The 9th Annual Meeting of the Saudi Association of Neurological Surgery Dammam, Saudi Arabia, 3-5 March 2015

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The 9th Saudi Association of Neurological Surgery (9th SANS) Annual Meeting was held in the Sheraton Dammam Hotel and Towers, Dammam, Saudi Arabia on March 3-5, 2015, organized by the Department of Neurosurgery, University of Dammam with a theme of "Research is the Bridge to the Future." The meeting was preceded by a Public Awareness Campaign on March 2, 2015 held at King Fahd Hospital of the University, Al-Khobar, Saudi Arabia, and several pre-conference workshops that were highly beneficial for neurosurgery today. The scientific program was loaded with innovative and interactive presentations from respected and reputable speakers from different parts of the world. Abstracts were carefully selected and reviewed based on their scientific value and relevance to the clinical, surgical, academic, and research aspects of neurosurgery in the Kingdom, and the world.

Meeting Highlights

Training and research in neurosurgery: Where are we? Hossam El-Husseiny, Ignatius N. Esene Department of Neurosurgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt.

There is a growing need for neurosurgeons to have an understanding of, and to be committed to research in neurosurgery and the translation of the research findings into evidence-based neurosurgical practice. This is achievable only through the apprehension and comprehension of the research process. Here, we succinctly present the concept of research in neurosurgery, its importance, and how it can be achieved in resource limited settings with illustrative examples from our institutions. The concept of evidence-based neurosurgery (EBN), which has become one of the pillars of modern neurosurgery is mentioned and emphasized. Although, neurosurgical research in most of our academic settings is commonly conducted in a difficult environment of competing priorities of a "busy surgical practice" versus "pressures by university departments to increase academic output," we advocate for an equilibrated practice between patient care, training, and research. Research is relevant to neurological surgery and neurosurgeons and neurosurgical trainees should cultivate sound evidence-based practice. Research requires an understanding of the basic concepts of the process, and an efficient use of available limited resources to provide a stronger scientific foundation for clinical work, to achieve consistency, efficiency, effectiveness, quality, and safety in neurosurgical care. Continuing medical education and training are mandatory as progress in technology is fast and there are different ways to achieve it even when resources seem to be insufficient. We will use our present situation to propose possible solutions to improve our training programs and research in our region.

Research is the bridge to the future *Abmed S. Ammar*

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What is research? Research is when one tries to find information in a scientific, systematic, and orderly manner. There is no improvement of patient's care, or work toward a bright future without true scientific research. What is the importance of preforming research? It allows researchers to pursue their interests. To learn something new. To gain problem-solving skills. It opens the mind and improves the way of thinking. It reflects on many aspects of life. It is required to climb the career leader. Scientific research has noble causes, which include answering important questions that will improve the health care of our patients. However, preforming research may have other objectives such as; personal and professional objectives, improving the status of researchers, promotion, and professional advancement, and improving salary, and job security. On analysis of the current status of research and of those we call researchers in our area, we find that most perform clinical research and publish cases reports only for personal reasons either for promotion or to obtain some financial reward. That is why we have truly insignificant researchers. Research should be carried out to find answers for unsolved medical or scientific problems. The greatest motivation and satisfaction should be obtained by the feeling of adding knowledge to the scientific and medical community and reducing a patient's pain and curing illness. These should be our main aims in preforming research.

Academic neurosurgery Hosam M. Al-Jehani Department of Neurosurgery, College of Medicine, University of Dammam, King Fahd Hospital of the University, Al-Khobar, Saudi Arabia

Neurosurgery is a field notorious for exaggerated workload in comparison with other fields of medicine. A neurosurgeon today is faced with increasing service demands due to the shortage of neurosurgeons to meet the population increase in our community. "Academic Neurosurgeons" working in University Hospitals or in charge of training programs face more limited time to pursue research and funding and ever changing resident culture. We present some of these challenges as they apply to our community, and suggest some solutions to improve the field of academic neurosurgery centers.

Survey of the h-Index for neurosurgeons in Saudi Arabia Abdulhakim B. Jamjoom King Khalid National Guards Hospital, Jeddah, Saudi Arabia

Objective: The h-index is a bibliometric measure that combines the number of publications and the citation count in a single number that signifies the scientific yield of a researcher. This study aims at calculating the h-index for neurosurgeons in the Kingdom of Saudi Arabia (KSA), and at determining its correlation with a number of features relating to neurosurgical practice in KSA. **Methods:** The h-index for 84 neurosurgeons that worked in KSA during 1990-2013 was determined using Google Scholar. The h-index was defined as the number of papers h, by a researcher with citation counts of h or above for each paper. The association between the h-index and neurosurgeons nationality, origin, and year of the neurosurgical certification as well as the KSA neurosurgical center and its region were analyzed and examined statistically. **Results:** The median h-index was 2.5 (range 0-33) and the mean (SD) was 5.04 (6.10). The h-index was significantly higher for neurosurgeons who obtained their neurosurgical certification before 2001 and those working at the King Faisal Specialist Hospital & Research Center.

The h-index was also higher, but without reaching significance, for neurosurgeons that were non-Saudi nationals, those with international neurosurgical certification, and those working at University Hospitals. In addition, the h-index was significantly lower for neurosurgeons working in the Ministry of Health Hospitals. **Conclusions:** The h-index is a useful measure that reflects the cumulative impact and relevance of an individual's academic productivity. Application of the h-index to KSA neurosurgeons revealed a significant correlation with the duration after neurosurgical certification and with certain neurosurgical centers. Evaluation of the h-index should be included during the application process for academic positions in KSA. Saudi neurosurgeons should be encouraged to publish papers that will have an impact on the field reflected by a high citation count.

Antisecretory factor a new peptide reducing intracranial pressure Mohammad Olama

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The antisecretory factor-16 (AF-16 or AS-Factor) is a synthetic 16 amino acid peptide, part of the AF protein. The AF is a protein with a molecular weight of 41kDa. It was originally isolated from a pig pituitary gland. The AF counteracts experimentally induced diarrhea and inflammatory reactions in the small intestine. Professor Stefan Lange et al conducted research on the antibody that provides people who survived cholera with at least one years immunity. In their search, they found AF-Factor in 80th. In 1995, they isolated the AF from piglets hypophysis. The AF cab be found in almost all living cells. It is normally inactive, but can be activated by bacterial toxins or by the oral intake of special processed cereals. Researchers found that AF-16 affects lipid rafts and caveolae via flotillin-1. The AF-16 exerts no or only minor effects under normal conditions. In contrast, AF-16 monitors and normalizes abnormal functions in lipid rafts and caveolae. It restores actin filaments and flotillin oligomers thereby influencing ion channel functions. We investigated how AF-16 reduced intracranial pressure caused by trauma or inflammation. Also, we showed how it decreased the tumor pressure allowing the cytostatic to easily penetrate the tumors for better effects. We also showed that a high AF concentration in serum gives 100% survival rate after herpes encephalitis in rats (where otherwise the mortality rate was 100%).

