CONTINUOUS LONG-TERM MEASUREMENT OF INTRACRANIAL PRESSURE IN AWAKE ANIMALS AFTER EXPERIMENTAL CLOSED HEAD INJURY.

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Introduction:
Intracranial pressure (ICP) has become an essential parameter in the therapeutic assessment of severe head-injured patients. In clinical and experimental studies, prolonged intraparenchymal ICP measurement is not yet routinely implemented.

Aims:
Continuous measurement of ICP and MABP after impact-acceleration injury in awake rats.

Material and Methods:
Animals subjected to mild or moderate closed head injury (CHI) by means of a weight drop, and non-injured controls (n=10/condition) were individually placed in a Bas-Rattturn® system that synchronously turns in response to locomotor activity of the animal. As such correct probe positioning is permanently assured and damage due to coiling is avoided. After recovery from anesthesia, MABP and ICP were monitored for 10 hours.

Results:
Immediately after neurotrauma induction, ICP was significantly higher in traumatized rats (sham: 7.7 ± 0.5 mmHg; mild CHI 10.4 ± 0.7 mmHg; moderate CHI 14.9 ± 2.4 mmHg; p<0.05). Regression analysis showed a stable ICP from 0-3 hours and significant increase from 4-10 hours, for all conditions. No drift of the probe was detected during a 10-hour period.

Conclusions:
The data show that ICP was elevated immediately after trauma and remained stable almost 4 hours. Thereafter ICP raised in all groups. This increase could not only be explained by changes in MABP. The method allows observation of ICP for a critical 4 hour period and hence can be regarded as clinically relevant to study early pathological aspects of intracranial hypertension and to define a therapeutic window for pharmacological intervention.
Preliminary result of a study for testing safety and efficacy of incubated autologous macrophages as a treatment for complete spinal cord injury in human subjects


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Introduction:
Spinal cord injury is a major cause of severe neurological handicap with few therapeutic possibilities. We report our preliminary results of a phase I study of injection of activated macrophages in spinal cord trauma.

Method:
From November 2001 to May 2002, four patients have been enrolled in this study. The inclusion criteria included complete cord transection located between C5 and Th 11. The patient had to be treated between day 5 and 21 after injury. All patients underwent MR imaging right after trauma and orthopedic fixation of the spine. Control MRI was obtained after the procedure and repeated three and six months later so as motor and sensory evoked potentials. Two patients were injured at the thoracic level and two at the cervical level. Laminectomy with injection of six million autologous activated macrophages in the injured spinal cord closed to the contusion area was performed. We evaluated the safety by daily monitoring during one month and the efficacy by neurological (ASIA impairment scale and modified BENZEL classification) and electrophysiological examination during one year.

Results:
The patients were followed for a period of 6-12 months. In our study, a moderate improvement in the neurological status occurred with the increase in motor and sensory scores as well as in ASIA impairment Scale. Patient #2 converted to ASIA B after 10 months of follow-up, patient #1 recovered two neurological levels of motor function, patients #3, four motor neurological levels. Patient #4 regained three levels of sensation below the neurological level of injury within the first year of follow-up. Functional improvement with increase of the quality of life were observed. Patient #1 recovered motor evoked potentials from the tibialis anterior muscle at 12 months. No serious adverse experiences occurred.

Conclusion:
Intraspinal cord injection of activated macrophages may safely be done. Even if commonly admitted that improvement of two levels in spinal cord injury can occur without treatment, our interim findings suggest that therapy may have some clinical benefits, enabling the patients to better perform their day-to-day activities, improving the quality of their life. This is an encouragement to pursue and improve the study.
**BIOMECHANICS OF ACUTE SUBDURAL HAEMATOMAS.**

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**Introduction:**
For the development of protective headgear precise tolerance criteria are primordial. Up to 1/3 of traumatic acute subdural haematomas are caused by the rupture of bridging veins. It is known from primate experiments that a forward directed sagittal rotational acceleration is the most likely condition provoking these ruptures. However, the animal tolerance levels are not applicable to humans because of differences in head and brain mass. Tolerance levels for humans are not known. Human cadaver experiments were performed to investigate rotational acceleration levels leading to bridging vein rupture in humans.

**Methods:**
Occipital impact tests were performed on unembalmed cadavers. Seven cadavers (55-93 years) were tested. Three uniaxial accelerometers were fitted on the side of the head. A tube was brought into the sagittal sinus superior to the torcular. After injecting Micropaque contrast the integrity of the bridging veins could be tested by means of radioscopy. Impacts were given by a steel pendulum (43kg). The impact duration was varied by mounting different thicknesses of foam on the impactor surface. Before and after each impact the bridging vein integrity was checked. Several impacts with increasing velocity were given until failure of a bridging vein was seen radioscopically. Autopsies were performed afterwards.

**Results:**
In total 16 impacts were given. The peak positive rotational acceleration varied between 2326 and 19775 rad/s\(^2\) and the impact duration between 4,5 and 15,5 ms. A bridging vein rupture could be provoked in 5 experiments. Since one rupture occurred at a 4th impact with an acceleration of only 2326 rad/s\(^2\), it was thought that the administration of repetitive impacts may have altered the bridging vein properties. If only 1st and 2nd impacts are considered a threshold is suggested of about 10000 rad/s\(^2\) for impact durations lower than 10ms and between 5000 and 10000 rad/s\(^2\) for longer durations.

**Conclusions:**
Our data suggest tolerance levels for bridging vein rupture in elderly human cadavers between 5000 and 10000 rad/s\(^2\). The higher the pulse duration, the lower the rotational acceleration that was needed for rupture. Repetitive impacts seem to alter the material properties and failure levels of the bridging veins.
Galectin-3 bindings sites, S100B and S100A6 proteins: markers for aggressive meningiomas?

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Introduction:
Most meningiomas (90%) are considered as benign neoplasm, however 10% are classified as atypical or anaplastic with a more aggressive behaviour (greater recurrence rate and significant decrease in survival periods). The biological factors responsible of the increased aggressiveness in atypical meningiomas are not well known. The aim of the study is to evaluate the discriminate value of some biological markers (S100 proteins, galectin-3 and its binding sites) between benign and atypical meningiomas.

Methods:
We performed a semiquantitative histochemical analysis of the expression of galectin-3 and its binding sites, S100A5, S100A6 and S100B in 63 meningiomas (39 benign and 24 atypical). For each marker, three features were considered, namely the labelling index (percentage of immunopositive cells, LI ranged from 0 to 3); the staining intensity (SI: from 0 to 3) and the global score (SC: from 0 to 6) which is the sum of LI and SI.

Results:
Low labeling index for S100A6 protein (LI < 1) was observed in 51% of the benign and in 25% of the atypical meningiomas (P = 0.035). The S100B expression gave more significant results. Indeed, high S100B scores (S100B-SC > 3) were observed in 46% of benign meningiomas and in only 8% of atypical meningiomas (P = 0.001). Seventy-one percents of atypical meningiomas exhibited a low staining intensity (SI < 1) for the galectin-3 binding sites compared with only 36% of the benign meningiomas (P = 0.007). The combination of these 3 markers (by means of a decision tree approach) enabled a more discriminatory criteria to be defined between the benign and atypical meningiomas: a low global score for S100B with a high staining intensity for galectin-3 binding site and with a low labeling index for S100A6 detected 9/10 benign meningiomas.

Conclusions:
Our results suggest that these three combined markers (S100B, S100A6 and the galectin-3 binding-sites) might play a role in the aggressiveness characterizing atypical meningiomas.
CORTICAL STIMULATION FOR INTRACTABLE TINNITUS: FIRST EXPERIENCE.

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Introduction:
Tinnitus is a distressing symptom affecting up to 15% of the population. Tinnitus can be considered an auditory phantom phenomenon similar to deafferentation pain seen in the somatosensory system. Thus the pathophysiology and treatment modalities of phantom pain can help in the clarification and treatment of tinnitus.

Methods:
Transcranial Magnetic Stimulation (TMS) is a non-invasive technique of activating or deactivating focal areas of the human brain. Linked to a navigation system, that is guided by fMRI images of the auditory system, it can suppress areas of reorganization (as demonstrated by fMRI). If successful in suppressing tinnitus, this focal and temporary effect can be perpetualized by implanting a cortical electrode.

Results and discussion:
A neuronavigation based auditory fMRI guided TMS session was performed in a patient suffering tinnitus caused by a cochlear lesion. Complete suppression of tinnitus can be obtained. An extradural electrode is implanted consecutively, also based on auditory fMRI guided navigation. Postoperatively the tinnitus has disappeared completely and remained as such after 2 months. Any lesion along the auditory tract, influencing its normal function, can generate tinnitus. The entire auditory tract is tonotopically organized. This tonotopy is genetically determined but its fine tuning occurs in response to sensory input during critical periods of early development. Under influence of environmental stimuli regulation of synapses occurs daily throughout life. Any alteration of the normal sensory input leads to a reorganization of the entire auditory tract starting peripherally and ending cortically. Cortical stimulation might induce a re-reorganization, suppressing tinnitus, by following the opposite pathway.

