

## Meeting of the Belgian Society for Neurosurgery 2005

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**Positron emission tomography for the early postsurgical evaluation of pediatric brain tumors.** A. LUBANSU, B. PIROTTE, M. LEVIVIER, D. MORELLI, P. VAN BOGAERT, P. DAVID, J. BROTCI, S. GOLDMAN (Department of Neurosurgery, Hôpital Erasme, Université Libre de Bruxelles, 808 route de Lennik, B-1070 Brussels, Belgium).

*Object* : To study the value of postoperative Positron Emission Tomography (PET) to assess the extension of brain tumor resection.

*Methods* : Twenty children operated for total resection of a glial tumor (18 low-grade, 2 anaplastic) presented a signal on postoperative magnetic resonance (MR) images raising the question of a possible tumor residue. PET was early performed (18F-Fluoro-deoxyglucose in 1, 11C-methionine in 16, both in 3) to further characterize the nature of the abnormal MR signal in order to consider second-look surgery.

*Results* : An increased tracer uptake found in 14 children lead to reoperate 11 of them, confirming tumor histologically. No 11C-methionine uptake lead to conservative attitude in 6 children in which MR imaging follow-up showed no tumor progression.

*Conclusions* : The early postoperative PET, especially with 11C-methionine, appears as a valid basis for complementary therapeutic decision, especially second-look surgery, in glial tumors for which a radical resection is a key factor of prognosis.

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**Facial nerve palsy in posterior fossa arachnoid cysts : report of 2 cases.** D. MORELLI, B. PIROTTE, G. ALESSI, A. LUBANSU, D. VERHULPEN, C. FRICKX, P. DAVID, J. BROTCI (Department of Neurosurgery, Hôpital ERASME, Université Libre de Bruxelles, 808 route de Lennik, B-1070 Brussels, Belgium).

*Introduction* : Arachnoid cysts most commonly occur in the middle cranial fossa and the etiological role of acquired factors has been suggested. Posterior fossa arachnoid cysts (PFAC) are more unusual and are considered to be mostly congenital in origin. They generally remain asymptomatic or cause vague and non-specific symptoms like gait disturbances and headache.

*Case description* : We present and discuss two personal observations (2 boys aged 7 and 8 years respectively) in which a PFAC was responsible for isolated facial nerve palsy. The relationship between the cyst and the facial nerve and between the facial nerve palsy and the size variation of the cyst are discussed and documented by pre- and post-operative magnetic resonance imaging.

*Discussion* : A subset of PFAC, located in the cerebellopontine angle (CPA), can produce symptoms due to a compression of the eighth cranial nerve such as hearing loss and tinnitus or signs and symptoms indistinguishable from those of Meniere's disease. Although a PFAC has been found as direct cause of hemifacial spasm in 2 cases in the literature, a facial nerve palsy, however, has never been reported neither in association nor as an isolated clinical presentation of a PFAC. In both cases reported, the comparison of the position of the seventh and eighth nerves on the MRI study suggested that these nerves might be displaced upwards by the cyst and brought to enter in sharp contact with the upper edge of the internal auditory canal.

*Conclusion* : The present observations suggest that acquired mechanisms might be involved in some PFAC and illustrate the interest of detailed MRI to better explore and understand the relationship between the cyst and the cranial nerves.

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**Integration of pet and mr imaging for image-guided surgical resection of brain tumors : experience in 103 consecutive procedures.** B. PIROTTE<sup>1</sup>, S. GOLDMAN<sup>2</sup>, O. DEWITTE<sup>1</sup>, N. MASSAGER<sup>1</sup>, D. WIKLER<sup>1</sup>, F. LEFRANC<sup>1</sup>, N. OULAD BEN TAIB<sup>1</sup>, S. RORIVE<sup>3</sup>, P. DAVID<sup>4</sup>, J. BROTCHE<sup>1</sup>, M. LEVIVIER<sup>1</sup> (Departments of <sup>1</sup>Neurosurgery, <sup>3</sup>Neuropathology and <sup>4</sup>Neuroradiology, <sup>2</sup>PET-Cyclotron Biomedical Unit, ERASME Hospital, Université Libre de Bruxelles, Brussels, Belgium).

*Object* : To evaluate the integration of Positron Emission Tomography (PET) images into the image-guided resection of brain tumors.

*Methods* : PET images using [18F]fluorodeoxyglucose and [11C]methionine were combined to magnetic resonance (MR) images in the navigation planning of 103 navigation procedures for brain tumors (63 low-grade ; 40 high-grade tumors). These procedures were performed in 91 patients (57M/34F) in which ill-defined tumor boundaries could not be clearly identified for image-guided resection. Level and distribution of PET tracer uptake were analyzed to define a PET contour, projected on MR images to define a final target contour for volumetric resection (displayed in the microscope). Maximal tumor resection was accomplished in each case, with the intention to remove the entire abnormal metabolic area comprised in the surgical planning. Early postoperative MR and PET assessed the quality of tumor resection. Survival analysis compared patients with total and subtotal/partial resection of PET tracer uptake. Metabolic information on tumor heterogeneity or distribution were useful for planning the surgery.