Misclassification of research methods in neurosurgery

Ignatius Esene, Mohamed ElZoghby, Hossam ElHusseiny Department of Neurosurgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Medical evidence is obtainable from approaches that might be descriptive, analytic, and/or integrative, and ranked into levels of evidence, graded according to quality, and summarized into strengths of recommendation. Sources of evidence range from expert opinions and anatomic studies through well-randomized control trials to meta-analyses. Recently, a number of papers have been published indicating that a significant proportion of neurosurgical articles is misclassified (16% confusion between case reports and case series, 70% misclassification for case series and 40-50% for case control studies). This inconsistent, inappropriate, and incorrect use, and mislabeling impair the appropriate indexing and sorting of evidence. Herein, we have underscored and addressed the problem of misclassification of research methods in neurosurgery, and the consequence on practice of evidence-based neurosurgery. A distinction between the different study designs is absolutely necessary to enable the appropriate indexing, sorting, and application of evidence. Researchers need better training in methods and terminology, and editors and reviewers should scrutinize manuscripts for publications more carefully.

The supraorbital-orbitotomy minicraniotomy for anterior circulation aneurysms Bassem Y. Sheikh

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The fronto-temporal (pterional) approach has been the main approach for clipping of the anterior circulation aneurysms and has the significant advantage of being a familiar technique. Although this has been extensively used for the management of various aneurysms in this region, it is considered ambiguous, exposing unnecessary parts of the cerebral brain region, with wide splitting of the Sylvian fissure and other subarachnoid cisterns. The complications associated with the unnecessarily large conventional pterional craniotomy, and the developments in visualization, neuroanesthesia, microneurosurgery, cerebrospinal fluid drainage, and brain protection have led to less invasive methods in cranial base surgery. Of which the supraorbital-orbitotomy minicraniotomy is one example that offers several advantages over the classic fronto-temporal craniotomies. Preoperative planning was individualized in each patient based on 3-dimensional computed tomography angiography. For each patient preoperative planning of the bony removal and angle of exposure was performed on the 3D-CT. The procedure consisted of a 5 cm periorbital skin incision, release of the temporal muscle attachment from the fronto-zygomatic junction. A 4.5 x 3 cm minicraniotomy is performed starting just lateral to the supraorbital groove or foramen, and involving the orbital rim. The supraorbital-orbitotomy minicraniotomy is a minimally invasive option combining advantages of minimal invasive principle with cranial base concept. It is a safe approach in the hands of experienced neurosurgeons for selected anterior circulation aneurysms. Of the advantages included, no hair shaving, and no drain placement is required. The anatomic fields that can be visualized with the use of this procedure are demonstrated. The advantages and potential surgical applications are described. Warning points and potential disadvantages are highlighted.

Characteristics, management, and outcome of intracranial pediatric aneurysms Yasser Orz, Mahmoud AlYamany, Sultan AlQahtani National Neuroscience Institute, King Fahad Medical City, Riyadh, Saudi Arabia

Objective: Complex intracranial aneurysms include not only giant aneurysms but also small ones in difficult locations. They are usually associated with high morbidity and mortality rates in their management. The objective is to discuss our multidisciplinary approach for management of such cases. **Patients and methods:** From 2007-2014 there are 40 patients with complex intracranial aneurysms out of 190 patients with intracranial aneurysms operated in our center using a multidisciplinary team approach including different microsurgical and also neurointerventional techniques were included in this review. **Results:** Thirty-four patients had good outcome without new neurological deficits while 2 patients died. **Conclusions:** The synergistic associations between microsurgery and endovascular modalities in management of complex intracranial aneurysms have become more common and resulting in improving patient outcomes.

Is pterional craniotomy adequate for total removal of olfactory groove meningioma? Sherif El Watidy King Saud University, Riyadh, Saudi Arabia

Objective: To study the feasibility of complete surgical excision of olfactory groove meningioma (OGM) through pterional craniotomy (PC). **Patients & Methods:** We reviewed all patients with OGM who had surgical excision through PC at King Khalid University Hospital (KKUH), Riyadh, Saudi Arabia between January 1990 and December 2012. Data of clinical presentation, radiological features, surgical procedure, outcome of surgery, and

tumor recurrence were collected and analyzed. **Results:** There were 40 patients 18% males, and 82% females; the median age was 44 years. The tumor was <3 cm in 12%, 3-5 cm in 58%, and >5 cm in 30% of patients. The pterional approach was used in all patients. We excluded patients with OGM who had surgery through other approaches (bifrontal approach, supra-orbital approach, and combined approaches). Total resection (Simpson I) was achieved in all patients. Postoperative complications included CSF collection, superficial wound infection in one patient, postoperative seizures in 2 patients, EDH in one patient, and DVT in one patient. Follow up period ranged from 6 months to 10 years (mean 43 months). Tumor recurrence was seen in 10% of patients. **Conclusion:** Pterional craniotomy is adequate for complete excision of OGM, it allows minimal brain exposure and manipulation with minimal postoperative brain swelling, complete removal with excellent neurosurgical outcome, minimal permanent morbidity, and low recurrence rates.

Endoscopic extracapsular resection of functioning pituitary Adenomas: technique and early outcomes Mohamed A. Elzoghby, Iman H. Hewedi, Yara M. Eid Departments of Neurosurgery, Pathology and Endocrinology, Ain Shams University School of Medicine, Cairo, Egypt

Context: Extracapsular approaches for pituitary adenoma resection have been reported as early as 1975 by Hardy. Nevertheless, the pseudocapsule based extracapsular resection has only been highlighted in 2006. It has been proven to elevate the postoperative remission rate and reduce the risk of recurrence. However, this technique was described using the operating microscope and no attempts to use the endoscope were published up to our knowledge. Objective: Our aim was to evaluate the feasibility, safety, and efficacy of endoscopic transsphenoidal pseudocapsule based extracapsular resection of functioning pituitary adenoma, in Ain Shams University Hospitals, Cairo, Egypt. Materials and Methods: Eighteen patients with functioning pituitary adenomas underwent endoscopic transsphenoidal surgery utilizing a pseudocapsule based extracapsular resection technique in the period between November 2010 and April 2012. Remission was defined as postoperative normalization of hormonal hypersecretion with evidence of complete resection on postoperative radiological assessment. Results: Remission was achieved in 95% of patients with functioning adenomas. Pituitary pseudocapsule was demonstrated histologically in 15 patients and for the remaining 3 patients capsular stains were not available. Intraoperative CSF leak was encountered in 30%; however, with appropriate repair only one patient (5%) experienced postoperative leakage that was managed conservatively. The complications encountered were transient diabetes insipidus and sinusitis. Conclusions: Endoscopic pseudocapsule based extracapsular resection provides a feasible, reasonably safe, and effective approach for functioning pituitary adenoma resection with a higher remission rate and reduced risk of recurrence.