Conclusion:
Focal extradural electrical stimulation of the primary auditory cortex at the area of cortical reorganization is capable of suppressing contralateral tinnitus completely. TMS is an ideal method for non-invasive studies of surgical candidates for implantation of stimulating electrodes for tinnitus suppression.
CONGENITAL DERMAL SINUS ASSOCIATED WITH INTRASPINAL ABNORMALITIES: A PROPOSAL OF 2 CASES.

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Introduction:
Congenital dermal sinus (CDS) is an abnormal connection between the skin surface and the central nervous system resulting from a failure during neurulation. It can be a source of infection and may be associated with other anomalies.

We report two paediatric cases:
The first case is a 16 month-old boy with a history of meningitis developing two months later fast progressive paraparesis and incontinence. Clinical examination showed a flat lumbosacral haemangioma, flaccid plegia of the left leg, and a gaping anus. MRI revealed a sinus tract associated with an intradural mass filling the lumbar spinal channel. Surgery consisted in removal of the sinus tract. A solid mass filled the intradural space preventing the identification of the normal structures and CSF flow. We aspirated pus from the mass and took biopsies. Microbiology demonstrated a multi-resistant staphylococcus epidermidis. Pathology described a chronic granulomatous pachymeningitis. The patient recovered well but was re-operated two times because of fistulas recurrence despite adequate long-term intravenous antibiotics. Eventually we found an infected dermoid cyst sticking to the conus terminalis. Three months after the last surgery, the patient is perfect and MRI is hopeful.

The second case is a one year-old male presenting with recurrent bacterial meningitis but without pathogen identification. The boy presented meningitis with fever. Skin inspection of the lumbosacral region showed a dimpling. MR imaging demonstrated a CDS with subdural collection. Surgery consisted on abscess drainage and resection of the CDS. Microbiology failed. We started empirical antibiotics with normalisation of the clinical status. A few weeks after antibiotics discontinuation, the patient was admitted with recurrent meningitis, severe constipation and hydrocephalus. Surgery consisted on lumbar exploration with abscess evacuation. Microbiology identified this time an Actinomyces species. Intravenous Penicillin was started for 6 weeks followed by oral Amoxicillin for one year. The patient remains asymptomatic.

Conclusion:
Reviewing the literature, we found CDS be associated with a high rate of morbidity. Surgery should be considered in all patients bearing CDS, consisting on excision the tract with correction of the associated abnormality and unthethering the spinal cord if needed.
LATERAL SAFETY LIMITS DURING TRANSORAL APPROACH OF THE CRANIO-VERTEBRAL JUNCTION.

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Introduction:
Transoral procedures are infrequently performed and most neurosurgeons do not have sufficient experience to feel safe in this approach. The carotid arteries and the hypoglossal nerves are the most important structures at risk during the subperiostal lateral dissection of the posterior wall of the oropharynx. These lateral landmarks are however not easily identified during the surgical dissection.

Method:
We measured the location of the foramen lacerum externum and the hypoglossal canal with respect to the midline. These measurements were performed on 76 non-pathological CT-scanned skulls, that were converted into accurate three-dimensional digital reconstruction models by use of 3D image-processing software and STL handling and manipulation software (developed by Materialise NV, Heverlee).

Results:
For the foramen lacerum, the average distance to the midline was 10.71 mm (SD 0.96 mm, smallest 8.14 mm, median 10.62 mm) on the right side and 11.10 mm (SD 0.98 mm, smallest 9.23 mm, median 10.93 mm) on the left side. For the right hypoglossal canal this distance was 17.37 mm (SD 1.21 mm, smallest 15.07 mm, median 17.27 mm) and for the left hypoglossal canal 16.95 mm (SD 1.23 mm, smallest 14.02 mm, median 16.72 mm).

Conclusion:
The posterior wall of the oropharynx can be safely dissected for at least 7 mm from the midline at the level of the foramen lacerum and for at least 13 mm towards the hypoglossal canal from the midline at the level of the anterior border of the foramen magnum. In addition, we can say that our technique of doing measurements with the help of 3D image-processing software and STL handling and manipulation software, after a thin-sliced CT, can be useful in a preoperative setting.
FOCAL FRONTAL ENCEPHALITIS MIMICKING A MALIGNANT BRAIN TUMOR IN AN IMMUNOCOMPETENT CHILD.

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Introduction:
Both infectious encephalitis and malignant CNS tumors are well-defined clinical entities in pediatric neurology. In the majority of cases, clinical presentation, radiological appearance, viral and bacterial serology and CSF examination permit a clear diagnosis. Rarely histological confirmation, and especially clinical and radiological evolution are necessary to establish the final diagnosis.

Methods:
We present the case of a 7 year old girl, transferred to our hospital because of a large space-occupying right frontal lesion presenting with vomiting, somnolence, mild left hemiparesis and hemiconvulsions. CT and MRI scan revealed a right frontal lesion with surrounding oedema and mass effect, heterogeneously contrast enhancing, strongly suggesting a malignant brain tumor. No systemic signs of infection, nor immunosuppression were present.

Results:
A right frontal craniotomy was performed for partial removal (excision biopsy) of a weak, necrotic lesion: samples for microbiological and PCR examination for Herpes Simplex Virus (HSV) were taken. Histological examination only revealed necrosis, reactive astrocytes and macrophages, but no sign of tumor. PCR for HSV and mycoplasma on the resection specimen was negative. We only found anti-HSV-Ig G and -Ig M in the serum, not in the CSF, as a possible etiology. Triple antibiotics and gancyclovir were administered for 21 days. Fourty-eight hours after the operation, there was a massive perilesional oedema with progressive loss of consciousness and need for intubation, mechanical ventilation, ICP-monitoring, mannitol and dexamethasone. After 10 days of intensive care, a progressive clinical and radiological improvement occurred over weeks. Three months after surgery, the patient is doing perfect, showing a normal clinical examination and ongoing radiological improvement with diminishing contrast-enhancement on MRI.

Conclusion:
We present the case of a 7 year old girl, transferred to our hospital because of a right frontal space-occupying lesion highly suggestive for a malignant brain tumor. Histology, surgical and serological findings and especially clinical and radiological evolution strongly favour a focal frontal HSV-encephalitis, mimicking a malignant CNS tumor. In the literature, such cases are extremely rare.
TREATMENT OF MULTIPLE BRAIN METASTASES WITH LEKSELL GAMMA KNIFE RADIOSURGERY: RESULTS IN 25 CONSECUTIVE PATIENTS.

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Introduction:
Radiosurgery has emerged as an important treatment modality in the management of brain metastases (BM). Existence of multiple BM is usually considered as an element of bad prognosis. Here, we report our results on tumor control and survival in patients treated for multiple BM with Leksell Gamma Knife® (LGK).

Methods:
Between December 1999 and December 2002, we treated 113 patients with 263 BM. In 25 of them, there were multiple BM (3 to 9 lesions) with a total of 111 BM treated in this group. Mean target volume for individual BM was 1138 mm³ (range 12 to 12900 mm³). The median prescription dose was 20 Gy (range: 16 to 25 Gy) at the median 50% isodose (range: 40 to 75%). Failure of tumor control was defined as an increase in lesion volume of 25% or more during radiological follow-up. Clinical status was classified using the Recursive Partitioning Analyze (RPA). Kaplan-Meyer curves were used for survival study, and the Log rank test for comparison of survivals.

Results:
Primary tumor was lung in 9 patients (36%), melanoma in 7 (28%), breast in 7 (28%), other in 1 (4%) and unknown in 1 (4%). Four patients (16%) were in RPA class III, 14 (56%) in RPA class II and 7 (28%) in RPA class I. Tumor control at the last radiological follow up was achieved in 95% of lesions. There was no new neurological deficit after LGK. Median survival was 4.6 months, which was significantly lower than median survival (13.3 months) of patients with 1 or 2 BM (p=0.045). Median survival in RPA class III patients was 2.6 months, which is significantly lower than median survival (15.2 months) of RPA class I and II patients (p=0.01). Other factors studied (gender, age, primary site, and tumor size) didn’t show significant statistical influence on survival.

Conclusions:
Our experience agrees with the literature, and suggests that LGK radiosurgery could be recommended as an alternative, even in patients with multiple BM, but in good medical and neurological conditions. In this group, it offers a high rate of tumor control, low risk of complications and longer survival.
ACUTE HYDROCEPHALUS CAUSED BY A MEGA-DOLICHO BASILAR ARTERY: CASE REPORT.

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Introduction:
Mega-dolicho basilar artery (MDBA) is a rare malformation. A few cases are described in the literature, which were found by computer tomography and confirmed by angiography. MDBA and acute hydrocephalus is rarely associated.

Case report:
A 66 years old man was admitted in emergency for recent headache and apathy with dorso-lumbar pain associated. Patient was known to have arterial hypertension, benign hypertrophic prostate, diverticulosis and peptic ulcer. The neurological examination revealed weakness and apathy. A computed tomography (CT) was done and an acute hydrocephalus has been diagnosed with a MDBA. The patient was admitted in intensive care and rapidly decreased his level of consciousness. An external derivation was done in emergency with an immediate neurological improvement. A magnetic resonance imaging (MRI) and angiography confirmed the diagnosis of hydrocephalus caused by the obstruction of the sylvius aqueduct by the MDBA and an endoscopic ventriculostomy has been done. Postoperative CT confirmed the good evolution with decrease of the ventriculomegaly.

