM is created, and an osteotomy is planned on the 3DPSM. Next, the 3DPSM is registered to the navigation system and the osteotomy line is planned on the cranial model within the navigation system. During the surgery, the patient's head is registered, and after a skin incision is made, the accurate osteotomy is performed using navigation system.

Results : In all 19 cases, the preoperatively planned osteotomy line could be reproduced to patient's cranium within a short time and the osteotomy performed safely. In one case, intraoperative re-registration was required for using navigation system.

Conclusions : The navigation guided osteotomy with 3DPSM can duplicate the accurate osteotomy as preoperative planning and improve the quality of management. Further investigations are required to verify the usefulness, potential risk, and limitations.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0008

Use of Piezoelectric for osteotomy in craniosynostosis – A single centre experience

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Introduction : Craniosynostosis is a congenital malformation resulting in various degree of cranial and craniofacial deformities due to premature closure of one or more cranial suture. Previously osteotomy for deformity correction was performed using drill which resulted in excessive bone and blood loss resulting in need of developing newer modality, Piezoelectric to overcome this problem.

Material & Methods : Retrospectively data was collected for last 10 years of patient operated for craniosynostosis at our center and divided into two groups based on equipment used for osteotomy during surgery.

Results : Total of 16 patients were operated in last 10 years. In initial 10 patients (Group A) Medtronic high speed drill was used and subsequently after 2021, Piezoelectric was used in 6 cases (Group B). Average age at time of surgery in group A and B were 20.7 and 13.5 months respectively. Average duration of stay in hospital in group A and B were 7 and 8.83 days respectively. We had dural tear in 2 patients of group A and none in group B. Blood and

bone loss was much less in group B patients.

Conclusions : Piezoelectric is a new advancement in field of osteotomy in craniosynostosis that can be used for performing bone cutting with precision with minimal bone loss and avoiding dural tear.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0046

Helmet therapy with Aimet: From the standpoint of also being involved in the Starband

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Introduction : Starband® and Aimet® are representative helmets used in Japan for helmet therapy for cranial deformity. We recently started helmet therapy with Aimet®. However, the criteria for determining the efficacy of the two helmets are not completely the same. We report the results of treatment using the cranial vault asymmetry index (CVAI) and the cephalic ratio obtained from both helmets.

Material & Methods : Sixty-one Starband® cases (46 with plagiocephaly and 15 with brachycephaly) and 14 Aimet® cases (9 with plagiocephaly and 5 with brachycephaly) treated were included in the study. In addition to the timing and duration of helmet wear, the degree of deformity and the degree of improvement before and after treatment were studied and analyzed based on the Starband® severity classification. Differences in the effect of treatment depending on the start of treatment were also examined.

Results : In plagiocephaly, a significant difference in the degree of improvement was observed between the Starband® group that started treatment by 6 months of age and the group that started treatment after that age, but not in the Aimet® group. For brachycephaly, there was no significant difference in the degree of improvement by time of treatment initiation. Aimet® was statistically non-inferior to Starband® in the treatment of plagiocephaly and brachycephaly.

Conclusions : We initiated Aimet® treatment with the goal of achieving stable results with Starband®, but were able to initiate it with statistical non-inferiority, and since both helmets have advantages over their counterparts, patient families can choose which helmet to use for treatment based on their preference.

Oral presentation 7: CRANIOSYNOSTOSIS

A-0070

Long-term outcome of Cranioplasty using hydroxyapatite granules and absorbable mesh plates for skull defects in children

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Introduction : For skull defects in children, autogenous bone reconstruction may not provide complete coverage of the defect. In addition, long-term implantation of titanium plates can lead to problems such as granulation and plate intrusion into normal tissues. We report on a trial cranioplasty using an absorbable plate and granular hydroxyapatite for cranial defects and its long-term results.

Material & Methods : Eight children with skull defects were included in the study. (cranium bifida occulta: 4 cases, epidermoid cyst: 2 cases, sinus pericranii: 1 case, postoperative bone defect: 1 case) The average follow-up period was 6 years and 2 months. Autogenous bone debris harvested by slightly removing the margins of the bone defect was mixed with granular hydroxyapatite artificial bone and formed into a plate using fibrin glue. This material was filled into the bone defect and covered and fixed with an absorbable mesh plate.

Results : In all cases, good closure of the bone defect was achieved without any surgical complications such as infection or stray tissue. In two cases, a tendency toward resorption of the artificial bone was observed at the edge of the defect repair area on imaging during the second follow-up period, but there were no strength problems on palpation and no cases requiring revision treatment.

Conclusions : Although the minimally invasive technique is superior in terms of minimizing the surgical field, including the extent of skin incision, some bone resorption was observed in relatively large bone defects over a long period of time after surgery, and further follow-up is necessary.

Oral presentation 8: HYDROCEPHALUS 1

A-0010

The analysis of cerebrospinal flow dynamics in mouse fetuses - Cerebrospinal fluid may flow out from the brain through the frontal skull base and choroid plexus-

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Introduction : Cerebrospinal fluid (CSF) has been believed to be produced in choroid plexus, and drain into sagittal sinus through arachnoid granules in one-way. Recently, new CSF drainage tracts were proposed such as brain capillaries, meningeal and nasal lymphatic system. In this study, we investigated the extracranial outflow of particles in CSF. This analysis will contribute for the treatment of hydrocephalus.