Free calcium and the extracellular calcium-sensing receptors regulate the degeneration of human cartilaginous endplates *Michael P. Grant Division of Surgery, McGill University, Montreal, Quebec City, Canada*

Introduction: Chronic low back pain is a debilitating disease and has been attributed to intervertebral disc (IVD) degeneration. The cartilaginous endplates (CEPs) separate the discs from the vertebral bone, and in addition to providing structural support, mitigate the movement of molecules in and out of the disc. Although several factors contribute to IVD disease, degeneration and calcification of CEP is viewed as a catalyst. Although biological repair strategies of the degenerative disc involving supplementation of growth factors are being pursued, disc nutrition is an important factor in considering their success. We have recently discovered increased levels of free calcium (Ca2+) in CEP tissue from degenerate discs; however, the importance of Ca2+ in CEP degeneration remains

unknown. The extracellular calcium-sensing receptor (CaSR) is a G protein-coupled receptor, and currently is the only known mechanism in sensing both local and systemic Ca2+ fluctuations. Recently, CaSR has been shown to modulate vascular calcification; however, its function in the calcification or degeneration of other tissues remains unknown. Materials and Methods: Human CEPs were obtained from IVDs through organ donations within 24 hours of death. The CEP chondrocytes were isolated from tissue by sequential digestion with Pronase followed by Collagenase. Western blotting was used to determine expression of type I and II collagen (Col I and II) and aggrecan in CEP cells and tissue. Bovine IVDs were cultured for 4 weeks in medium supplemented with Ca2+. The CEP tissue was dissected and extracted for aggrecan and newly synthesized collagen fibrils using guanidinium chloride buffer. Glucose diffusion in IVDs was determined by measuring fluorescence in IVD tissue following incubation with the glucose analog 2-NBDG. Results: Immunohistochemistry and Western blotting on CEP demonstrated an upregulation of CaSR that paralleled the degree of IVD degeneration. Expression of Col I, II, and aggrecan decreased dose-dependently in CEP cells cultured in medium supplemented with increasing concentrations of Ca2+ [1.0-5.0 mM]. Inhibition of CaSR with either antagonists or siRNA knockdown reversed this effect. Although Ca2+ did not increase the synthesis and release of catabolic enzymes; namely, MMP-13, ADAMTS-4, and -5, it did increase their activity. Following 4 weeks of culture in medium supplemented with 2.5 mM Ca2+, calcification and decreases in the expression of aggrecan and Col I and II were apparent in cultured IVDs; however, co-incubation with a CaSR antagonist abrogated this effect. Degeneration of CEP played a role in glucose metabolism as IVDs incubated in 2.5 mM Ca2+ demonstrated decreased glucose diffusion, a property that was reversed when the CaSR antagonist was introduced. Conclusions: Calcification and degeneration of CEP are contributing factors in IVD disease; however, the mechanisms regulating this process are unclear. We provide evidence that Ca2+ actively participates in CEP degeneration and that activation of CaSR is a principle mediator. Inhibition of CaSR or decreases in the accumulation of Ca2+ in the disc may be beneficial when considering introduction of IVD anabolic therapeutics.

Serum leukocyte count (WBC) levels as an indicator for severity of traumatic brain injury in patients in Saudi Arabia *Mubarak Al-Gahtany*

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Background: Traumatic brain injury (TBI) is widespread and leads to death and disability in millions of individuals around the world each year. In Saudi Arabia it was found to be 32,000 head injury per year with a mortality rate of 10,000/year. Young children, adolescents, and the elderly, predominantly male, suffer the highest rates of TBI. The treatment and improvement of outcome in TBI subjects still remains a challenge. It is estimated that despite all the recent advances in the management of TBI, approximately half of the patients suffering head injuries still have unfavorable outcomes, which represents a substantial health care, social, and economic burden to societies. The nature and extent of recovery after TBI is heterogeneous and is not fully explained by known and apparent demographic and injury related prognostic factors. Traumatic brain injury is associated with elevated serum levels of catecholamines. Brain swelling occurring after head trauma is probably an inflammatory response due to intracerebral cytokine production and increased leucocyte adhesion as a result of a direct effect on vascular permeability and leucocyte activation. However, Glasgow Comma Score (GCS) is often used as part of the decision tool in major trauma centers. This study evaluated the association of serum leukocyte (WBC) levels with GCS score as an indicator for severity of TBI in patients in Saudi Arabia. Methodology: This prospective study included 43 patients with TBI from the Neurosurgery Clinic, Asser Hospital, Abha, Saudi Arabia. The age range was 12 to 65 years. After obtaining their informed consent, a serum blood sample was obtained from each patient for WBC count at initial time of admission and after 24 hrs, 72 hrs, and one week. All patients were divided into 3 groups

according to their GCS scores. Severe GCS (3-8), moderate GCS (9-13), and mild GCS (14-15) during hospital stay. The relationship between these parameters and WBC levels were evaluated by repeated measures of ANOVA and paired t-test statistical methods. **Results and Conclusion:** Significant association between WBC count and GCS score is observed in all 3 groups using the repeated measures of ANOVA method (p<0.0001), and the pairwise comparison using paired t test also showed significant association between these groups, post hoc Bonferroni value (p=0.0021). The leukocyte value exceeding 14.18 x 10⁶/l has a predictive value for poor GCS score. These findings have implications for TBI outcomes research and for protocols and research selection criteria that use the GCS with WBC count.

Comparative analysis of anterior versus posterior decompression and stabilisation in burst fracture at the thoraco-lumbar junction with neurological deficit *G. Muthukumar, Hani Azzouni King Fahd General Hospital, Jeddah, Saudi Arabia*

Background: The indication for surgical management of thoracolumbar junctional burst fracture is controversial. There is general agreement that patients with neurological deficit should undergo surgical decompression and fixation. The 2 options to achieve the objective are anterior and posterior decompression with fixation. Many authors believe that decompression could be more effective from an anterior approach, while others have claimed comparable outcome with posterior decompression and fixation. Objective: To compare the 2 modalities and identify the procedure with better outcome in regards to neurological recovery, correction, and maintenance of kyphotic deformity, relief of pain, and complications rate. Methods: Fifty-four patients admitted through the Emergency Services with traumatic burst fracture at the dorsolumbar junction associated with neurological deficit were alternatively allocated at the time of admission to either anterior corpectomy with instrumentation or posterior pedicle screw fixation and cancellous bone grafting. The patients were evaluated for the extent and duration of neurological recovery, correction, and maintenance of segmental kyphosis, and residual pain. The patients were followed up for 2-7 years. Results: Demographic and injury profiles were similar in either group. Operating time, blood loss, morbidity, duration of hospitalization, and cost were significantly less in the posterior instrumentation group of patients. Extent of neurological recovery, correction, and maintenance of kyphosis were similar in both groups. Residual pain at fracture site was marginally more with posterior instrumentation but significantly higher at the iliac graft donor site in the anterior fixation group. Conclusions: Posterior decompression and pedicle screw fixation achieves equally comparable neurological recovery and kyphosis correction as the anterior procedure and significantly surpasses the other in regards to safety, simplicity, cost, and morbidity.