Discussion:
MDBA is described as a widened, elongated and tortuous course of the basilar artery. About 350 cases have been reported world-wide. Many patients do not exhibit any symptoms. Cranial nerves and/or ischemic lesions are the most common manifestation. Acute hydrocephalus has been rarely associated. The mechanism can easily be explained by the compression of the Sylvius aqueduct by the MDBA provoking an obstruction of the cerebral flow. MRI and angiography are the principal methods for diagnosis. Ventriculostomy constitutes a sure and effective technique to solve the hydrocephalus and a good alternative to ventriculo-peritoneal shunt.

Conclusion:
Even if rare, MDBA must be excluded in the cause of unexplained hydrocephalus. Ventriculostomy is an elegant alternative to ventriculo-peritoneal shunt.
ALTERNATIVE SITE OF IMPLANTATION OF PULSE GENERATOR FOR S.C.S.

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Introduction:
Spinal cord stimulation is a common treatment of chronic pain. Usually the pulse generator is implanted in the abdominal wall or in the subclavicular space according to the location of the electrodes. Recently, the use of bigger generator (like Synergy®) has been responsible of some discomfort for patient. From 2001 we give the patient the possibility to choose a alternative location for the generator in the buttock region.

Material and method:
From march 2001, 17 of our patients have chosen this location for the implantation (10 Synergy® and 7 Itrel®). Incision has 6 to 9 cm length and is horizontally oriented 2 cm under posterior iliac crest, 4 to 5 cm outside middle-line. A pocket is created under the skin to receiver the generator.

Results:
This technique permit a “one session” operation, patient being positioned in ventral decubitus. The intervention is so more easy and faster. Consequently the infection risk is minimized. 16 patients describe this location as very comfortable. One of them, first implanted in the abdominal wall, has chosen the buttock because troubles when seating and has excellent result. One skinny woman implanted with a “Synergy®” describe some discomfort when lying on her back.

Conclusions:
We think the implantation in the bottom simplify the surgical act, reduce infectious risk and improve the comfort of surgeon and the patient.
A CASE REPORT OF HYPOGLOSSAL SCHWANNOMA.

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Summary:
We report a 39 year-old man who presented with a history of right glossal hemiatrophy, dysesthesia and weakness of the left extremities. These symptoms were caused by a unilateral hypoglossal schwannoma located at the cranial base. This lesion was exposed through a suboccipital, extreme lateral, transcondylar approach which was navigated with the frameless stereotactic guidance. We also describe the epidemiology, symptomatology, diagnosis, histopathology and treatment of hypoglossal schwannoma, as well as comparing our operation technique to other surgical approaches previously described for access to the cranial base region in the treatment of hypoglossal schwannoma.
CHARACTERIZATION OF GASTRIN-INDUCED EFFECTS ON EXPERIMENTAL GLIOMAS.

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Gastrin is widely distributed in the brain and can bind to CCKA, CCKB and/or CCKC receptors. We investigated the influence of gastrin on the in vitro cell cycle kinetics and migratory abilities of experimental gliomas. The influence of gastrin was also characterized in vivo in terms of the survival periods of rats orthotopically grafted with experimental models. The presence of the three receptors was determined by means of RT-PCR on 20 gliomas obtained from surgery and 3 experimental gliomas (9L, C6 and U373). The data show that 9/20 of the gliomas exhibited RNAs for the CCKB receptor as did the C6 rat glioma, 13/20 RNAs for the CCKC receptor as did the U373 human glioma and the 9L rat gliosarcoma. Of the 20 gliomas, 17 expressed RNAs for either the CCKB or the CCKC receptor (or both), a feature which was also observed in the experimental models. Excepted 9L, no glioma exhibited RNAs for CCKA. Gastrin significantly decreased the overall growth rate (determined by means of the colorimetric MTT assay) in the rat C6 and the human U373 tumor models but not in the 9L rat gliosarcoma. This effect seems to occur via a cytostatic effect. The cytostatic effect (determined by means of flow cytometry) could relate to a decrease in the amounts of the cyclin D3/CDK4 complex (determined by means of Western blotting). Gastrin also severely reduced the in vitro invasive (on a collagen matrix) and migratory (quantitative videomicroscopy) abilities of the three glioma cell lines. The gastrin-induced modifications at the levels of migration occurred by means of gastrin-induced modifications at the level of actin cytoskeleton organization. In vivo, gastrin significantly increased the survival periods of C6 and U373 glioma-bearing rats. All models have first undergone tumor debulking by means of surgery before gastrin treatment. The gastrin-induced increase in the survival of the C6 and U373 glioma-bearing rats could relate partly to the gastrin-induced cytostatic effects observed in vitro and to the decrease in tumor a gastrin can act as an endogenous modulator of glioma progression.
TREATMENT OF SPINAL METASTASES BY COMBINED DECOMPRESSIVE LAMINECTOMY AND PEROPERATIVE VERTEBROPLASTY.

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Introduction:
Metastatic disease of the spine may represent a difficult neurosurgical challenge, especially when vertebral body infiltration is associated with a large epidural extension. In these cases, none of the standard techniques, i.e. posterior laminectomy, anterior corporectomy or percutaneous vertebroplasty, is quite satisfactory in terms of spinal stability, pain relief and neurological function restoration. We propose therefore a simplified surgical technique combining decompressive laminectomy and peroperative vertebroplasty.

Surgical procedure:
After laminectomy and decompression of the spinal canal, the posterior corporeal wall is exposed. Using a large needle and a specially designed syringe, fluid radioopaque methyl methacrylate cement is injected into the vertebral body under visual and fluoroscopic control, until resistance occurs. During exothermic polymerization, the operative field is irrigated with cold water. Depending on the vertebral level, an additional osteosynthesis can be performed.

Cases report:
We describe the case of two patients (53 and 58 year-old) presenting respectively with a thyroid papillary carcinoma and a lung epidermoid epithelioma. Both developed lumbar pain and a paraparesis. MRI revealed a diffuse metastatic infiltration of the L5 and L3 vertebra, with an anterior epidural extension and a partial vertebral body collapse. A laminectomy with an open vertebroplasty and a short posterior osteosynthesis was performed in the two cases. After surgery, pain and neurological deficits completely disappeared. The patients received postoperative radiotherapy. No further instability was observed.

Conclusions:
Although the posterior approach is easy and feasible at any level, it cannot solve the problem of the vertebral body collapse. On the other hand, the anterior approach offers adequate spinal stability but may be hazardous at some thoraco-lumbar levels and does not allow decompression of the posterior part of the canal. Percutaneous vertebroplasty can be effective for pain relief, but can be performed only when the posterior corporeal wall is not disrupted. The combined technique we recommend is not only simple and minimally aggressive but also allows an optimal decompression of the vertebral canal as well as a stabilization of the vertebral body. Furthermore, heating of the metastatic deposits during polymerisation of the cement might have a local anti-tumoral effect.
CLINICAL EVALUATION OF ELECTRO-MAGNETIC TRACKING FOR CRANIAL IMAGE-GUIDED NEUROSURGERY: A SERIES OF 10 CASES.

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Introduction:

Frameless image-guided neurosurgery systems are based on a 3D-localizing device that tracks the position of surgical tools in the operating room (OR). Common 3D localizers are either mechanical (arms, robots) or optical (cameras). Recently, electro-magnetic tracking devices (EM) have been introduced for pinless cranial applications. We used this new technology in 10 cranial procedures to evaluate its behavior in terms of accuracy, reliability, ease of use and overall clinical benefit.

Material and Methods:

Since October 2002, we enrolled 10 patients: 6 women and 4 men, aged from 36 to 81 years old (mean 62 years). Lesions were 3 meningiomas, 4 gliomas, 1 cavernoma, 1 pericallosum aneurysm and 1 cerebral metastasis.

Medtronic/SNT StealthStation® Treon™ EM surgery navigation system provides a viewing workstation and an electro-magnetic navigation cart. The Transmitter Coil Array (TCA), a triangular cushion covered device producing a cubic magnetic field (45x45x45 cm$^3$) secured to the operating table is proposed as head holder. Provided tools are a pointer and a miniature screw-based patient reference frame equipped with internal coils that allow the tracking of their position as far as they are included in the magnetic volume of the TCA.

Results:

With current pre-release, patient setup procedure is still not optimal because of the lack of an appropriate head holder. Registration procedure was very quick compared to other tracking techniques. Placement of the reference frame was not a problem. Registration accuracy was estimated below 2mm for the lesion location and remained valid throughout surgery. Tool tracking was very easy thanks to the suppression of line-of-sight problem. Tracking response was very quick. Interference with large metallic retractors invalidated navigation in one case. No movement of the reference frame or loss of patient tracking was observed for the other cases. Operating microscope did not generate any interference.

Conclusion:

The equipment was of a great help in reaching deep-seated lesions with minimum trauma. Low setup time and ease of use makes this technology an excellent candidate for wide use of cranial navigation provided head holder issues are addressed in the final release. Future applications where its ability to track non-rigid tools will be applied will certainly be of great interest.
POSTERIOR CERVICAL SCREW FIXATION FOR COMPLEX CERVICAL INSTABILITY. TECHNIQUE, ADVANTAGES AND LIMITATIONS.