Material & Methods : Mouse fetuses at a gestational age of 13 days were used. Either Fluorescent proves with differing molecular weights (MW) or gold particles with different size or fluorescent labeled cadaverine were injected into the lateral ventricle. The probes movements were monitored in live. Gold particles deposition was studied under stereomicroscope or electron microscope (EM). Cadaverine deposition were observed under fluorescent microscope.

Results : 1) Fluorescent study: With an injection of low and high molecular weight (LMW, HMW) probes conjugate, both probes dispersed into the brain, but only the LMW probe dispersed into the whole body. The gate size to go out from brain is suspected as less than 1400. 2) Gold particle study: The gold particles accumulated at the frontal skull base. EM study revealed gold particles deposition between the ependymal cells. And only small size particle (2 nm) was found in liver. 3) Cadaverine study: Its deposition was observed on the frontal skull base, choroid plexus, ependyma and peri-vascular space.

Conclusions : The particles in CSF may drain to extracranial space via frontal skull base and choroid plexus through ependyma and peri-vascular space. This particles outflow is regulated by its MW and size.

Oral presentation 8: HYDROCEPHALUS 1

A-0126

Family-base rare variant association analysis in Saudi Arabian hydrocephalus subjects using whole exome sequencing

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Introduction : Hydrocephalus is a highly heterogeneous multifactorial disease that arises from genetic and environmental factors. Familial genetic studies of hydrocephalus have elucidated four robustly associated hydrocephalus associated loci. This study aims to identify potential genetic causation in cases of hydrocephalus, with or without spina bifida and Dandy Walker Syndrome (DWS), using family-based rare variant association analysis of whole exome sequencing.

Material & Methods : We performed whole exome sequencing in 143 individuals across 48 families where at least one offspring was affected with hydrocephalus (N.=27), with hydrocephalus with spina bifida (N.=21) and with DWS (N.=3), using Illumina HiSeq 2500 instrument.

Results : No pathogenic or putative pathogenic single-nucleotide variants were evident in the four known hydrocephalus loci in our subjects. However, after examining 73 known hydrocephalus genes previously identified from literature, we identified three potentially impactful variants from the cohort. Using a gene panel comprising variants in known neural tube defects loci, we identified a total of 1024 potentially deleterious variants, of which 797 were missense variants and 191 were frameshift variants, 36 were stop gain/loss variants. A small portion of our family pedigree analyses yielded putative genetic signals which may be responsible for hydrocephaly elated phenotypes, however the low diagnostic yield may be due to lack of capture of genetic variants in the exonic regions i.e. structural variants may only be evident from whole genome sequencing.

Conclusions : We identified three potentially impactful variants from our cohort in 73 known hydrocephalus genes previously identified in literature.

Oral presentation 8: HYDROCEPHALUS 1

A-0022

Normal Growth Curve of Choroid Plexus in Children: Implications for Assessing Hydrocephalus and Choroid Plexus Hyperplasia

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Introduction : Pediatric hydrocephalus assessment requires consideration of intracranial structure growth, yet data on choroid plexus growth in children is limited. This study aimed to establish normal growth curves for choroid plexus volume, and lateral ventricles volume. Additionally, we assessed hydrocephalus caused by choroid plexus hyperplasia (CPH).

Material & Methods : Head computed tomography (CT) scans of pediatric patients with minor head trauma from Osaka Women's and Children's Hospital between March 2006 and May 2023 were retrospectively analyzed. Intracranial volume, choroid plexus, and lateral ventricles volume were calculated. Growth curves were constructed using sequential mean values.

Results : A total of 229 CT scans (94 from females) were analyzed, revealing positive correlations among intracranial volume, choroid plexus volume, and lateral ventricles volume. Intracranial volume showed rapid growth until around 20 months of age, while choroid plexus and lateral ventricles volume increased rapidly at approximately one year of age, reaching plateaus at 1.5 mL and 10 mL, respectively. Among three patients with CPH, abnormal volumes of choroid plexus (ranging from z-normalized values of 24.11 to 51.17) and lateral ventricles (ranging from z-normalized values of 46.78 to 122.36) were observed. Two patients showed improvements in z-normalized intracranial and lateral ventricles volumes following surgical interventions. In one patient, choroid plexus volume reduced by approximately 24% (from z-normalized values of 51.17 to 38.93) after bilateral endoscopic plexus coagulation.

Conclusions : This study establishes normal growth curves for choroid plexus volume, and lateral ventricles volume. These reference values enable objective assessment of abnormal values related to hydrocephalus and choroid plexus diseases, including CPH.

Oral presentation 8: HYDROCEPHALUS 1

A-0016

A Demographic Study and Success Rate of ETV + CPC in RSUP HAM Medan: A 5-Year Clinical Experience

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Introduction : Hydrocephalus is the symptomatic accumulation of cerebrospinal fluid (CSF) inside the cerebral ventricles. However, VPS is prone to frequent failures from mechanical obstructions, which require urgent shunt revision surgery. Innovated the treatment of infant hydrocephalus by developing the ETV/CPC procedure. The main objective of this study was to describe the success rate of Endoscopic Third Ventriculostomy (ETV) Choroid Plexus Cauterization (CPC) H. Adam Malik General Hospital Medan in 5 years of clinical experience.