Preventable mortality and morbidity due to medical error in the management of acute neurotrauma cases Mohamed Y. Sahib

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More than 45 cases treated for neurotrauma associated with or without poly trauma, succumbed to preventable mortality, and morbidity due to medical error, are extensively studied with clinical course, neuro imaging, and in a few cases with postmortem studies in the past 25 years. The following underlying errors are identified as the main cause of such results. 1. Poor understanding of pathophysiology of saltwater mechanism and rapid correction of hyponatremia due to lab error (mortality one case). 2. Lab error misquoting Hypokalemia as normal, patient was intubated and admitted to ICU on ventilator, hypokalemia was diagnosed, corrected, recovered well, but needed tracheostomy for vocal cord injury during intubation (severe morbidity 2 cases). 3. Failure to recognize cervical

spine injury in emergency department. The x-ray technician innocently rotated the head for an x-ray of the skull and cervical spine lateral view, dislocating the fractured site of cervical spine (mortality 2, and morbidity 3 cases). 4. Ignoring the warning signs of x-ay, such as a fissure fracture skull crossing vascular markings, sutural diastasis in children, and so forth (mortality 2 cases). 5. Inappropriate and hurried endotracheal intubation in the emergency department, ultimately leading to difficult extubation, tracheostomy, and further complications such as vocal cord injury, retroglottis hemorrhage, tracheal stenosis, tracheoesophageal fistula, and so forth (mortality 2 cases, and morbidity >10 cases). 6. Lack of self-confidence in the clinical diagnosis and demanding the neuroimaging diagnostic facilities, and refusal to make life saving procedures based on clinical and x-ray findings (mortality 3 cases). 7. Failure of other colleagues in the trauma team to follow up the poly traumatized cases on the basis of day I primary and secondary survey along with first line investigation negative reports. (mortality 3 cases, and morbidity 7 cases). 8. Administration of unnecessary heavy sedation and pharmacologically paralyzing the case when they come out of post ictal LOC, post traumatic transient coma, recovering from LOC and to overcome restlessness and agitation (mortality 3 cases, and morbidity 3 cases) 9. Dorsal spine injury associated with hemopericardium, cardiac tamponade, and subsequent bradycardia, severe lung contusion and defective alveolar exchange, and so forth. The patient is neurologically intact and the MRI did not show any cord trauma; however the patient remained under the neurosurgeon (due to shock and bradycardia, mistaken as spinal shock) (mortality one case, and morbidity 2 cases). This paper is from the personal experience of the author. The main aim of presenting this is to create awareness among the practicing young neurosurgeons and to exercise adequate caution in the vital steps in implementing the management protocol of neurotrauma cases with high accuracy and to avoid such errors. Interesting cases are highlighted with illustrations.

Atlas instrumentation guided by the medial edge of the posterior arch: An anatomic study Amro Al-Habib, Abdulkarim Al-Rabie, Sami Al-Eissa King Saud University, Riyadh, Saudi Arabia

Background: Atlas lateral mass (ALM) central point is required for accurate instrumentation. It is described as midway between the medial ALM border and the C1-transverse foramen. This may be challenging given the rich venous plexus in lateral dissection and the rounded ill-defined medial border of ALM. This report examines the use of the medial edge of C1 posterior arch (MEC1) as a fixed and easy reference for the entry point of the ALM screw. **Methods:** Posterior exposure of ALM of 10 human fresh cadavers was performed. O-arm 3D imaging was performed for anatomy verification. Entry point was 2-3 mm lateral to MEC1. It was one mm medial to a nutrient vessel foramen frequently found (but not well described previously). The trajectory was guided by inferior arch border (IBC1) into ALM. Multiaxial vertex screws (Medtronic, USA) 2 were inserted perpendicular to ALM. Another O-arm 3D imaging was performed afterwards to confirm instrumentation accuracy. **Results:** Twenty screws were successfully inserted within the ALM. No encroachment was found into the spinal canal or foramen transversarium. Two screws were superiorly directed and violated the occipitocervical joint. They were not parallel to the C1 arch. **Conclusion:** The MEC1 provides a fixed and easy landmark for ALM instrumentation. The IBC1 also provides a guide for the screw trajectory. This may avoid extensive dissection in a tight area that has a rich venous plexus. Biomechanical studies are required to determine the pull out strength of these screws compared with standard techniques.

Cavernous sinus surgery: Serving the BOSS (base of skull surgery) Atul Goel Department of Neurosurgery, King Edward Memorial Hospital, & TATA Memorial Hospital and Cancer Institute, Mumbai, India

The progressive refinements of imaging techniques have helped neurosurgeons delineate pathologies close to the skull base, an arena wherein, so far, even angels feared to tread. The past 2 decades have been marked by a global, concerted effort to confront these pressing problems by the healing knife. Base of Skull Surgery - BOSS - has come of age as a super-specialty that must turn safer and easier as the years roll by. The crowding of structures on either side of sella turcica and sphenoid sinus has forced anatomists into describing the cavernous sinus as an area through which cranial nerves and carotid artery course. A little embryological retrospection will clarify the issue for us. The cranial nerves have a well-defined dural and arachnoid covering in their course along the cavernous sinus, which keeps them isolated from direct contact with the venous blood. The anterior clinoid processes, which are extradural structures, project into and separate the internal carotid artery from the 'cavernous sinus' and nerves. The site of the origin of the lesion, and its nature, determine the extensions and displacements in the cavernous sinus. The direction of approach holds the key to successful resection of the lesions involving the cavernous sinus. The BOSSist, working or in the making, has to be most Hippocratic- Primum, non nocere. Towards this end, it is important that a BOSSist appreciates the epigenetic sequence that fashions all the blood vessels, nerves, and meninges first and then the skull base, as an afterthought later. A clear understanding of the forgoing will lead the BOSSist to have a mental picture of tissue planes that separate pathology from the neighboring structures. Handson experience would reveal these concepts to be verifiable realities that can be put to the advantage of the patient and the ease of the surgeon. No wonder, a BOSS practitioner must be conversant as much with the evolution and embryology of the area of interest, as also its anatomy, and images. The BOSS discipline offers a great vista for the coming future.