*Results* : In 83/103 procedures (80%), PET improved tumor delineation and contributed to define a final target contour different from that obtained with MR alone. Total resection of the increased PET tracer uptake was achieved in 54/103 (52%) procedures and provided a longer survival ( $p = 0,007$ ) compared to patients with postoperative residual PET tracer uptake.

*Conclusions* : PET-guidance helps to increase the amount of tumor removed and to target image-guided resection to tumor portions which present the highest evolving potential. A complete resection of the increased PET tracer uptake might increase the patient's survival.

**Radiation induced meningiomas following treatment of brain tumor.** F. VAN CALENBERGH, J. MENTEN, B. DEPREITERE, J. VAN LOON, C. PLETS, J. GOFFIN (Dept. of Neurosurgery and Radiotherapy, University Hospital Gasthuisberg, Catholic University of Leuven, Belgium).

*Introduction* : Radiotherapy in childhood has been implicated in several late complications, including growth and endocrine disorders, radionecrosis, white and gray matter changes, mental and intellectual changes. The induction of secondary tumors is one of the most serious late complications, and occurs often in patients in whom the first tumor was completely cured.

*Material and methods* : From 1995 onwards, we prospectively identified all patients presenting with possibly radiation induced tumors presenting to our department. There were 16 cases of meningioma, of whom 12 had radiotherapy in childhood. The files of these patients were studied.

*Results* : The interval between radiotherapy and the diagnosis of the secondary meningioma was 12 to 34 years (average 21 years). The primary diagnosis was low grade glioma in 7, pituitary adenoma in 3, ependymoma and medulloblastoma in 2 and pineal tumor and hemangioblastoma in 1. The patients were between 3 and 49 years of age at the time of radiotherapy. There were multiple meningiomas in 3 patients. In 8 patients (50%), the diagnosis was made on a surveillance scan, still asymptomatic. Many patients had other post-irradiation complications, and 3 had also cavernous angiomas. The meningiomas were all grade I (transitional or meningotheliomatous). In 10 patients, the tumors were genetically analyzed : there were variable abnormalities, most frequently deletions in chromosomes 1 and 22. All patients did well after surgery, after follow up of 1 to 7 years.

*Conclusion* : From this series with an undefined population at risk, it is not possible to calculate the risk for the development of secondary meningioma. However, these tumors are apparently not rare. In our experience, contrary to some data in the literature, there were no atypical meningiomas, and the genetic abnormalities were as far as we can determine at the present, not different from normal meningiomas. Patients treated with brain irradiation in childhood may be candidates for lifelong regular surveillance scanning.

**Intra-spinal myoepithelial carcinoma. A first case report.** A. MENDILI, G. MILBOUW, V. PETROV (Department of Neurosurgery, CHR Namur).

*Introduction* : Myoepitheliomas tumors were only recently recognized to occur primarily in soft tissue, and to date only small case number have been described. At the best of our knowledge no intra spinal case was reported in the literature.

*Case Report* : We present a young 38 year old woman who was admitted to our department for right occipital and cervical pain evolving for two years. Neurological examination was without peculiarity. CT-scan and MRI images revealed a 3.8 cm solitary extra and intra spinal mass at the level of C1/C2. The initial diagnosis was a hourglass right schwannoma of C1/C2. The mass was resected. Seven days after surgery, the patient reported appearance of a pain of right upper limb. Control MRI shows small residue of C1/C2, epidural carcinomatoses at level of C6/C7 and collapse vertebral body of C3 and C7. Pet-scan of the whole body revealed a osseous lesions C2, C3, C7, D10 and L3, hepatic and lung metastasis. Anatomico- pathological analysis was discussed, and finally was confirmed as a myoepithelial carcinoma. The patient received postoperative radiation and chemotherapy but she died three months later.

*Conclusion* : Myoepithelial tumor are composed predominantly or exclusively of myoepithelial cells. They are well described especially within the salivary gland, but their occurrence in soft tissues is less known and this often results in diagnostic problems. The myoepithelial carcinoma has to be differentiated from extra skeletal myxoid chondrosarcoma, chordoma, extraskeletal sarcoma of ewing. The prognosis is uncertain because these tumor can be malignant and more aggressive. Unfortunately it was impossible to have a pre-operative diagnosis of this tumor by radiological images. Immuno- histochemical analysis is crucial for unequivocal diagnosis. A review of the literature revealed no similar case.

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**A study of anatomical variations of the V2 segment of the vertebral artery.** M. BRUNEAU<sup>1,2</sup>, J.F. CORNELIUS<sup>2</sup>, V. MARNEFFE<sup>1</sup>, M. TRIFFAUX<sup>1</sup>, N. MISSON<sup>1</sup>, C. VAN RUYSSSEVELT<sup>1</sup>, B. GEORGE<sup>2</sup> (Clinique Saint-Pierre, Ottignies, Belgique<sup>1</sup> - Hôpital Lariboisière, Paris, France<sup>2</sup>).