Material & Methods : A retrospective study was undertaken at the H. Adam Malik General Hospital Medan between January 2018 and December 2022. All records for pediatric patients who underwent ETV and choroid plexus cauterization (CPC) at our center were included in the study. During the study, 23 cases of hydrocephalus were reviewed who were treated with ETV and CPC

Results : The success of ETV in treating hydrocephalus appears to be influenced by factors such as the underlying etiology of hydrocephalus and the age of the patient. ETV shows lower success rates in infants, particularly those younger than 1 year, compared to older children and adults. ETV remains the preferred method, even for patients who have undergone shunt surgery in the past. The success of ETV may vary depending on different factors such as the ETVSS threshold, the underlying cause of hydrocephalus, and the presence of shunt malfunction

Conclusions : These findings highlight the significance of age, etiology, and prior shunt usage history as influential factors in the success or failure of ETV+CPC procedures

Oral presentation 8: HYDROCEPHALUS 1

A-0019

Utility of Stented ETV (SETV)

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Introduction : ETV is a well-established surgical procedure for obstructive hydrocephalus, but it has risks of stoma closure and obstructive scarring of the basal cistern. To enhance the patency of ETV, we employed stented ETV (SETV) under certain conditions.

Material & Methods : A total of 10 patients who underwent SETV at the age of 3 months to 11 years (median 2 years) from 2010 to 2021 were retrospectively analyzed. Observational periods, durations of using stent, were 6 days to 9 years.

Results : SETVs were conducted as second surgeries after the failure of prior standard ETV in 8 patients. In 2 patients whose tumor or hematoma immediately made ETV stomas blocked during primary ETV, SETVs were adopted as first surgeries. Pathogeneses of ETV failure observed in 8 patients were regrowths of the third ventricle floor in 4 patients, adhesive obstructions of the basal cistern in 2 patients, and blockages of stoma by recurred cyst in 2 patients. During the survey periods, 6 stents were removed due to cures of hydrocephalus in 2 patients, switchings to VP shunt in 3 patients, or patient's death in 1 patient. The other 4 stents have been effectively working for 6 to 9 years. No stent caused occlusion, difficulty in removal, and infection.

Conclusions : To avoid using foreign materials, standard ETV should take priority over SETV. SETV makes CSF pathway more sustainable, however, and can be an option for salvage surgery after ETV failure. If tumors or hematomas are about to occlude ETV stoma during surgery, SETV can become a first-line surgery.

Oral presentation 8: HYDROCEPHALUS 1

A-0073

Endoscopic treatment for complications related to CSF shunt

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Introduction : To clarify the management strategy and surgical technique with endoscope for complications related to CSF shunt.

Material & Methods : Complications of CSF shunt were roughly classified into four types as follows; Obstruction, over-drainage, infections, Rostral MB syndrome. Endoscopic operations for those four types were reviewed retrospectively. Indications, goals of operation and some special techniques are discussed following the review.

Results : Diversion of CSF pathway with endoscope was a major procedure for functional impairment of CSF shunt, which causes simple-complex hydrocephalus, such as unilateral hydrocephalus or isolated fourth ventricle. This procedure works not only as bypass, but also as buffer for pulsatile pressure in the ventricles. To replace a simple shunt is considered standard goal. But some patients with communicated hydrocephalus including slit-ventricle syndrome were successfully converted into shunt-independent state. ETV was effective for Parkinsonism and mutism i.e. rostral midbrain syndrome following CSF shunt, since repeated attacks of ventricular dilation and relaxation by changing shunt pressure setting makes damages of MB reticular formation. Endoscopic CSF lavage was indicated as an initial treatment for ventriculitis in some cases. In addition, endoscopic choroid plexus cauterization makes time for delay in shunt replacement and was indicated in infectious complications.

Conclusions : Endoscopic procedures should be considered in the first place for treatment of shunt-related complications. The main objective is re-setting of a simple CSF shunt, however, convert into shunt-independency with resolution of symptoms might be possible in certain cases.

Oral presentation 8: HYDROCEPHALUS 1

A-0132

Endoscopic Third Ventriculostomy Success Rate in Younger Than 1 Year Old Hydrocephalus Patients: A Meta-Analysis.

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Introduction : In the last 2 decades, Endoscopic Third Ventriculostomy (EVT) is getting more popular in treating hydrocephalus cases as it helps in reducing the lifelong shunt insertion complications and it shows promising results. However, its success rate still not well established especially in infants (younger than 1 year old). In this meta-analysis, we sought to calculate the cumulative success rate of ETV in infants.

Material & Methods : Systemic Ovid MEDLINE and Cochrane Central Register of Controlled Trials databases searches were conducted in 2023 by specific keywords, and without time limitation. Inclusion criteria was: (1) ETV procedures were conducted on hydrocephalus cases. (2) Patients age less than 1 year. (3) Success rate was calculated and documented. (4) Study design was retrospective or retrospective cohort, or randomized clinical trial.