Unusual intracerebral schwannoma

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Schwannomas or neurilemmomas are benign tumors derived from the cells ensheathing the fibres of peripheral and cranial nerves. They are usually solitary, encapsulated, and are eccentric to their nerve of origin with the nerve fibers spread over their surface. It makes up about 8% of all brain tumors, of which the majority are vestibular schwannomas and contribute to 90% of all intracranial schwannomas. The anatomical and histological features are identical among all cranial nerves except the optic nerve. Based on this fact, we expect to have majority or higher percentage of schwannomas along other cranial nerves. Nobody knows the exact reason of the rare occurrence of this tumor among other cranial nerves. Currently, there is numerous publications on involvement of other cranial nerves apart from the optic nerve. Few papers has been written on its existence within the brain and the ventricular system where Schwann cells are not existing. In our study, we are trying to find an answer to the rarity of this tumor along other cranial nerves and its almost zero existence in other areas of the brain. Finally, since schwannomas could present anywhere within the cranial cavity we have to consider it in our differential diagnoses for any intracranial mass.

Subpial resection: Virtual reality simulation scenario on the NeuroTouch platform

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Background: Subpial dissection and aspiration is a highly delicate procedure that requires special fine motor skills. This technique is used in glioma surgery, epilepsy surgery especially in areas of eloquence in the brain. Currently only simple tasks and skills exist in the mainstream virtual reality (VR) simulation platforms, and such complex procedures do not exist commercially. We are using the NeuroTouch Platform, built by the National Research Council (NRC) of Canada. Objective: Using the neurosurgical scenario building roadmap that we developed from the extensive basic scenario creation experience accumulated at the Neurosurgical Simulation Research Centre (NSRC) and at the NRC, to simplistic and a realistic subpial resection models. Methods: Using the roadmap carried out the scenario creation in 4 phases: 1) planning and storyboarding of a subpial lesion removal, this included: brainstorming, sketching, storyboarding stop-motion video making and deciding to use only 3 existing instruments in the NeuroTouach Platform, Ultrasonic aspirator, or suction and bipolar. 2) Construction of the VR scenario: a) Model assembly: for the simplistic model we used the Blender (software) and for the realistic model we segmented and reconstructed images and built a fabricated subpial lesion and added it to the segmentation, b) tissue subgrouping c) biomechanical property assignment, d) texturing. 3) Designating measurement files to create metrics for validation and 4) creation of proficiency based benchmarks for performance assessment that address several bimanual psychomotor assessments and focused learning objectives. Results: We created simplistic and realistic subpial resection VR scenarios and are presently testing to assess their face, content, and constructive validity. Conclusion: Using our roadmap, we created 2 complex neurosurgical VR scenarios that are currently being tested.

Cavernous sinus involvement by pituitary adenomas: Clinical implications, outcomes of endoscopic endonasal resection, and proposed treatment algorithms

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Introduction: Parasellar invasion of pituitary adenomas (PA) into the cavernous sinus (CS) is common. The management of the CS component of PA remains controversial. To analyze CS involvement in PA treated with endoscopic endonasal approaches, including incidence, surgical risks, long-term surgical outcomes, and our treatment algorithm. **Methods:** We reviewed a series of 183 surgically treated PA with particular attention to CS involvement and whether CS tumors were approached medial or lateral to the CS internal carotid artery (ICA). **Results:** The median patient age at the time of surgery was 50 years (range, 18-89 years). The median duration of follow-up was 36 months (range, 1-78 months). The most common presenting symptom was hormonal disturbance (37%). Macroadenomas and non-functional adenomas represented 77% and 60% of cases. The CS invasion was documented in 23% of cases. The CS invasion was more common among ACTH-staining adenomas. The CS involvement was associated with a significantly diminished odds of gross total resection (47% versus 86%, odds ratio [OR] 5.2, 95% confidence interval [CI]: 2.4-11.5, p<0.0001) and increased the need for subsequent intervention

(4% versus 40%, OR 14.4, 95% CI: 5.1-40.6, p<0.0001). Hormonal remission was achieved in only 15% of patients with hormonally-active tumors. Rates of surgical complication were similar regardless of CS involvement. **Conclusion:** Our tailored strategy beginning with a medial approach and adding lateral exposure as needed resulted in good outcomes with low morbidity in non-functional adenomas. Functional adenomas involving the CS were associated with low rates of hormonal remission necessitating higher rates of additional treatment.

Neurosurgical management of intracranial epidermoid tumors in children Dr. Ibrahim Al-Ahmed King Fahd Hospital, Hofuf, Saudi Arabia

Background: Epidermoid tumors are benign lesions representing 1% of all intracranial tumors. There have been few pediatric series of intracranial epidermoid tumors reported previously. We present our experience in the management of these lesions. Methods: A search for children whose intracranial epidermoid tumors were managed surgically was conducted in the neurosurgical database. The patient charts were reviewed for demographic data, details of clinical presentation, surgical therapy, and follow-up. Ethics board approval was obtained. Results: There were 7 children, all female patients, identified between 1980-2007. The average age at surgery was 11 years (range 8-15). The mean maximal tumor diameter was 2.1 cm. Headache was the most common presenting symptom and one tumor was found incidentally. Most patients were neurologically normal. However, meningismus was found in 2 cases. There were 3 cerebellopontine angle (CPA) lesions, one pontomedullary lesion, and three supratentorial tumors. One patient developed hydrocephalus after aseptic meningitis and was shunted. No operative mortality was seen. Complete resection was performed in 3 patients. One of these patients experienced a small recurrence not requiring re-operation, while one subtotally resected lesion recurred and the patient underwent a second operation. Conclusion: Intracranial epidermoid tumors are rare in the pediatric population. Total resection is desirable in order to minimize postoperative aseptic meningitis, hydrocephalus, and tumor recurrence. However, aggressive neurosurgical resection may be associated with cranial nerve or ischemic deficits. Here, neurosurgical judgment at the time of surgery is warranted to ensure maximum resection while minimizing neurological deficits.

Transnasal endoscopic surgery for skull base lesions: KFSH-D experience Mohammed Mohsen King Fahd Specialist Hospital Dammam, Dammam, Saudi Arabia