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Introduction:
Posterior cervical instability, especially when it is involving the craniocervical or cervicothoracic junction, is a therapeutical challenge. This is also the case when an anterior approach for anterior located pathology is impossible for different reasons. Screw fixation has been proven to offer the most stable result. Options for the craniocervical junction are transarticular or isthmic screw fixation or (exceptionally) bridging the C1-C2 level. At lower cervical levels we prefer lateral mass screws, except for the cervicothoracic junction where pedicle screws are the best choice.

Methods:
We present a series of seven patients with multilevel posterior cervical screw fixation. Four patients underwent posterior cervical screw fixation involving the craniocervical region for the treatment of posttraumatic or neoplastic instability. One further patient showed a multilevel cervical stenosis and unstable anterolisthesis C7-T1, one patient was treated for cervical instability after complicated anterior surgery and the last one was treated for late posttraumatic instability due to a subluxated facet joint. Four examples are shown where we preferred other treatment options than posterior screw fixation.

Results:
In all our patients with screw fixation, we obtained a stable intraoperative fixation. During the follow-up there was no evidence for residual or recurrent instability. All patients with a deficit demonstrated neurological improvement and most experienced a decrease in pain. One patient developed progressive kyphosis on an adjacent level for which an anterior fusion was performed.

Discussion:
Posterior cervical screw fixation is a demanding but efficient technique for difficult posterior cervical stability problems. Technical aspects, advantages and limitations of the technique and the different available devices are discussed.
AGGRAVATING VASOGENTIC EDEMA AFTER EXPERIMENTAL CLOSED HEAD INJURY USING INTRACAROTID-INJECTED ULTRASOUND CONTRAST AGENTS WHICH DESTABILIZE THE BLOOD-BRAIN BARRIER IN RATS.

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Introduction:
It is known that the blood-brain barrier (BBB) plays an important role in the pathophysiology of central nervous system disorders e.g. neurotrauma. Experimental models of CNS-injury based upon destabilization of the BBB might therefore be of benefit to understand the pathophysiology of increased intracranial hypertension.

Aims:
To characterize BBB damage induced by ultrasound contrast agents and their possible use to amplify vasogenic edema after experimental closed head injury (CHI).

Material and Methods:
Male Spraque-Dawley rats were injected with Evans Blue IV followed by intracarotid injection of Optison®, Levovist®, Intralipid or saline. Intracarotid injections were either alone or combined with CHI. Rats survived 90 minutes after the injections.

Results:
Both Optison® and Levovist® administration produced a macroscopic dose dependent blue staining of the ipsilateral hemisphere, and microscopical lacunar zones of vasogenic edema. In these regions neurons were slightly coagulated indicating an early stage of neurodegeneration. In the contralateral hemisphere these effects were not seen. Combination of Optison® or Levovist® and CHI resulted in a high mortality. Macroscopic or microscopic vasogenic edema was not present after CHI alone, saline alone or after saline injection followed by CHI.

Conclusions:
This study clearly shows that intracarotid injection of the ultrasound contrast agents Optison® and Levovist® induces extravasation in the rat brain. Both agents also considerably amplify the pathology after CHI, as could be derived from the increased mortality and a more pronounced macroscopic and microscopic pattern of extravasation when given in combination with mild CHI.
EXPERIENCE WITH GAMMA KNIFE RADIOSURGERY IN THE TREATMENT OF INTRACRANIAL MENINGIOMAS.


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Introduction:
Radiosurgical treatment of intracranial meningiomas has become a valid treatment as an alternative or a complement to conventional neurosurgery. The aim of this study is to evaluate our early results in the treatment of meningiomas with Leksell Gamma Knife (LGK) radiosurgery, with emphasis on the clinical and radiological outcomes.

Methods:
Between December 1999 and December 2002, we treated 510 patients with LGK radiosurgery. Among them, there were 97 (19%) intracranial meningiomas. All patients underwent a prospective clinical and radiological follow up after LGK, at 6 and 12 months, and then annually; 58 patients with a follow-up of 6 months or more were applicable for this study. The local tumor control (LTC) was based on the size of the treated lesion on MR, defined as stable/unchanged, decreased or increased compared with the scans obtained at the time of radiosurgery. Similarly, the clinical outcome was classified as stable/unchanged, improved or worse, as compared to the pre-operative condition.

Results:
There were 39 women and 19 men; age ranged from 31 to 83 years (median: 57 years). Radiosurgery was the first treatment in 26 patients (43%) and in 32 patients (57%) radiosurgery was given as complementary therapy after open surgery (13 recurrences, 17 post-operative residues, 2 cases where surgery failed). The locations of meningioma was the supratentorial skull base in 30, the infratentorial skull base in 17, the convexity in 8, parasagital in 2 and the posterior fossa in 1 patients. There were 1 atypical, and 4 multifocal meningiomas. The mean target tumor volume was 5072 mm³ (ranging from 131 to 19800 mm³). The mean peripheral prescription dose and isodose were 13.4 Gy (ranging from 12 to 16 Gy) and 50% (ranging from 40 to 55%), respectively. LTC was achieved at the last follow up control in 52 of the 53 patients with focal benign meningiomas (actuarial LTC: 98% at 3 years). The symptoms were unchanged in 39, improved in 18, and worsened in 2 patients.

Conclusion:
Radiosurgery is an useful alternative in the management of meningiomas, especially in patients with contraindications of open surgery, or as an adjunct therapy after partial resection.
AN UNUSUAL CASE OF CEREBRAL CAVERNOMATOSIS.

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Introduction:
Cerebral cavernous angiomas are recognised as incidental or symptomatic, unique or multiple, sporadic or familial vascular malformations and responsible for an incidence of symptomatic hemorrhage of 1.1% per. For unclear reasons, some of them display features that make them dynamic lesions especially in familial forms. We present a case of sporadic multiple cerebral cavernomatosis who presented a 13-year delay rebleeding from a de novo cavernoma after successful removal of a pteryonal meningioma.

Case report:
A 25 year-old man, with no familial history had presented at the age of 12 a right rolandic intracerebral hemorrhage from a cavernoma. Multiple lesions were noted on MRI. The radiological follow-up showed size progression of the pre-existing lesions and appearance of new cavernomas. Recurrence of seizures, 13 years later, led to diagnose a right temporal meningioma. Surgical removal of the tumor was uneventful but 4 weeks later, the patient related a progressive loss of strength in his left hand. A new MRI showed a new hemorrhage in the inverted omega-shape of the right central sulcus, from a de novo cavernoma. The lesion was removed. After a transient deficit worsening, the patient recovered normal strength.

Discussion:
We review the literature concerning the natural history of multiple cavernomas, the mechanisms of growth and of appearance of de novo lesions, the association with meningiomas and the management of multiple cavernomas.

Conclusion:
Sporadic multiple cerebral cavernomatosis can behave as familial forms and is a dynamic disease. A prior hemorrhage increases the risks of rebleeding. The association with meningioma is exceptional. These patients require careful follow-up monitoring, and significant changes in neurological symptoms warrant repeat MR imaging. Surgery should be considered only for lesions that produce repetitive or progressive symptoms.
INTRAVENTRICULAR NEUROCYSTICERCOSIS: A CASE REPORT.

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**Introduction:**
Neurocysticercosis is the most common parasitic disease of the central nervous system. The disease is caused by deposition of larvae of Taenia solium in cerebral parenchyma, meninges and spinal cord.
The ventricular system of the brain is affected by cysticerci in two different ways; by the presence of intraventricular cysts and by the development of granular ependymitis.

**Case report:**
A 53 year old Bolivian male was found comatose (GCS: 7/15) at home.
The CT on admission showed acute hydrocephalus with signs of raised intracranial pressure without obvious cause. The patient was intubated and a ventricular drain was placed.
A day later, the patient was successfully extubated.
An MR image of the brain demonstrated a 1,5x1x1 cm lesion in the floor of the third ventricle, obstructing the aquaductus.
Additional MR images a few days later revealed that the lesion had migrated into the body of the right lateral ventricle. Removing the ventricular drain did not result in ventricular dilatation.
By ventriculoscopy, the cyst was successfully aspirated. Histopathological studies of the lining of the bilobular cyst was consistent with that of a cysticercosis cyst.

**Discussion:**
Approximately 17% of patients with neurocysticercosis have intraventricular cysts which tend to occur in isolation. When the cysts are viable, they do not adhere to the ependyma and can migrate through the ventricular system.
MR imaging is preferable to CT scanning for demonstration of intraventricular cyst. This modality demonstrates that the cyst is usually isointense to CSF in all phases (T1, T2).
In the different stages of involution of the parasite, the fluid component in the cyst becomes turbid and gelatinous, probably because of debris and proteinaceous material within it. This makes the radiological presentation highly variable.

**Conclusion:**
Intraventricular cysticerci cysts can migrate through the ventricular system causing mechanical obstruction at the foramina.
Intraventricular cysticercosis should be considered in the differential diagnosis of intraventricular tumours not just in developing countries where it is endemic but in developed countries as well because of increasing travelling and immigration.
BIOMECHANICS OF CORTICAL CONTUSIONS.

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Introduction:
The frontal and temporal lobes are known predilection sites for cortical contusions. This has been attributed to the relative skull/brain motion and the rough surfaces of the skull base. However, this hypothesis has never been proven. It has been hypothesized that skull/brain decoupling occurs in impacts with frequencies higher than 150 Hz, but this hasn’t been proven either. To gain insight in the mechanical pathogenesis of frontotemporal contusions, impedance studies on a human cadaver were combined with relative motion measurements. Further, the vibration characteristics of the skull base were studied.