Results : 763 articles were found, after applying the inclusion criteria, only 11 were recorded and analyzed using SPSS. 935 patients underwent ETV procedure, 338 (36%) of them underwent ETV with choroid plexus cauterization (CPC). The weighted mean for success rates for ETV and ETV with CPC were more than 52.14% (SD= 10.81) and 66.2% (SD= 2.33), respectively, after 6 months follow up.

Conclusions : ETV with and without CPC in hydrocephalus patients younger than 1 year were rarely reported even though it could help in reducing shunt consequences from a young age. More than 50% of ETV cases were successful giving 1 between every 2 infants with hydrocephalus who require treatment the chance of living shunt free.

Oral presentation 8: HYDROCEPHALUS 1

A-0192

Assessing the Efficacy of Endoscopic Third Ventriculostomy with Choroid Plexus Cauterization (ETV/CPC) in Pediatric Hydrocephalus: A Comprehensive Study from South of Vietnam

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Introduction : Pediatric hydrocephalus presents a significant challenge in neurosurgery, impacting children's health worldwide. We aimed to assess endoscopic third ventriculostomy (ETV) efficacy, with and without choroid plexus cauterization (CPC), in pediatric hydrocephalus management. Our study, the largest in South Vietnam, includes diverse etiologies and an extended follow-up.

Material & Methods : A key distinguishing feature of this study lies in its all-inclusive inclusion criteria, which encompassed all pediatric hydrocephalus patients treated with ETV/CPC and meticulously tracked through the Redcap database until the study's conclusion. Statistical analysis was performed using SPSS software, incorporating Fisher's exact tests and chi-square tests.

Results : Initially, 149 patients participated; 50 were excluded (33 tumors, 17 lost). 49.5% were male, mostly under 12 months (mean age 26 months). Common etiologies: Dandy Walker (30.3%), arachnoid cysts (16.2%), post-infection (12.1%), post-hemorrhage (12.1%). ETV success varied (8.3%-93%). Mean follow-up: 1,282 days; complications in 6 cases (4.03%). Age and etiology influenced outcomes.

Conclusions : ETV, with or without CPC, demonstrates effectiveness comparable to that reported in numerous international studies. Notably, our study unveils a novel finding: the presence of residual hemosiderin staining in the ventricles predicts treatment failure. The retrospective nature of the study, primarily reliant on Redcap, while characterized by regular follow-ups, inherently harbors limitations. The absence of a specific scoring system for success evaluation based on neurocognitive indices represents a noteworthy limitation. Furthermore, the absence of comparative analysis with alternative hydrocephalus treatment modalities, such as ventriculoperitoneal shunting, within the same timeframe presents an opportunity for future research to provide a more comprehensive understanding of pediatric hydrocephalus management.

Oral presentation 8: HYDROCEPHALUS 1

A-0110

Clinical Outcome of Endoscopic Procedure in Patients with Shunt Malfunction

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Introduction : The goal of this study was to analyze the clinical outcomes of endoscopic third ventriculostomy (ETV) and endoscopic septostomy when shunt malfunction occurs in a patient who has previously undergone placement of a ventriculoperitoneal shunt.

Material & Methods : From 2001 to 2020 at Seoul National University Children's Hospital, patients who underwent ETV or endoscopic septostomy for shunt malfunction were retrospectively analyzed. Initial diagnosis (etiology of hydrocephalus), age at first shunt insertion, age at endoscopic procedure, magnetic resonance or computed tomography image, subsequent shunting data, and follow-up period were included.

Results : Thirty-six patients were included in this retrospective study. Twenty-nine patients, with shunt malfunction underwent ETV. At the time of shunting, the age ranged from 1 day to 15.4 years (mean, 2.4 years). The mean age at the time of ETV was 13.1 years (range, 0.7 to 29.6 years). Nineteen patients remained shunt revision free. The 5-year shunt revisionfree survival rate was 69% (95% confidence interval [CI], 0.54-0.88). Seven patients, three males and four females, with shunt malfunction underwent endoscopic septostomy. At the time of shunting, the age ranged from 0.2 to 12 years (mean, 3.9 years). The mean age at the time of endoscopic septostomy was 11.9 years (range, 0.5 to 29.5 years). Four patients remained free of shunt revision or addition. The 5-year shunt revision-free survival rate was 57% (95% CI, 0.3-1.0). There were no complications associated with the endoscopic procedures.

Conclusions : The results of our study demonstrate that ETV or endoscopic septostomy can be effective and safe in patients with shunt malfunction.

Oral presentation 8: HYDROCEPHALUS 1

A-0158

Long-term outcome of pediatric ventriculoperitoneal shunt surgery: a single-center study

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Introduction : We assessed a single-center long-term outcome of ventriculoperitoneal shunt surgery in pediatric patients.

Material & Methods : We reviewed patients aged 15 years and younger who underwent initial ventriculoperitoneal shunt in our hospital between 1994 and 2007, under follow-up for more than 15 years.