Background: The trans-nasal endoscopic approach is becoming the preferred minimally invasive approach for some skull base lesions including pituitary adenomas, meningiomas, craniopharyngioma, skull base defects with or without CSF leak, and so forth. **Objective:** To assess the efficacy and safety of this approach in our hospital over the last 4 years. **Methods:** Retrospective chart review analysis of cases with skull base lesions operated via this approach. We had 38 procedures performed since we started this technique in early 2011. Follow up ranged from 3 months to 4 years. **Surgical Technique:** All procedures are performed by a team of dedicated neurosurgeons and an ENT surgeon. Four hand techniques used. Neuro-navigation (Stealth 7) utilized for all cases. No intra-op x-ray was used. Lumbar drain was not used routinely and all patients had intravenous antibiotics at induction. **Results:** Thirty-eight procedures performed on 31 patients. Average age was 38.5 (17-64). Male to female ratio was almost 50:50 (15/16). We had 20 procedures for CSF leak (10 spontaneous, 8 post trauma, and 2 post operative). Three cases had lumbar drain inserted at induction. Three cases had recurrence; 2 patients had high ICP which required VP shunt. Ten procedures for pituitary adenoma; 9 were non-functioning, 9 were either large or invasive and required post op referral for radiotherapy, 2 required second stage surgeries by craniotomy. One case had delayed infection at the tumor bed that required endoscopic drainage and antibiotics. Two cases of skull base

invasive meningioma treated as staged procedure (endoscopic trans-nasal then trans-cranial). Two cases of cystic craniopharyngioma treated endoscopically; one required trans-cranial due to recurrence. One case of suprasellar invasive chordoma operated twice endoscopically then referred for radiotherapy. We had 2 biopsies for diffuse invasive skull base lesions (one B-cell lymphoma and one adenoid cystic carcinoma). We had no surgical mortality, one delayed infection at the tumor bed (pituitary), 4 post op CSF leak. No visual or neurological deterioration were encountered post operatively. No deterioration were noticed in the hormonal profile post op. Patients with hypopituitarism remain the same post op. Conclusion: Trans-nasal endoscopic approach is safe. It is effective in cases of CSF leak and biopsy of skull base lesions. For cases with large or invasive pituitary adenoma; staged surgery and/or postoperative radiotherapy (stereotactic or conventional) is recommended.

Spinal navigation associated with IOM: A new protocol

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Introduction: It is widely accepted that navigation in brain neurosurgery is an essential tool for intra parenchymal brain lesions and in functional brain neurosurgery. Neurosurgeons are very familiar with the use of brain navigation, but few have experienced the use of navigation in spine surgery. When spinal navigation started 2 decades ago, the pre-operative CT-based spinal image guidance was the main technique. It was hard to convince surgeons of the real benefits, because of many reasons: complicated planning, time consuming, doubtful accuracy, incomplete availability of navigated tools, and so forth. Then in the last decade more refinement of the spinal navigation techniques with the introduction of pre-calibrated instruments, followed by the revolutionary 3D integrated imaging modality with automatic real time registration resulted in increased placement accuracy of pedicle screws compared to conventional fluoroscopy guided technique and increased safety for the surgeons and the OR staff by a significant reduction of radiation exposure and the possible immediate intraoperative diagnosis of screws malposition, which allows revision whenever necessary without the need for post-operative scanning. Gelalis et al in their review of 26 prospective randomized studies on 1105 patients, with 6617 screws, concluded that navigation exhibited higher accuracy and increased safety than free hand technique and use of fluoroscopy, with the CT based navigation (O-Arm) results reach from 89-100%. Many studies confirmed the increased accuracy of pedicle screws placement with reduction in operation time, reduction of radiation exposure, and subsequent increasing safety. Fehlings et al in a systematic review of 32 prospective studies articles, showed a high level of evidence that multimodal IOM is sensitive and specific for detecting intraoperative neurologic injury during spine surgery. They recommended the use of IOM in procedures involving deformity correction and procedures requiring placement of instrumentation. In the Neuro Spinal Hospital, we started the use of spinal navigation in 2002, then it was stopped due to some difficulties and being time consuming, then we started again to use it in 2005 with the introduction of navigated tools and the improvements of software and imaging integration especially the 3D fluoroscopy. Nearly all major and instrumented spinal operations were carried out under IOM. For the last 4 years we started with the O-Arm based navigation and as we used the IOM routinely, we started with the use of triggered EMG pedicle screws stimulation as a routine for the last 2 years. We conducted studies involving around 150 patients with the following protocol: Performing O-Arm Imaging for the navigation and after the placement of screws, we stimulate the pedicle screws and check the response, then we performed the O-Arm again before connecting the rods and comparing the results between the imaging and the stimulation. Our preliminary results in the first 71 patients with 4 screws showed the following results. Results: A total of 447 screws were inserted in 71 patients. In 10 patients, 11 screws needed repositioning. Comparing results of PS triggered EMG responses to the 3D scan, we found: negative stimulation response with negative 3D scans findings, corresponding to 432 acceptable screw positions (96.6%) in 62 patients (87.3%). In these cases, the redo 3D scan could be avoided. Positive stimulation response with positive

3D scans findings, corresponding to 7 unacceptable screw position (1.5%) in 6 patients (8.4%). In these cases, PS stimulation detected mal-positioned screws that would be missed without a redo 3D scan. **Conclusion:** We propose a protocol of routinely performing PS stimulation after screw insertion using spinal navigation. In the case of positive stimulation, a 3D scan must be performed to rule out a probable screw malposition (6 patients 8.4%). However, in the case of negative stimulation (87% of patients), a redo 3D scan can be avoided.

Prestige cervical disc replacement to treat degenerative disc disease: 2 years follow up from an international prospective, multicenter, observational study *Saleh Baeesa, King Abdulaziz University, Jeddah, Saudi Arabia*

Purpose: To describe routine surgical practice and patient reported outcomes (PROs) when treating degenerative cervical disc disease with the PRESTIGE cervical disc replacement in a multicenter 2-year prospective observational study (NTC00875810). Methods: A total of 194 patients were enrolled (190 patients implanted) by 15 sites across 7 countries. Patient demographics and intra-operative data were collected; PROs [EO-5D, EO-VAS and Neck Disability Index (NDI)], intervertebral disc space and adverse events (AEs) were assessed preoperatively and at 3, 6, 12, and 24 months (mo) follow-ups (FUs). Results: Sixty-seven percent of the patients were female, mean age 44.0 years, mean BMI 25.6. Compliance to follow up was: 92% (175/190) at 3 mo, 42% (80/190) at 6 mo, 59% (112/190) at 12 mo, and 78% (148/190) at 24 mo. Disc herniation was the most frequent primary indication for cervical arthroplasty (80.5%). Thirty-seven percent of patients already experienced pain for more than one year prior to baseline assessment. Mean procedure duration was 87.1 minutes and mean blood loss was 43.8 ml. The majority (71%) of PRESTIGE cervical discs were implanted at level C5-C6 while 16.3% of patients received implants at 2 levels. There was a significant improvement from baseline to 3, 6, 12, and 24 months follow ups (FUs) in all 3 PROs: EQ-5D index (baseline 0.59 to 0.78, 0.77, 0.8, 0.76 FUs, p<0.001), EQ-VAS (baseline 51.8 to 73.0, 72.0, 74.3, 71.5 FUs, p<0.001) and NDI (baseline 24.1 to 13.2, 12.6, 12.3, 13.4 FUs, p<0.001). After implantation, the mean disc height at the affected level increased by 0.19mm from baseline (0.22mm) to the 3 mo FU (0.41 mm) remaining constant thereafter (0.42, 0.40, 0.39). Mean disc height of levels above and below the implant remained comparable among baseline and all FUs. A total number of 63 AEs were recorded in 44 patients, of which 8 serious AEs and 2 serious adverse device effects. Conclusion: The study shows a significant improvement in patient reported outcomes in the first 3 months after PRESTIGE cervical disc implantation and these significant results are maintained throughout the 24 months follow-up.