Methods:
Occipital impacts were delivered on an unembalmed cadaver by a steel pendulum. Skull acceleration and impact force were measured. The impedance was calculated from the Fast Fourier transformated signals. Subsequently, an accelerometer was placed in the frontal lobe. Impacts were given with varying impactor velocities and varying stiffnesses of the impactor surface. The relative skull/brain motion was calculated by double integration of the acceleration signals.
A modal analysis of a dry human skull was performed. A random vibration was imposed on the skull by a shaker. The resultant acceleration in 54 points of the skull was measured. The data were processed using CadaX software.

Results:
The head impedance curve consistently showed a peak at 150Hz and at 300-400Hz. All impacts resulted in a backward motion of the brain, but this was followed by a subsequent forward motion only in impacts with frequencies exceeding 400 Hz. The maximum amplitude of the motion was higher in low frequency impacts.
Most eigenmodes were associated with high vibrational amplitudes of the orbital roofs, ala major and temporal squama. This phenomenon was most pronounced at eigenfrequencies 986 and 1434 Hz.

Conclusion:
Our data suggest that the skull/brain boundaries are indeed frequency-dependent. However, skull/brain decoupling is also present at low frequency impacts and the relative motion amplitude is highest in low frequency impacts. This suggests that it is not the relative motion itself that provokes the frontotemporal contusions. The vibration of the skull underlying the frontal and temporal lobes, maximal at frequencies that are encountered in human cadaver impacts, may be a contributing mechanism.
CEREBELLAR HEMORRHAGE AFTER SPINAL SURGERY : A CASE REPORT.

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Introduction:
Remote cerebellar hemorrhage (RCH) is an extremely rare complication associated with intradural spine surgery. A plausible explanation is that, due to loss of cerebrospinal fluid (CSF), hemorrhagic venous infarction occurs secondary to obstruction of draining veins, caused by a cerebellar "sag", as a result of intracranial CSF hypovolemia.

Methods:
A case is reported of a 52 year old male who underwent resection of an intramedullary glioma (astrocytoma grade 2) at the level of the conus medullaris causing preoperatively severe ischialgia. The patient recovered well but on the second postoperative day, he develops an intracerebellar hematoma.

Results:
The cerebellar hematoma was evacuated and the dorsolumbar wound was reopened, showing no leak of CSF at all. Two years after surgery now, the patient has no residual cerebellar signs.

Conclusion:
The possibility of RCH should always be considered if unexplained neurological deterioration occurs after an intradural spine procedure. In our case the previously mentioned theory of venous infarction due to cerebellar "sagging" is difficult to maintain because the patient was operated in a very slight degree of head down; there was no postoperative postural headache nor CSF leak. However, the dural opening and peroperative CSF loss is the only common factor between our case and the five reported cases in the litterature. Perioperative findings and the possible causative role of patient positioning are discussed.
CROHN’S DISEASE COMPLICATED BY A DISSEMINATED SPINAL AND INTRACRANIAL INTRADURAL EMPYEMA: A CASE REPORT.

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Introduction:
A spinal abscess is an unusual complication of Crohn’s disease. The few described cases are located extradurally and present with back pain and rarely with neurological signs. We present a case of an intradural spinal empyema with upward migration to the craniocervical junction and presenting with hydrocephalus because of brainstem compression.

Case Report:
A 36-year-old male patient was known with Crohn’s disease which primarily affected the sigmoid colon with fistulization and presacral abscess. He was transferred to our Hospital because of a subacute coma due to a supratentorial hydrocephalus. After an emergency external ventricular drainage showing normal CSF, there was a recovery of consciousness. He still had diffuse sensory deficits in the legs, with a peri-anal anaesthesia. Sphincter function was absent.

MRI showed meningeal enhancement with gadolinium from the sacral region to the posterior fossa and fluid collections at the lumbosacral level and craniocervical junction. The latter were located posterior to the cerebellum and upper cervical spinal cord, with an anterior displacement of the brainstem and a cranial displacement of the cerebellum.

A posterior fossa decompression was performed with removal of a subdural encapsulated empyema. An ileostoma was performed one day after.

Finally a lumbar laminectomy was performed which surprisingly showed complete destruction of the lumbosacral dura by an extra- and subdural empyema.

Cultures showed streptococcus, coagulase negative staphylococcus and yeasts. Broad spectrum antibiotic treatment for 6 weeks followed these procedures and the external drainage could be removed.

There was a gradual and complete recovery of cognitive function, sensory and motor deficits as well as sphincter and sexual function. At one year follow up there were no residual symptoms.

Conclusion:
To our knowledge, this is the first case of intradural infection in continuity with presacral abscesses. This case proves that long-lasting inadequate treatment of Crohn’s abscesses can cause important life-threatening neurological complications because of extension into the intradural space and CSF dissemination.
We present a case of a 43-year-old Caucasian male, who was admitted to our hospital in a state of confusion and agitation. He has a long neurological history starting 1.5 years earlier. Following a lumbar discectomy, he developed fever and signs of meningeal irritation and CSF analysis confirmed the diagnosis of bacterial meningitis. However, since standard antibiotic treatment failed, tuberculous meningitis was suspected and he was treated accordingly and successfully. A few months later an in situ adenocarcinoma of the stomach was discovered and removed. The antituberculous treatment was interrupted at that time. Following a relapse four months later, an intramedullary abscess was diagnosed at the level of the 10th dorsal segment. PCR analysis of the punctate turned out to be positive for Mycobacterium tuberculosis and the antituberculous treatment was reinstalled. Because of treatment failure and continuous neurological deterioration a brain MRI scan was performed and showed many small tuberculomata. A few months later the patient was referred to our hospital. Diagnosis of tuberculous meningitis was confirmed on brain biopsy. Because of lack of efficiency of the usual oral combination therapy, a treatment with intraventricular rifampicin was started. An intraventricular Ommaya drain was placed under local anesthesia with a right frontal approach. For 50 days 1cc (5mg) was injected daily under strict aseptic conditions into the Ommaya reservoir subcutaneously after removing 2cc of CSF. After the injection of the rifampicin, the drug was flushed with 1cc saline.

The patient’s speech and cognitive functions improved gradually. A brain MRI performed two months after starting this intraventricular therapy revealed a regression in size of the tuberculomata and even the disappearance of some lesions.

This case report illustrates that intraventricular administration of rifampicin may be an alternative for treating tuberculous meningitis, relapsing despite adequate oral drug therapy and illustrates that when oral anti-tuberculous treatment fails, intraventricular administration of rifampicin is a safe, well-tolerated and effective treatment of tuberculous meningitis.
**PRELIMINARY EXPERIENCE WITH THE USE OF A LARGE INTERCORPORAL CARBON CAGE FILLED WITH ALLOGRAFT BONE WITH ANTERIOR PLATE FIXATION AFTER CERVICAL CORPECTOMY.**

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**Introduction:**
Anterior approaches to the cervical spine, first described in the 1950’s, have become widely accepted in the treatment of cervical spine disease. In cases of tumor of the vertebral body or in lesions involving multiple levels and extending posteriorly to the vertebral body, a corpectomy may be indicated. The structural integrity of the anterior column may be restored with autograft (fibula or iliac crest) or allograft bone eventually combined with anterior plate fixation. In the literature on cervical corpectomy events such as non-union, deformity, graft extrusion and hardware failure account for 9 up to 44 % of the reported complications. To avoid these problems the use of a large intercorporal poly-ether ether ketone (PEEK) cage containing allograft bone combined with anterior plate fixation after cervical corpectomy was evaluated.

**Methods:**
We evaluated prospectively 13 patients in which anterior cervical corpectomy was performed. The anterior column was restored by using a large intercorporal carbon (PEEK) cage filled with allograft bone and anterior plate fixation. The mean length of the used cages was 35 mm (range 24 – 46 mm). Six patients had previously undergone anterior-approach surgery. Most patients had a multilevel degenerative spinal stenosis with myelopathy (5 patients) or radiculopathy (6 patients). Two patients had a vertebral body tumor.

**Results:**
The average follow-up period was 9 months (range 1 – 20). Excellent clinical outcomes were found among the patients with radiculopathy and vertebral body tumor. Notwithstanding proven good decompression of the cervical medulla, patients with myelopathy showed only stabilisation or small improvement of the neurological status. All patients had a solid stability of the cervical spine. There were no graft related complications.

**Conclusion:**
The use of a large intercorporal carbon (PEEK) cage filled with allograft bone in combination with anterior plate fixation seems to be a promising procedure in restoring the anterior column integrity after cervical corpectomy. In all cases this technique provided a solid stability of the cervical spine. There were no graft related complications. Neurological results depended on the nature, duration and severity of the preoperative neural compression.
A MULTICENTER, PROSPECTIVE, RANDOMIZED, STUDY OF AN ARTIFICIAL CERVICAL DISC VERSUS FUSION FOR PRIMARY CERVICAL DISC SURGERY.

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Introduction:
A prospective, randomized, controlled study has been conducted to compare the clinical outcomes of patients treated with an Artificial Cervical Disc to patients who receive fusion after cervical discectomy for the treatment of primary cervical disc disease.