Results : 199 procedures performed on 131 patients. Patients ranged from 0 day and 5 years old (mean 8.5 months old). The follow-up period ranged from 15 to 27 years (median 18 years). 100 of first implanted valves were nonprogrammable and 31 were programmable. The causes of hydrocephalus were myelomeningocele (32.8%), intraventricular hemorrhage (22.9%), congenital hydrocephalus (19.8%), meningitis (5.3%) and other (19%). The causes of shunt revision were 130 shunt dysfunction, 14 infection, 4 other, and 51 shunt extension due to growth. Excluding planned revisions for extension, the shunt survival rate at 1 year after shunt insertion was 67.2%, 54.2% at 5 years, 42.7% at 10 years and 40.5% at 15 years. The shunt survival rate at 1 year post-operatively was 58.6% in patients first operated on within 3 months of age, and 84.1% after 4 months of age, a significant difference between the two. The shunt survival rate of programmable valves was significantly higher than nonprogrammable valves.

Conclusions : Revisions after ventriculoperitoneal shunt in children tended to be performed in the first year post-operatively. If planned extension was not taken into account, shunt survival rate reached a plateau after approximately eight years post-operatively. Shunt implantation within 3 months of the month was associated with a higher risk of shunt revision.

Oral presentation 8: HYDROCEPHALUS 1

A-0006

Outcomes comparing Ultrasound-guided VP shunt placement and Freehand insertion

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Introduction : Ventriculoperitoneal shunt (VPS) insertion is a routine neurosurgical procedure done to manage hydrocephalus. The final position of the shunt is crucial for shunt viability and durability. Insertion can be conducted either by solely using anatomical landmarks (“freehand”) or under image guidance. In this study, we retrospectively evaluated the accuracy and shunt revision rates between US-guided placement and freehand insertion. Our secondary aim was to explore the learning curve of surgeons adopting US-guided VPS insertion.

Material & Methods : This study included patients who underwent VPS placement over the period of January 2018 to December 2021 at a single-center tertiary hospital. Both adult and pediatric patients were recruited into the study. Accuracy of shunt placement was determined by evaluating the location of the shunt catheter tip in the first post-operative imaging and the shunt revision rate. Shunts revised within 30 days were presumed to be likely attributed to suboptimal VPS placement. Data analysis was performed using RStudio.

Results : Rates of optimally placed and functioning shunts were higher under US guidance (79.5% vs 50.6%) compared to freehand insertion ($p < 0.01$). Rates of shunt revision within 30 days were statistically lower in US-guided VPS insertion (5.7% vs 0.0%) compared to freehand even after propensity-matched analysis ($p = 0.02$). There was no statistical difference in accuracy between shunts placed by consultants and residents in the US cohort ($p = 0.71$).

Conclusions : Our findings support the advantages of adopting US-guided ventricular catheter insertion. The learning curve for surgeons to adopt US guidance in VPS insertion is likely less steep than imagined.

Oral presentation 8: HYDROCEPHALUS 1

A-0024

Risk factors for slit ventricle in the hydrocephalus children treated with ventriculo-peritoneal shunt

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Introduction : The study analyzes the reasons for slit ventricle (SV) related ventriculo-peritoneal (VP) shunt failure in pediatric patients with hydrocephalus.

Material & Methods : The study included 98 patients treated from 1991 – 2022. The VP shunts were revised due to SV syndrome or SV related catheter obstruction in 19 patients (SV group). The shunts functioned until the final follow-up day in 39 patients (Control group). The patients with shunt malfunction not related to SV (n = 40) were excluded. Age at surgery, communication in CSF pathway, brain atrophy, pressure setting of the shunt valve, and implantation of an anti-siphon device were compared between the groups.

Results : The age at surgery in the SV group was 0.7 ± 1.1 years which was significantly younger than that in the Control group at 2.3 ± 3.9 years ($p < 0.05$). The absence of brain atrophy was 94.7% in SV and 51.3% in the Control groups ($p < 0.01$). None of the non-communicating hydrocephalus, low-pressure valve, or no use of anti-siphon device significantly affected the shunt malfunction. Among the 19 patients in SV group, 3 patients developed free from shunt due to compensation. The other 16 patients received shunt revision with anti-siphon devices, and no shunt malfunction recurred for 12.8 ± 7.6 years.

Conclusions : Shunts implanted in infancy and in no atrophic brain were the risk factors for SV related shunt malfunction. Type of hydrocephalus and shunt system did not significantly influence shunt malfunction. Anti-siphon device did not prevent SV; however, it did prevent recurrence of SV related shunt malfunction.

Oral presentation 9: HYDROCEPHALUS 2

A-0002

Pressure volume index withdrawal could be express by linear curve and it also has a significant prognostic value.

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Introduction : Intracranial pressure (ICP) may be the most commonly applied neurophysiologic monitoring and correlated well with clinical outcomes of the neurosurgical patient. In this study, authors studied weather pressure volume index withdrawal (PVIw) could be expressed by linear curve. And weather this PVIw value is significant as an additional prognostic factor, in patients with similar initial ICP and GCS.

Material & Methods : 171 patients, their PVIw curve was valid in linier curve ($R^2$³0.95) were included in this analysis. Authors defined PVIw3, as initial ICP minus ICP at 3 cc CSF withdrawal then divided 3. Analyze the correlation between the linear curve and exponential curve of PVIw. And also, analyze the correlation between the patient clinical outcome and initial ICP, PVIw3, and both initial ICP plus PVIw3.