High accuracy of fluoroscopic based navigation of pedicle screw fixation in the lumbar spine utilizing cylinder pedicle design: Innovative technique *Salah Al-Akkad*

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Introduction: Navigation in spine surgery used with different software registration techniques, automatic registration utilizing fluoroscopic techniques has the advantage of easy operation, no need for CT scan, navigating our target without the need to localize the level, but it misses out the third dimension (axial), so less experienced surgeon may have some difficulty to target a pedicle screw in the lumbar area. A perfect pedicle screw placement was taught through considering the pedicle as a cylinder to control the trajectory of pedicle screw in the lumber spine, applying it in practice with standard fluoroscopy was a technically demanding task since it required 2 simultaneous trajectories and a highly experienced surgeon. In this study we used fluoroscopy-based navigation utilizing this idea to make lumbar pedicle screw targeting simple, highly accurate, and safe. Methods: Using fluoroscopic based

navigation utilizing the pedicle design, 37 consecutive adult cases with 196 lumber pedicle screws were placed in 2 trauma, 7 degenerative/28 with spondylolisthesis grade I, excluded scoliosis, we carried out fluoroscopic – CT fusion technique for a few cases for demonstrative and teaching purposes to help understanding the idea, but the fluoroscopic based navigation was the only images used for targeting the pedicles. **Results:** The misplacement rate was 2.6% (5 screws), 2 screws had cortical encroachment medially (both are L1) the other 3 had lateral minor breach (<2mm) to the pedicle (all were L4), none resulted in neurological symptoms. **Conclusion:** Using fluoroscopic based navigation on the lumbar spine utilizing pedicle cylinder design is safe and reliable way for targeting lumbar pedicle and may achieve high level of accuracy, applying fluoro-CT fusion can be used initially to understand the principle.

Role of stereotactic and epilepsy surgery in the evolution of brain science

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Functional neurosurgery is a progressive field in many respects. This field has been supported by advancements in many technologies and the development of neuroimaging techniques. Basic science research has also gained significantly from many functional surgical techniques that have been used to explore different areas within the brain. The path toward a better understanding and exploration of many brain circuits and functions has been paved by functional neurosurgery, and these techniques will remain at the forefront of future research. This type of surgery may be used to treat functional neurological disorders by altering and modulating abnormally functioning neuronal circuits and physiological activities. There are many clinical indications for functional neurosurgery, including movement disorders, epilepsy, pain, psychiatric disorders, addiction, memory disorders, and other conditions. Herein, we review the impact of functional neurosurgery on the neural science discoveries over several decades.

Stereotactic neurosurgery for psychiatric disorders

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Stereotactic neurosurgery for psychiatric disorders is becoming widely practiced. The primary results of this new era of surgery for psychiatric disorders are promising. The consensus on guidelines for stereotactic neurosurgery for psychiatric disorders was published by Nuttin et al in the Journal of Neurology, Neurosurgery and Psychiatry in 2014. This document on ethical and scientific conduct of psychiatric surgery worldwide is designed to enhance patient safety. The proposed consensus document highlights that, while stereotactic ablative procedures such as cingulotomy and capsulotomy for depression and obsessive-compulsive disorder are considered 'established' in some countries, they still lack level I evidence. Further, it is noted that deep brain stimulation in any brain target hitherto tried, and for any psychiatric or behavioral disorder, remains at an investigational stage. Researchers are encouraged to design randomized controlled trials, based on scientific and data-driven rationales for disease and brain target selection. Experienced multidisciplinary teams are a mandatory requirement for the safe and ethical conduct of any psychiatric neurosurgery, ensuring documented refractoriness of patients, proper consent procedures that respect patient's capacity and autonomy, multifaceted preoperative as well as postoperative long-term follow-up evaluation, and reporting of effects and side effects for all patients. We will present the guidelines and implications on the practice of neurosurgery for psychiatric disorders.

An in-vitro and an in-vivo study of direct reprogramming of astrocytes to neurons using vector specific transcription factors in canine stroke models and humans cells

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Background data: The attempt of mouse, rat, and non-human primates transduction using retroviruses, lentiviruses, and adeno-associated viruses (AAV) has been utilized in the past with success in using retrovirus and AAV in those animal species. This study focuses on using retroviruses in canines by a developed new protocol to culture them in vitro proceeded by an in-vivo live injection into a canine stroke model. Followed by an in vitro experiment on human progenitor cells (HPCs) and mature human astrocytes (HA) using those same vectors. Objectives: To determine the specificity of retroviral transduction compared to AAV across species with close focus on the comparison of the specificity of AAV8, AAV9, and AAV10 in human cells. Study design: This is an in vitro culturing and in vivo experimental study of direct reprogramming of mature astrocytes to neurons using vector packaging specific transcription factors transduction injected into canine and non-human primate stroke models. Transcription factors of interest to be used to package both viral species are: GFAP, GFP, DCX, NeuN, NG2, RECA1, Oligo2, PAX6, and Brdu. Methodology: Experiment A: In-vitro a specific canine astrocyte culture protocol was developed using canine meningioma cells transduced with retrovirus free transcription factor first. After realizing that canine cells can be infected by retroviruses those transcription factors packaged retroviruses were then used on mature canine astrocytes harvested from a live animal. Canine cortical astrocytes were cultured in astrocyte medium on poly-l-lysine-coated flasks. Astrocyte transductions were performed at 24 hours post-plating on coated dishes as described or with nucleofection. Transfected cells were cultured in human NSC medium supplemented with EGF and FGF. Cells were then picked for further culturing and some were fixed in 4% paraformaldehyde (PFA) for 10 minutes. Then they were permeabilized with 0.5% Tween-20 in PBS and then exposed to 0.1% Tween-20 with 10% horse serum. We incubated the cells with primary antibodies overnight and with secondary antibodies for one hour when unconjugated primary antibodies were employed. The transcription factor was prepared from a DNA prep carried out on bacterial cultures. In-vivo a pterional craniotomy on the canine stroke model was performed. The internal carotid artery and the middle cerebral artery were then identified. Coagulation was carried out to the middle cerebral artery distal to the lenticulostriate vessels to preserve them. After developing a stroke in these animals a neurological examination was carried out to determine the extent of the deficit. Later, they were injected with the same vectors used in vitro. Observations were carried out for their neurological status, and the progression in the resumption of the neurological functions lost. Euthanization was carried out later on those animals when the experiment was complete a few weeks later. Experiment B: An in-vitro experiment include the usage of AAV in transducing HPCs and HAs using 3 different AAVs know from in literature AAV8, AAV9, and AAV10 to be the most potent candidates in successfully transducing HAs using the same protocols used in the canine experiment. Results: AAV8 were highly specific transducers in-vitro to HA followed by AAV9 and AAV10. The AAV viruses were found to be a superior candidate for the transduction of both human and canine astrocytes with robust results. Conclusion: AAV8 was found to be the best candidates for the transduction of canine and human astrocytes followed by AAV9. Further experimentation needs to be carried on those 2 species using different transcription factors. Moreover, further testing on non-human primates should also be carried out in vitro and in vivo.