Materials and methods:
In four centers, 60 patients with primary, single level cervical disc disease producing radiculopathy and/or myelopathy are randomized prospectively to receive anterior cervical discectomy with either fusion or artificial cervical disc placement. Ethics committee approval of the study as well as patient informed consent was obtained prior to randomization. The patients are evaluated with pre and postoperative serial flexion-extension cervical x-rays at 6 weeks, 3, 6, 12, and 24 months. Preoperative MRI is used to confirm the single level cervical disc lesions. At the same intervals, the patients have pre and postoperative neck disability indexes, visual pain analogue scales, European myelopathy scores, SF-36 general health scores, and neurological status examinations assessing the patient’s reflex, motor and sensory function. All data will be analyzed, however, the primary endpoint is the Neck Disability Index.

Results:
This preliminary report presents the results in the first 45 patients. Data has been analyzed through the 12 month postoperative interval. No device related complications have occurred. Improvement in all clinical outcome measures has occurred in both treatment groups, however, patients treated with the artificial cervical disc have demonstrated greater improvement than patients receiving fusion.

Conclusion:
Our previous experience has demonstrated the safety and efficacy of the artificial cervical disc for patients undergoing adjacent disc surgery after previous cervical fusions. This primary disc study is aimed at ultimately reducing the rate of occurrence (2-3%) of developing adjacent cervical disc disease in those patients who receive anterior fusion. The preliminary results are encouraging.
Introduction:
Subtotal corporectomy without fusion (SCWF) is a misunderstood surgical procedure used in the treatment of spondylotic myelopathy. This clinical study was performed to evaluate the efficiency of the SCWF. Long term neurological status and cervical spine stability were specially addressed.

Methods:
77 patients, operated between 1990 and 1998, were evaluated. The average follow-up period was 53 months (10-111 mo). To assess the severity of the neurological symptoms, a functional seven-point classification scale (1) was used. Discriminant analysis was applied as statistic.

Results:
There was a significant correlation between outcome, functional preoperative score \(r=0.67; p<0.0001\) and age \(r=0.35; p<0.0017\). No secondary cervical instability was observed. On the contrary, on the basis of late 3D CT Scan, there exists, after a few years, a true rebuilding of the cervical bone with spontaneous fusion and respect of the cervical cord decompression.

Conclusions:
We conclude that the SCWF is a safe and efficient treatment for cervical spondylotic myelopathy. Clinical myelopathy severity and age are significant predictors of the outcome. No fusion is required regardless of the number of levels, providing there is no preoperative instability. This surgical procedure which does not require any cervical immobilization considerably decreases the surgical risks and the costs imposed on the society.
Preliminary results of the dynamic lumbar disc prosthesis (Prodisc®): a study of 65 cases.


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Introduction:
Degenerative disc disease has been treated in the past by interbody fusions, with a posterior or anterior approach. Total disc replacement by a dynamic prosthesis has been forwarded as a treatment option for degenerative disc disease. In a prospective study we evaluate the use, effectiveness and post-operative outcome of the dynamic lumbar disc prosthesis.

Methods:
In this study we included 63 patients (n=63) and 65 disc replacements. The prostheses were implanted through a minimally invasive anterior retroperitoneal approach. 61 patients were operated on one level, 2 patients were operated on two levels. We operated on 21 male and 42 female patients (male / female ratio = 1 :2).
Pre-operative and post-operative evaluation of each patient was done and included radiographs of the lumbar spine, physical examination. Subjective evaluation by the patient according to the Oswestry scale was also obtained.
The discs were implanted at the L3-L4 level in 2 patients, L4-L5 level in 34 patients and the L5-S1 level in 29 patients.
Follow-up period ranged between 6 months for 43 patients (68.2 %) and 12 months (31.8%). Number of visits was minimally 3.

Results:
In 90 % of the patients excellent results were observed after a minimum of six-months follow-up. In 6.8 % good results were recorded. Fair results were seen in 3.2 %.
Operating time varied between 75 and 160 minutes. No evidence of anterior or posterior migration of the prosthesis was seen. In two patients (3.2 %) postoperative bleeding was seen, but no reintervention was needed.

Conclusions:
The favorable preliminary results suggest that total disc replacement by this dynamic lumbar prosthesis might be a good alternative to lumbar fusion. Long-term studies are needed to confirm these first results and to investigate if problems such as wearing or loosening of the prosthesis will occur.
SYMPTOMATIC SYRINGOMYELIA ASSOCIATED WITH AN ARACHNOID WEB, A QUESTION OF RESTORING THE NORMAL CSF FLOW?

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Introduction:
The use of syrinx shunting procedures has been largely practised. However, this procedure has a questionable value; the risk of a myelotomy, the tendency of shunts to block and the risk of gliosis of the cord with worsening of the symptoms.
In syringomyelia associated with arachnoid webs or pouches, we believe that the resection of the obstructing arachnoid abnormalities, without any shunting, is a good alternative and a less invasive treatment.

Methods:
We report three patients with progressive symptomatic syringomyelia with no readily predisposing factors.
The preoperative MRI myelography showed an arachnoid abnormality in two cases.
One patient was found to have an arachnoid web at the time of operation.
The three patients underwent a laminectomy and a resection of the obstructing arachnoid web.

Results:
One patient had a good clinical improvement and a collapse of the syrinx on postoperative MRI.
Two patients had a clinical stabilisation and in one of these cases a collapse of the syrinx was demonstrated on postoperative MRI.

Conclusion:
We conclude that the first treatment of choice in syringomyelia associated with an obstructing arachnoid web is surgery directed to restore the normal CSF flow by resecting the arachnoid abnormality and that this approach is an efficient and less invasive alternative to syrinx shunting.
THE MICROANATOMICAL ENVIRONMENT OF THE STN AND SURROUNDINGS: PROPOSAL FOR A NEW TARGETING METHOD.

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Introduction:
High frequency stimulation of the subthalamic nucleus (STN) is nowadays a widely performed method to treat idiopathic Parkinson's disease. There is no consensus regarding the best technical approach to this surgery. The aim of this preliminary study is to reconsider the microanatomy of the STN and make a proposal for a new targeting method.

Methods:
During postmortem investigation on a human brain a cubicle of tissue in the area around the STN was isolated. This brain tissue was scanned in the three orthogonal planes using a high field MR device at 9.4 Tesla with a slice thickness of 1 mm. The images generated this way were compared to photographs of conventionally stained slices of brain tissue in different neuroanatomical books.

Results:
The STN is recognizable in the scans. In all three of the orthogonal planes it appears as a biconvex lens. The laterocaudal tip of the nucleus adjoins the rostral part of the substantia nigra. More cranially, the STN is situated mediadorsally to the cerebral peduncle. Other recognizable structures are the superior colliculus, medial and lateral geniculate bodies, red nucleus and several tracti. The STN is located in the same plane as the posterior commissure and the mammillary bodies.

Conclusion:
High field MRI scanning is an appropriate method to visualize the microanatomy of the STN and surroundings. The images allow an optimal analysis of the microenvironment of the STN in the three orthogonal planes. Instead of using AC-PC-based coordinates, it might be better to use the line connecting the CM and PC as internal reference for targeting the STN. The latter is more logical because the STN itself is situated in the same plane as the two mentioned structures.
**EVALUATION OF ENDOSCOPIC THIRD VENTRICULOSTOMY BY MAGNETIC RESONANCE IMAGING.**

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**Introduction:**
We evaluated the clinical usefulness of magnetic resonance imaging (MRI) in flow void mode, to verify the patency of the third ventricle after a per-operative successful endoscopic procedure. The absence of cerebrospinal fluid (CSF) flow on MRI imaging may predict the necessity for a shunt procedure.

**Material and Methods:**
Over a period of one year seven hydrocephalic patients (i.e. aquaductstenosis, fossa posterior tumor) underwent endoscopic third ventriculostomy (MINOP Microinstruments, AesculapTM). Early (< 3d) post-operative MRI flow void imaging evaluated patency of the third ventricle. Patency was analyzed by CSF flow velocity measurements through the flour of the third ventricle.

**Results:**
In five patients CSF flow was visualized through the ventriculostomy by dynamic MRI study. These patients also had a beneficial clinical outcome. MRI imaging of two patients showed no CSF flow. A shunt procedure was necessary in these patients; one patient underwent previous fossa posterior surgery whereas the other suffered multiple episodes of arachnoiditis.

**Conclusion:**
Patency of the third ventriculostomy after per-operative successful endoscopic procedure can be evaluated by early MRI flow void imaging. A correlation between good clinical outcome and visualization of CSF flow through the ventriculostomy was demonstrated. However, the small sample size in this study warrants further investigation, quantification and confirmation of the CSF flow.
Combining Magnetic Resonance (MR)- and Positron Emission Tomography (PET)-Guided Radiosurgery for Brain Tumors Treated with Leksell Gamma Knife® (LGK)

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Introduction:
Integration of PET in LGK radiosurgery is a project with Elekta R&D, as part of our ongoing developments with the use of PET in image-guided neurosurgery. The goal is [1] to improve targeting in recognized indications (metastasis, pituitary adenoma), [2] to optimize targeting for more novel indications (i.e. infiltrative and primary tumors).