Results : Brain compliance could be expressed by linear curve as well as exponential curve (correlation valid in 165/171 cases, p=0.047). And the correlation between the clinical outcome and these two types of curves was (p=0.061 in exponential curve and p=0.022 in liner curve). The clinical outcome (linear regression, R2 value) was 0.076 in initial ICP, 0.073 in PVIw3 and 0.093 in both initial ICP and PVIw3. On c2 analysis, PVIw3 values above 3, shows significant favorable outcome (p=0.017).

Conclusions : From this study, the ventricular pressure changes according to the CSF withdrawal could be expressed by linear curve. Initial ICP plus PVIw3, shows more significant prognostic value than initial ICP only.

Oral presentation 9: HYDROCEPHALUS 2

A-0044

Volume of cerebrospinal fluid removal by ventricular reservoir tapping for posthemorrhagic hydrocephalus in very low birth weight infants.

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Introduction : For controlling intracranial pressure in preterm infants with posthemorrhagic https://www.google.co.jp/hydrocephalus (PHH), intermittent removal of cerebrospinal fluid (CSF) is widely utilized. However, consensus on the optimal CSF removal volume remains elusive. We retrospectively investigated the actual volume of CSF removal for PHH in very-low-birth-weight (VLBW) infants.

Material & Methods : This study included VLBW infants who underwent perioperative management between 2011 and 2022. The study endpoint was either the time of ventriculoperitoneal shunt (VPS) placement or the cessation of CSF removal. Patients were categorized into two groups: those undergoing VPS and those avoiding it. CSF removal was quantified as a/bc ml/kg/day (a: total CSF removal, b: the mean weight at reservoir placement and endpoint, c: the days from reservoir placement to endpoint). Statistical analysis was carried out with Mann-Whitney U test.

Results : Fifteen patients, eleven with Grade 3 and four with Grade 4, were included. VPS was performed in 10 patients and avoided in 5 patients. The removal volume was 10.5 ± 3.1 ml/kg/day (mean ± SD) in the VPS group and 5.2 ± 1.6 ml/kg/day in the group that avoided VPS, demonstrating a significant difference between the two groups ($P < 0.05$).

Conclusions : The mean daily removal volume in the VPS group closely approximated the previously reported value of 10 ml/kg, while some cases required more removal. VPS may be avoided when the volume of CSF removal is small. The removal volume should be considered in the individual case.

Oral presentation 9: HYDROCEPHALUS 2

A-0100

Ventriculoperitoneal (VP) Shunt-Associated Abdominal Pseudocysts: two cases successfully treated by long term antibiotics therapy with external CSF drainage.

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Introduction : Ventriculo-peritoneal shunt (VPS) associated abdominal pseudocysts (APC) is relatively rare complication. While bacterial infection is suspected to form APC, the mechanism is not fully understood. Furthermore, there is no clear consensus as to treatment strategy. We report two cases of VPS-associated APC successfully treated with long-term intravenous antibiotics administration (IA) along with external cerebrospinal fluid (eCSF) drainage.

Material & Methods : Case1 : A 19-year-old male with congenital hydrocephalus had severe abdominal distension due to a VPS-associated APC with negative CSF culture. The shunt revision was performed after eCSF drainage for 18 days along with short term IA. However the APC had recurred two weeks later, so we adopted much longer treatment i.e. for 6 weeks along with long term IA which enabled the sterile revision without recurrence. Case2 : A 9-year-old girl who had underwent VPS surgery during infancy without history of shunt replacement. Her first shunt malfunction occurred with APC. Even though CSF culture was negative, four week treatment of thorough IA with eCSF drainage was chosen. Her APC had never recurred after VPS revision.

Results : Temporary eCSF drainage along with thorough broad spectrum IA for 4 ～ 6 weeks was needed to avoid the recurrence of APC. The P. acnes was detected in Case1,while no bacteria was detected in Case2 throughout her clinical course.

Conclusions : No matter if the CSF culture is negative, we believe that the VPS replacement after long term administration of broad spectrum antibiotics is effective for reducing the re-development of APC.

Oral presentation 9: HYDROCEPHALUS 2

A-0106

CT Studies on Disproportionally Dilated Lateral Ventricles in Infants with Congenital Hydrocephalus in Bandung, Indonesia

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Introduction : Congenital hydrocephalus is caused by a complex interaction of genetic and environmental factors during fetal development. It is one of the most common congenital anomalies of the central nervous system and is characterized by extensive accumulation of cerebrospinal fluid within the ventricles of the brain due to an imbalance between synthesis and absorption of cerebrospinal fluid. This study was planned to investigate disproportionally dilated lateral ventricles in infants with congenital hydrocephalus.