Minimal invasive correction of frontal plagiocephaly without the use of helmets: Technical modifications and faster correction *Khaled B. Aly, Cairo University, Egypt*

Introduction: Minimal invasive craniosynostosis correction for plagiocephaly has been performed in our institute for the past 6 years. We present our recent modifications in the technique of correction. **Patients and methods:** Thirty-two patients had been operated upon by the minimal invasive technique. It consists of suturectomy followed by Y- shaped osteotomies of the frontal bone. Recently, we substituted suturectomy by making a thin cut behind the suture, followed by front orbital advancement. This was followed by Y shaped suturectomy. Another modification used in 4 more cases is to add a reductive osteotomy on the healthy side to correct for frontal bossing. **Results:** In 4 patients with the new modification, the forehead correction was faster and more complete. Adding a contra lateral osteotomy was efficient to remove the contra lateral bossing. **Conclusion:** We present 2 technical modifications that made frontal plagiocephaly correction faster, and more complete.

Management of enlarging syrinxes after decompression for Chiari I malformation

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Introduction: Chiari I malformations (CMI) often present with syringomyelia (SM). Successful surgical treatment of the CMI leads to improvement in both the symptoms as well as the SM. Persistent SM after decompression has been described, and conservative management may allow for improvement over time. We present 3 children, who after decompression had enlargement of their SM without further symptoms. Delayed imaging on these patients revealed a decrease in the SM, to sizes smaller than those seen preoperatively. Methods: Of 157 children less than age 18 with CMI and SH evaluated at our institution, 110 underwent decompression. There were 55 males and 55 females, ages ranging from 1.66-19.03 years. Surgically, 23 had bony decompression alone, while 53 underwent duroplasty, and 23 had duroplasty with fourth ventricular stent. Results: Seven of 86 patients had an increase in their SM on subsequent postoperative imaging. Three had further surgery because of either worsening scoliosis (1) or worsening pain (2). The other 4 were watched expectantly. These patients remained clinically stable, and subsequent imaging revealed reduction in the size of the SM. Two of these children required duroplasty, and one had bony decompression alone, and one had duroplasty with fourth ventricular stent. Conclusion: Although the majority of SM will improve after CMI decompression, certain patients will have postoperative imaging showing no improvement, and rarely, enlargement of the SM. In these patients, in the absence of any progressive signs or symptoms, conservative management may be indicated. In time, the SM may diminish in size, as in these patients, to sizes smaller than those seen preoperatively.

Decompressive craniectomy in the management of medically intractable intracranial hypertension B. M. Elshetry, B. Y. Sheikh, Y. E. Akkaya, M. A. Abdelrahim, H. B. Ibrahim, N. A. Latif, Neurosurgery Department, Taibah University and King Fabd Hospital, Almadinah Almunawwarah, Saudi Arabia

Background: Intracranial hypertension refractory to conservative medical measure is a serious potentially fatal condition. Decompressive craniectomy is the best-known way to reduce otherwise life threatening intractable intracranial hypertension. Aim: The aim of this study was to evaluate the inclusion criteria, extension of bony decompression and outcome of patients with decompressive craniectomy for life-threatening intractable intracranial hypertension secondary to various pathologies. **Setting:** King Fahad Hospital, Almadinah Alnabaweyya Almunawwarah, Saudi Arabia. **Study design:** Retrospective analytic study. **Methods:** Seventy patients were enrolled

in this study between 2012 and 2014. Patients had intracranial hypertension, which was not responsive to nonsurgical measures. Intracranial hypertension resulted mainly from traumatic brain injury (contusions, brain oedema). Other etiologies included; middle cerebral artery occlusion, and cerebral venous sinus thrombosis. These patients were followed for at least 6 months. Preoperative and postoperative clinical and radiological data were evaluated. Outcome was assessed using Glasgow outcome and modified Rankin scores. **Results:** Decompressive craniectomy had a good prognosis in 70 percent of cases (able to live independently and return to normal activity). 22% of cases were dependent, 8% became vegetative and died. Good prognosis was achieved in young adults with early intervention (within 6 hours of deterioration).

The vertebral artery anatomy in relation to cervical pedicles in a Saudi population: A morphometric analysis for surgical considerations

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Introduction and background: Precise knowledge of the anatomy of the cervical pedicle and vertebral artery (VA) is essential for surgical procedures on the cervical spine (CS). While previous studies have identified anatomic references for CS, none have been carried out in a Saudi population. The purpose of this study was to quantify the anatomic relationship between cervical pedicle (CP), VA, lateral mass (LM) and its surrounding structures with comparison to published literature. Such data is critical for safety of cervical spine decompression and instrumentation. Methods: This is a retrospective study. It included 50 consecutive patients (35 male and 15 male) who underwent CT angiography (CTA) of the neck between 2012 and 2014. The following parameters were measured from C3 to C7: pedicle diameter at isthmus (PD), lateral pedicle border to VA (LPVA; safe zone for pedicle screw insertion), VA sagittal (VASD) and coronal (VACD) diameters, and transverse foramen (TF) sagittal (TFH), and coronal (TFW) diameters. The level of entry of the VA into the TF was examined. Results: The mean PD increased from 4.2 to 5.7 mm from C-3 to C-7. The VA entry into TF on the right side was mostly at C-6 (92%) followed by C5 (4%), then at C4 and C7 (2% each). On the left side, VA entry was at C-6 (94%) followed by C5 (4%) then at C4 (2%). Within individual cases, VA level of entry was variable in 14% when comparing right to left sides. Left VA was bigger than right side, but not significant (mean VA axial diameter 3.8mm versus 3.5 mm; p=0.115). The VA was bigger in males than females in both right and left sides (p=0.001, and p=0.005). The mean transverse and anterior/posterior spinal canal diameters were bigger in males compared with females (transverse 24.9 mm versus 23.6 mm, p=0.004, anterior/posterior diameter 14.6 mm versus 13.1mm, p=0.002). The mean for LPVA was (0.95 mm) with no significant differences between right and left sides (p=0.116) and between male and female (p=0.155). Conclusions: Pedicle diameter is smaller in a Saudi population as compared with published data. There is a less than one mm safety zone for pedicle screws insertion in the subaxial cervical spine. Assessment of VA entry in each level should be performed on an individual basis. More studies with larger sample size are needed for further assessment and to provide better guidance for surgical procedures.