Methods:
Forty-six patients with recurrent brain tumors were treated using combined guidance of PET and MR for the dosimetry planning. This represents 10% of the patients treated with LGK during this period. There were 30 gliomas (5 pilocytic astrocytomas, 8 low-grade astrocytomas or oligodendrogliomas, 7 anaplastic astrocytomas or ependymomas, 10 glioblastomas), 2 neurocytomas, 1 ganglioglioma, 5 metastases (single or multiple), 8 pituitary adenomas. PET with FDG was used in 24 cases, mostly (21 cases) for the identification of specific areas of high metabolism within malignant primary tumors and metastases. PET with methionine was used in 22 cases, mostly (20 cases) to define tumor limits in benign primary tumors and pituitary adenomas. The final target selection also takes into account the nature of the tumor, the clinical condition, and the prognosis.

Results:
PET provided contributive data in 43 cases (93%) and the information were specifically used to adapt the target volume in 35 cases (76%). Preliminary analysis shows that this approach is accurately applicable in clinical routine and that it provides additional information significant benefit for the patients with primary or metastatic recurrent brain tumors. The use of PET-MET to guide LGK in recurrent pituitary adenomas helps to differentiate between the normal residual pituitary gland, the scar tissue and the residual or recurrent adenoma. PET also appears to be useful for the pre-treatment (i.e. for defining the indications for radiosurgery) as well as the follow-up (i.e. for assessing the response to radiosurgery) evaluations of these patients.

Conclusions:
The integration of PET metabolic data influences the targeting of LGK radiosurgery, which may benefit to selected indications. Stereotactic PET also allows to accurately compare PET-based metabolic data with MR-based anatomical data which contributes to better understand the metabolic changes associated with radiosurgery.
RADIOSURGERY AS A TREATMENT FOR PATIENTS WITH BRAIN STEM METASTASES. A THERAPEUTICAL OPTION.


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Introduction:
Efficacy of radiosurgery for the treatment of brain metastases (BM) has been well demonstrated in the literature, but there are few specific information about patients with brain stem (BS) metastases. Because this location has been considered as an ominous clinical element, we thought to study our experience with Leksell Gamma Knife (LGK) radiosurgery in BS metastases.

Methods:
Of a total of 113 patients treated for BM at our institution between December 1999 and December 2002, there were 10 patients with 11 BS metastasis. Volume of the lesions ranged from 0.034 to 2.4 cc (mean 1.053 cc). Treatment was made with a LGK C, with a peripheral mean dose of 19 Gy (range: 15 to 24 Gy) at a mean isodose of 55% (range: 50 to 68%). Stratification of patients according to severity of the disease was done using the Recursive Partitioning Analyze (RPA). Survival was studied using actuarial Kaplan-Meyer curves and Log rank test for survival comparisons.

Results:
The primary tumor was lung in 7 patients, breast in one, melanoma in one, and colorectal in one. Single metastasis was observed in 5, double in 1 and 3 or more in 4 patients. Six lesions were located in the pons, 3 in the medulla oblongata and 3 in the mesencephalon. Four patients were classed RPA III, 3 RPA II, and 3 RPA I. All patients were clinically followed; radiological follow up was available in 7 patients (8 lesions). Local tumor control was achieved in all radiologically controlled lesions, and there were no radiosurgery-related complications. Median survival was 11.1 months, which is similar to the median survival (13.2 months) in patients with brain metastases outside the BS (p= 0.47). There was a slight tendency to a better survival in RPA I patients in comparison with RPA II and III patients, but this difference is not statistically significant (p= 0.26).

Conclusion:
LGK radiosurgery is an effective treatment for BS metastases. It seems that rather than location, outcome of these patients is determined principally by neurological and oncological conditions at treatment.
**Gamma Knife Treatment of Cavernous Sinus Lesions is Safe and Effective. An Experience of 36 Patients.**

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**Introduction:**
Surgical removal of lesions located into the cavernous sinus is associated with a significant morbidity. Gamma Knife radiosurgery represents an interesting therapeutic alternative for these lesions.

**Material and Methods:**
From February, 2000 to December 2002, we have treated 36 patients with a lesion involving the cavernous sinus with Gamma Knife radiosurgery. There was 29 women and 7 men; age ranged from 22 to 82 years (median 54). All patients underwent a periodic clinical and radiological follow-up after the radiosurgical procedure.

**Results:**
There was 32 meningioma, 1 Vth nerve schwannoma, 1 metastasis, 1 chordoma and 1 dural fistula. The lesion was located completely or partially inside the cavernous sinus for respectively 14 patients (39%) and 22 patients (61%). For 15 patients (42%) GK radiosurgery was the first surgical procedure performed; the lesion treated was a postoperative residue, an evolutive residue after surgery or a recurrence for respectively 9 (25%), 8 (22%) and 4 (11%) patients. Eight patients had a follow-up of less than 6 months or were lost of follow-up and were excluded from this study. Follow-up duration ranged from 6 to 30 months (median: 19 months) for 28 patients. No patient had a significant increase of the volume of the lesion on last MRI; 18 patients had a stable volume and 10 showed a significant decrease of the lesion volume. No patient developed a new neurological deficit during the follow-up period. Twenty-eight patients (93%) had no increase of their preoperative neurological deficit; 1 patient increased his trigeminal pain after GK radiosurgery; 1 patient with a suboptimal Gamma Knife treatment related to the proximity of the lesion to the optical pathway worsened his visual field.

**Conclusions:**
Gamma Knife radiosurgery represents an effective and safe therapeutic option for the management of selected lesions located into the cavernous sinus, either as the primary treatment, or as a complement to surgery.
THE ROLE OF PERFUSION-WEIGHTED IMAGING IN BRAIN GLIOMA: A PROSPECTIVE STUDY.

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Object:
Neuroimaging plays a paramount role in brain gliomas to define the optimal surgical approach and predict the tumor grade. Because gliomas are typically heterogeneous and therapeutic strategies depend on the tumor grade, histopathological samples must be obtained within areas bearing a higher yield for malignancy. Standard MR imaging remains however unable in up to 40\% of cases to differentiate low- from high-grade gliomas.

Methods:
We studied how did Perfusion-weighted MR imaging (PWI) correlate with the tumor grade and evaluated its predictive value in a prospective series of 55 patients with newly diagnosed cerebral glioma, during a 5-year follow-up period. PWI is a noninvasive imaging method based upon time-intensity curve analysis of the susceptibility effects produced by the first pass of an intravenous bolus of Gadolinium using echo-planar sequence. Considering the existing differences between the maximum relative cerebral blood volume (rCBV) ratios of the different glioma grades, we preoperatively evaluate the contrast enhancement and the tumor activity on PWI in all cases. In 29 cases treated by stereotactic biopsy, the targets were chosen in areas with the highest rCBV ratios.

Results:
PWI was able to detect malignant areas even when non-enhancing. PWI data correlated significantly with the tumor grade with a specificity of 93.3\% and a sensitivity of 97.5\%
. Hyperperfusion presented a significant negative correlation with both survival time and final outcome (p<0.01).

Conclusions:
We found PWI very useful in the routine assessment of cerebral gliomas. PWI was able to detect microvascular alterations related to neoangiogenesis in malignant gliomas, correlating significantly with the tumor grade and the final outcome.
AWAKE CRANIOTOMY IN BRAIN TUMOUR SURGERY.

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Introduction:
Since a positive correlation seems to be proved between the extent of particularly glial tumour resection and survival, the challenge exists to remove as much tumour as possible without causing any additional neurological dysfunction. The major problem consists in the possible invasion by tumoural cells of functional tissue, as has been proven by many reports.

Methods:
In highly functional neurological areas, in both cortical and infra-cortical regions, only direct cortical electrical stimulation can provide safety in defining the resection margins.
In the precentral motor area, stimulation can be applied in anesthesized patients; however, testing of language or sensory cortical areas, or testing of supplementary motor area necessitate patient’s collaboration, so awake monitoring is needed. For the patient’s comfort, a tuned anesthesia (asleep, awake, asleep) is preferred in our center, since the collaboration of the patient is only required during stimulation, which rarely exceeds more than one to one and a half hour. We use preoperative mapping with functional-MRI, combined with the anatomical data of neuronavigation, to determine the exact positioning and size of craniotomy and to define an ideal and comfortable positioning for the patient.
The authors discuss step-by-step the preoperative assessment, the intraoperative anesthesiologic preparation, then mapping techniques of motor and language areas, and a novel technique for registration of data, by a grid superimponed on the video image of the monitored cortex. After complete mapping, fiberoptic guided intubation is performed.

Results:
A series of ten cases is discussed, in which cortical stimulation has been applied with awake craniotomy, in different eloquent areas, without causing additional permanent morbidity- in the contrary, for several patients preoperative neurological deficit decreased, sometimes after temporary worsening, particularly in tumours of the supplementary motor area.

Conclusion:
In conclusion, the authors recommend intraoperative monitoring with language mapping using cortical stimulation in awake patients; this provides maximal tumour removal with minimal, if any, permanent neurological worsening.
TRANSSPHENOIDAL MICROSURGERY FOR CRANIOPHARYNGIOMAS.

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Introduction:
Transsphenoidal microsurgery (TSS) for craniopharyngiomas is not a frequent approach to these tumors. This review of our series allows us discuss its indications.