Material & Methods : The dilatation of the lateral ventricle was analyzed based on CT scan or MRI imaging from a total of 55 infants with congenital hydrocephalus that were hospitalized at a tertiary hospital in Bandung, West Java, Indonesia from January 2022 – August 2023

Results : The majority of patients had posterior horn dilatation (n=25, 45.45%), followed by diffuse dilatation of lateral ventricles (n=24, 43.63%), while anterior horn dilatation occurred in 6 out of 55 patients (n=10.91%). The most common associated pathology was holoprosencephaly (n=17, 30.90%) and commonly observed in patients with dilatation of the posterior horn.

Conclusions : The posterior horn predominant type has a tendency to occur in congenital anomalies, particularly in patients with holoprosencephaly, and diffuse type, particularly in patients with aquaduct stenosis. This disproportional dilatation of the posterior horn suggests a vulnerability of periventricular structure in the developing brain.

Oral presentation 9: HYDROCEPHALUS 2

A-0124

Problems in Management of Congenital Hydrocephalus in rural areas of Garut-Indonesia: Three years working experience

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Introduction : Congenital Hydrocephalus is a common health problem in the world. However, the main problem related to the congenital hydrocephalus in Indonesia is related to the absence of clear epidemiological data; differences in socioeconomic levels, knowledge, attitudes and behavior of the local communities towards congenital hydrocephalus; and lack of access to the health insurance system

Material & Methods : This study take place in neurosurgery's outpatient clinic from January 2020 – January 2023 and the method is descriptive observational with mixed design, qualitative and quantitative, Respondents were 2 general practitioners, and 5 Neurosurgery's outpatient clinic nurses who were carried out by whole sampling, while for patient respondents it was conducted on 100 respondents by incidental sampling method. Univariate data analysis is presented in the form of distribution tables for qualitative and theoretical analysis for qualitative.

Results : The results showed us that the parent(s)/guardian(s) had begun to understand hydrocephalus. However, there are still some obstacles that disrupt the education and management process for patients with congenital hydrocephalus and will have a negative impact on patients and society in terms of health and resulted in the patient being brought to the hospital late. Apart from that, lack of funds and difficulty in accessing health facilities make families reluctant to take patients for treatment.

Conclusions : TThere are still obstacles in management of congenital hydrocephalus like the lack of access for health insurance system, local culture and beliefs from local community that must be changes to improve the treatment of congenital hydrocephalus in rurals area in Indonesia

Oral presentation 9: HYDROCEPHALUS 2

A-0131

The Impact of Strict Shunt Protocol on Reducing the Infection Rate Following Shunt Placement: A Prospective Cohort Study.

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Introduction : Ventriculo-peritoneal shunt (VPS) is the treatment of choice in many hydrocephalus cases. However, one of the common complications that increases its mortality and morbidity rate is infection, as our center yielded 32% infection rate post-VPS in the literature. Thus, this paper aims to develop new shunt protocol to reduce the infection rate post-VPS.

Material & Methods : Data from ninety-two controls was collected prospectively from hydrocephalus patients who required VPS of a period of six-years (2017-2022), in Alkhobar, Saudi Arabia. The data was categorized into pre and post Covid-19 pandemic cases, where those operated between 2017-2019 were considered as pre-pandemic cases.

Results : Ninety-two procedures for a total number of sixty-five cases were analyzed. The age average was 141.4 months (SD=232.9), and 73.9% of the procedures were done on males. The average compliance to the new protocol was 90.9%. Culture results were missed in 8 cases, and positive in 4.8% only (4 cases) giving a ratio of 1 per 23 cases.

All infected patients were males, 75% were aging less than a month when operated, and they were pre-Covid-19 cases. Twenty-eight elements of the new protocol were analyzed by Fisher's Exact Test. Multilayered wound closure with antibiotic was significantly associated with less infection rate (LR=7.5, Fisher's Exact Test p-value=.024). Other elements were statistically insignificant.

Conclusions : Development and following new shunt protocols could reduce infection rate especially in areas where they have high post-VPS infection rate. Although, one element was statistically significant, other components were clinically or "financially" significant, particularly those which are technical, and must be considered.

Oral presentation 9: HYDROCEPHALUS 2

A-0146

Preferences in the Diagnosis and Treatment of Pediatric Hydrocephalus among Thai Neurosurgeons

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Introduction : Hydrocephalus is one of the most commonly treated neurosurgical conditions in Thailand. We aimed to describe the clinical experience and preferences of Thai neurosurgeons in the diagnosis and treatment of pediatric hydrocephalus.

Material & Methods : We conducted an online survey using Google Forms among board-certified neurosurgeons in Thailand from April 1 to May 31, 2023. The 48-item questionnaire collected data on hydrocephalus etiology, surgical technique, shunt preferences, complications of treatment, and follow-up practices.

Results : A total of 61 out of 538 registered neurosurgeons in Thailand completed the survey, equivalent to an 11% response rate. The diagnosis of hydrocephalus is made using CT (93%) and/or MRI (79%). The most common etiologies for hydrocephalus are post-hemorrhagic (57%) and aqueductal stenosis (53%). Among all respondents, the preferred entry sites are frontal (53%) and parietal (41%), and about 61% would use a differential-pressure valve as their first shunt. The estimated rates of shunt infection, and overdrainage are 5% or less.