Patients and methods:
From December 1982 to January 2001, 23 patients (12 M and 11 F) underwent TSS in our institution. There were 19 adults (aged 21.0 to 70.4 years) and 5 children (aged 7.0 to 16.6 years). At the operation, the normal pituitary gland was often displaced forwards by the tumor and had to be reclined upwards or laterally to visualise the tumor. After intracapsular debulking, the capsule of the tumor was carefully freed from its surroundings using blunt dissection and gentle traction to clear it from firm adhesions. The diaphragma sellae was absent in 4 cases and was partially excised for complete tumor removal in 3 cases. The pituitary gland, posterior lobe and stalk were respected in all cases.

Results:
There was no mortality. Complications occurred in 5 cases: 2 CSF leaks requiring a packing of the sphenoid sinus, 1 intrasellar hematoma and 2 diabetes insipidus. Complete resection of the tumor was achieved in 15 patients. Out of the remaining 8 subtotal resections, transcranial redo surgery was performed on the residue in 3 patients, radiotherapy in one. No progression of the residue could be seen in 4 cases (follow-up: 13-37 months). Preoperative hormonal insufficiencies remained unchanged with the exception of the cure of gonadal function in 2 cases and thyroidal function in 1 case. The visual function was preoperatively altered in 10 patients. It recovered completely in 4 patients, partially in 4 and remained stable in 2. No new deficits occurred. There was no tumor recurrence over the follow-up period (m=48.5 months; range 4-135 months).

Conclusion:
In our experience, TSS is safe and efficient for the removal of intra- and suprasellar craniopharyngiomas located beneath the diaphragma sellae. We believed it is contra-indicated in dumbbell-shaped solid tumors or in the presence of suprasellar calcifications.
MANAGEMENT OF TRIGEMINAL NEURINOMA: OUR EXPERIENCE IN 4 CASES.

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Introduction:
Neurinomas originating from the trigeminal nerve are rare tumors, they are more frequent in patients with neurofibromatosis. The specific localisation of the tumor in the cisternal or cavernosal part of the nerve, in Meckel's cave or extracranial implicates an appropriate surgical approach to remove these tumors with minimal damage to the surrounding structures.

Methodes:
The mean age of our patients (3 males and 1 female) was 45 year (26-71). The major presenting symptom was paraesthesia in one or more divisions of the affected trigeminal nerve. Three tumors were located in Meckel's cave, one of them was very large (5cm diameter). The fourth patient had a small tumor in the cisternal part of the trigeminal nerve and presented with a typical history of trigeminal neuralgia, refractory to anti-epileptic drugs.

Results:
This last patient underwent a suboccipital, retrosigmoidal craniectomy. In all others an orbitozygomatic frontotemporal craniectomy was done; only in the patient with the large neurinoma the dura was opened, in the other two the approach was purely extradural. All cranial nerves could be spared macroscopically, nevertheless all had a transitory facial numbness. Only the patient with the large neurinoma had a supplementary ipsilateral visual deficit with a minor motor weakness in the contralateral hemicorpus. On radiological follow up (4 months to 7 year) there was no evidence for residual or recurrent tumor.

Conclusion:
The surgical approach for trigeminal neurinomas needs to be tailored to the specific localisation of the tumor. In our experience is the extradural approach to the temporal skull-base an elegant technique with no surgical complications for the removal of neurinomas in Meckel's cave. Total tumor removal can be obtained with none or minor neurological deficits. For cisternal neurinomas a retrosigmoidal approach is more appropriate.
RESULTS OF TRANSSPHENOIDAL MICROSURGERY IN CUSHING'S DISEASE.

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Introduction:
Transsphenoidal surgery (TSS) is the method of choice for the removal of the pituitary corticotrophic adenoma in Cushing’s disease. We reviewed a large series of patients operated on and emphasized on long-term follow-up.

Patients and method:
From November 1974 to June 2001, 194 patients (45 M and 146 F; aged 9.6-70.7 years) with Cushing’s disease underwent TSS: 167 patients had adenomectomy, 14 had antehypophysectomy, 5 had subtotal hypophysectomy and 4 had central hypophysectomy. Complications occurred in 18 patients (9.3 %) including 4 deaths (three were apparently not related to the surgical procedure).

Results:
Remission of disease was achieved in 162 out of the 190 (85.3 %) patients analysed. Among patients with confirmed adenomas, the rate of remission was significantly higher (p<0.01) in patients with microadenomas (92.6%) than in patients with macroadenomas (66.7%). Redo surgery in 6 failures achieved remission in 4 patients. The overall remission rate was 87.4 %. Surgical failures were associated with the absence of a demonstrable pituitary adenoma, large size of the tumor or invasiveness.

In the 162 patients with immediate success, duration of follow-up was 10.0 ± 5.9 years (m ± SD; median = 10.0). Recurrence of the disease occurred in 24 (14.8 %) out of 162 patients at a mean 4.8 years (range: 0.8-12.0 years). The longest sustained remission to date was 25.6 years. According to actuarial analysis, the probability of a patient remaining free of disease 12 years after surgery is 80 %. It is 86.2 % in microadenomas versus 52.5 in macroadenomas and 94.5 % in the patients with postoperative hypocortisolism versus 59.2 % in patients with postoperative eucortisolim.

Conclusions:
TSS in Cushing’s disease achieves the highest rate of remission immediately after operation and a minimal rate of recurrence even after a long-term follow-up as indicated by our results. We thus believe it remains the first treatment to be proposed to patients.
A RETROSPECTIVE ANALYSIS OF PITUITARY APOPLEXY.

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Introduction:
Pituitary apoplexy is an uncommon clinical syndrome resulting from pituitary hemorrhage or infarction. Since the description by Brougham et al. in 1950, pituitary apoplexy has been an increasingly recognized clinical entity. Diagnosis on clinical and radiographic grounds, endocrine replacement therapy with steroids, and rapid surgical decompression are the cornerstones of management. The purpose of this report is to review cases of pituitary apoplexy seen at our institution over a 14-year period.

Methods and Results:
Fourteen patients with pituitary apoplexy were analysed. Their mean age was 47 with a male to female ratio of 8:6. Presenting symptoms included headache (93%), vomiting (43%), nausea (36%), ocular paresis (50%) and reduction in visual fields (36%).
Hyponatremia was present in 4 patients. The average duration of symptoms before the diagnosis of pituitary apoplexy was 16 days (2d &#8211; 28d). Four patients had known pituitary adenomas at the time of presentation. In 3 patients, a precipitating event could be identified; (a) dynamic testing of the pituitary using TRH and (b) administration of anticoagulant drugs.
All, but one (pace-maker-) patient, underwent magnetic resonance imaging (MRI). MRI correctly identified pituitary haemorrhage in all cases.
All of them received steroid replacement therapy. Three patients were managed conservatively, the remainder underwent surgical decompression of the sella. The criteria for surgery was pronounced neuro-ophtalmological complications, associated with the apoplectic event.
Pituitary haemorrhage or necrosis was identified in all patients at time of surgery and confirmed on histological examination. All specimens were stained immunohistochemmically, 10 surgical specimen had been obtained to allow identification of tumour type, in one, the entire adenoma was necrotic, preventing identification of cell type.
Surgery resulted in improvement in visual field deficits in 90% and ocular paresis in 100%. Long-term replacement therapy following surgery was necessary in 64% (mean follow-up : 4 years ). In the conservative group, none required therapy after 2 months.

Conclusions:
Although pituitary apoplexy is variable in its clinical appearance, it should be considered in any patient with abrupt neuro-ophtalmological deterioration associated with headache. One major problem is the that preoperative diagnosis is sometimes delayed and difficult. MRI is the imaging method of choice and transsphenoidal decompression safe and effective. Surgery should be performed soon as this appears to optimize visual outcome.
LHERMITTE-DUCLOS DISEASE: TUMOR OR DYSPLASIA? METHIONIN-PET DATA IN 4 PATIENTS.

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Introduction:
Lhermitte-Duclos disease (LDD) is a cerebellar lesion, characterised by an overgrowth of cerebellar ganglion cells, which replace granular cells and Purkinje cells. It is unclear whether it should be considered as a cerebellar hypertrophy, a developmental abnormality, or a true neoplasm. Using the metabolism of methionin, the protein synthesis can be measured. This may give a clue to the nature of LDD: true neoplasms would be expected to have an increase in protein synthesis, while dysplasia should have the same or a lower protein synthesis than normal cerebellum.

Patients and methods:
We are following seven patients with LDD. 11C-Methionine Pet scan was done in four of them. In 2 patients, diagnosis of LDD was made based on characteristic MRI-imaging. In two patients LDD was histologically proven, after surgical partial or subtotal resection because of important mass-effect.

Results:
In three patients, there was a marked increase of 11c-Methionin uptake in the abnormal cerebellar cortex. In two patients this uptake reached levels seen in malignant tumours. There was no increased uptake in the residual tumour of the patient who had undergone subtotal resection.

Conclusion:
Based on pet-scan studies in four patients with Lhermitte-Duclos disease, we suggest that LDD is a true neoplasm of the cerebellum. Other arguments for this hypothesis are: the appearance of symptoms is usually in adulthood, the PTEN gene is a known oncogene, and in rare patients, evolution of a radiologically diagnosed lesion has been described. We therefore suggest that patients with an MR-diagnosed LDD should be followed for the rest of their lives.