Conclusions : There is variability in the clinical practice of Thai neurosurgeons when treating hydrocephalus in children. Long-term follow-up data are needed to determine whether these differences have an impact on patient outcomes. The government should allocate additional resources to manage patients with complex hydrocephalus and those with shunt-related complications.

Oral presentation 9: HYDROCEPHALUS 2

A-0041

Ventriculoperitoneal Shunt Insertion as Primary Surgical Management for Pediatric Idiopathic Intracranial Hypertension in Low- and Middle-Income Countries: A Case Report and Review of Related Literature

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Introduction : Idiopathic intracranial hypertension is a condition of elevated intracranial pressure in the absence of clinical, laboratory or radiological evidence of an intracranial space occupying lesion, which commonly affects women of reproductive age but can occur in the pediatric population. Typical clinical manifestations change with age thus diagnosis could be late. Ventriculoperitoneal shunt is one of the surgical options for medically resistant IIH but outcomes in the existing studies and literatures among pediatric population were limited.

Material & Methods : Case Report

Results : We present a case of a 10 year-old male admitted in our institution for sudden blurring of vision. Series of tests were done including Cranial MRI/MRA, CT venogram and immunoserology revealed unremarkable results. Lumbar tap showed high opening and closing pressure with normal CSF studies, fulfilling the Modified Dandy criteria for the diagnosis of IIH. He subsequently underwent right parietal ventriculoperitoneal shunt insertion using neuronavigation. Post-operatively, improved visual acuity and resolution of headaches were documented.

Conclusions : Ventriculoperitoneal shunt has become the procedure of choice for treatment of idiopathic intracranial hypertension among other surgical interventions. The use of neuronavigation has shown to achieve optimal placement of ventricular catheter when compared to conventional shunt surgery. Significant improvements in headache, stabilization of vision and resolution of papilledema have been reported. Given the limitations in setting such as here in the Philippines, it is therefore prudent to prioritize this as surgical management of pediatric idiopathic intracranial hypertension.

Oral presentation 9: HYDROCEPHALUS 2

A-0114

TREATMENT OF PEDIATRIC SHUNT INFECTIONS IN INDONESIA: A SINGLE-CENTER EXPERIENCE

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Introduction : Shunt infection is a catastrophic complication of VP shunt insertion in children with hydrocephalus. The management is complex and requires a long time of hospitalization, resulting in increased morbidity and mortality.

Material & Methods : An observational prospective study of pediatric patients (<18 years old) with shunt infections at Hasan Sadikin Hospital Bandung Indonesia was performed between March 2019 and March 2020. The patients were treated according to the hospital's shunt infection protocol, which consists of shunt removal with EVD insertion, antimicrobial treatment administration, and 2 times-negative cultures before putting on a new device. Patient outcomes were assessed by looking at the mortality rate and Functional Status Scales (FSS).

Results : A total of 28 patients were included in this study. The median age was 5 months and most of the patients were boys (60,7%). The median time interval between the first surgery to the onset of infection was 10 weeks. Seventeen patients (60,7%) had shunt revision surgery before the infection. The most isolated bacterial pathogens from the culture were *Staphylococcus aureus* (35,7%) and *Staphylococcus epidermidis* (32,1%). The median length of hospital stay was 36.5 days. Seven (25%) of the patients died during the hospitalization. Based on cumulative FSS scores among 21 patients discharged at the end of the treatment, 12 had mild dysfunction, 6 had moderate dysfunction, and 3 had normal functional status.

Conclusions : Shunt infection remains a cause of morbidity and mortality in children with hydrocephalus who underwent shunt surgery. A rigidly applied therapy protocol is important in the treatment of shunt infection.

Oral presentation 9: HYDROCEPHALUS 2

A-0056

Diagnosis and Treatment of Cerebrospinal Fluid Leakage in Children

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Introduction : Orthostatic headache associated with cerebrospinal fluid(CSF) leakage may occur as a result of sports injuries, traffic accidents, fall injuries, or sudden increases in abdominal pressure, and may be difficult to diagnose and treat.The purpose of this study is to present our institutional experience in the diagnosis and treatment of CSF leakage in children.

Material & Methods : This is a retrospective study of the treatment of children 15 years old or younger presenting with orthostatic headache associated with CSF leakage between April 2020 and August 2023.Orthostatic headache was evaluated with the Lumbar-uplift test (LUP test).Medication, intravenous infusion, epidural saline infusion, and epidural blood patch were selected according to symptoms.

Results : 9 patients were conducted. 2 patients were male and 7 were female.The median age of patients was 13.4 years (range 9 to 15 years).Causes of CSF leakage were sports injury in 4 cases, traffic accident in 2 cases, fall injury in 1 case, and sudden increase in abdominal pressure in 2 cases.LUP test was positive in all patients. Radioisotope cisternography (RIC) was performed in one patient.Medication alone was given to 1 patient, medication and intravenous infusion to 2, medication and epidural saline infusion to 2, medication, intravenous infusion, and epidural saline infusion to 3, and medication, intravenous infusion, epidural saline infusion, and epidural blood patch in 1 patient. Orthostatic headache improved in all patients.

Conclusions : RIC and CT myelography require dural puncture, which is more invasive to the patient.

It may be useful to perform epidural saline infusion for diagnostic and therapeutic purposes.