*Background* : Anatomical variations of the V2 segment of the vertebral artery can lead to inadvertent laceration and potentially serious complications. An unrecognized abnormal level of entrance into the transverse foramen means that the artery is not protected up to their level of entrance by the transverse process during a lateral approach to the intervertebral foramen. A tortuous vertebral artery eroding the vertebral body can be damaged during an anterior corpectomy or an antero-lateral approach to the intervertebral foramen.

*Aim and Methods* : Our goal was to study the incidence of such anomalies. For this purpose, we studied 320 vertebral arteries on 130 MRI and 30 contrast-enhanced CT scan. Results : The vertebral artery enters the C6 transverse foramen in 93.4%. An abnormal level of entrance is observed in 21 courses, with a level of entrance into the C4, C5, or C7 transverse foramen respectively in 0.94%, 5.0%, and 0.63%. Eleven (52.4%) abnormalities are on the right side and ten (47.6%) are on the left side. Nineteen patients out of 160 (11.9%) have a unilateral anomaly and one has a bilateral anomaly (0.6%). In 3 patients (1.88%), the vertebral artery forms a loop into an unusually large transverse foramen with the internal border medial to the unco-vertebral joint.

*Conclusions* : The incidence of anatomical variations of the vertebral artery V2 segment is high. Potentially dangerous conditions can be detected on pre-operative imaging.

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**Biomechanics of frontal skull fracture under dynamic loading.** H. DELYE<sup>1</sup>, P. VERSCHUEREN<sup>2</sup>, B. DEPREITERE<sup>1</sup>, C. VAN LIERDE<sup>2</sup>, J. VANDER SLOTEN<sup>2</sup>, G. VAN DER PERRE<sup>2</sup>, J. GOFFIN<sup>1</sup> (<sup>1</sup>Division of Experimental Neurosurgery and Neuroanatomy, K.U.Leuven, Leuven, Belgium ; <sup>2</sup>Division of Biomechanics and Engineering Design, K.U.Leuven, Leuven, Belgium).

The exact mechanical pathogenesis of skull fracture has not been completely clarified. It was suggested by Yoganandan et al. (J. Neurotrauma, 1995) in a series of 12 head impacts that the energy to failure was a possible tolerance criterion. This was however not confirmed in a series of 61 skull impacts at our institution (Depreitere, doctoral thesis). In this experiment, in which a double-pendulum set-up was used, the energy to failure increased with increasing kinetic energy input. The main purpose of the present study was to investigate whether an energy failure level would apply to the skull fracture mechanics in unembalmed post mortem human heads under dynamic frontal loading conditions. A double-pendulum set-up was used to conduct frontal impact tests on specimens from eight unembalmed post mortem human subjects. The specimens were isolated at the occipital condyle level and pre-test computed tomography images were obtained. The specimens were rigidly attached to an aluminum pendulum in an upside down position and obtained a single degree of freedom, allowing motion in the plane of impact. A steel pendulum delivered the impact and was fitted with a flat-surfaced, cylindrical aluminum impactor, which distributed the load to a force sensor. The relative displacement between the two pendulums was measured using a laser sensor and used as a measure for the deformation of the specimen in the plane of impact. Two impact velocity conditions were created : low ( $3,60 \pm 0.24$  m/s) or high ( $5,18 \pm 0.04$  m/s) velocity. Computed tomography and dissection techniques were used to detect pathology. If no fracture was detected, repeated tests on the same specimen were performed with higher impact energy until fracture occurred. Eventually all specimens were fractured. Peak force, displacement and energy variables were used to describe the biomechanics. These preliminary data suggest a positive correlation between impact velocity and energy to fracture. Further experiments are necessary to elucidate the possibility of an energy criterion for skull fracture in head impacts.

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**Sophy adjustable valves : a single-center retrospective study of 54 patients.** M. MOENS, R. ATEs, K. VAN ROMPAEY, L. CAVENS, C. CHASKIS, J. D'HAENS (Department of Neurosurgery, AZ-VUB Free University Brussels).

*Objective* : The goal of this study was to assess the value of making adjustments to the opening pressure of a shunt valve and to evaluate the possible advantages and drawbacks of the Sophy adjustable valves.

*Material and Methods* : The authors conducted a single-center retrospective study of 54 patients who received Sophy valves from January 2000 till December 2002 (43 adults and 11 children). 26 patients are treated for idiopathic normotensive hydrocephalus, 27 patients for secondary hydrocephalus and 1 patient for an arachnoidal cyst. The mean follow-up was 36 months.

*Results* : Eight patients (15%) needed a non-invasive adjustment of their valve's opening pressure. Two patients underwent an adjustment twice. This adjustment was achieved to higher levels in 3 patients presenting with overdrainage and to lower levels in 7 patients presenting with underdrainage. Only in three times of all external adjustments (33%) we noticed a positive clinical result after an adjustment for underdrainage. They were all adults and 2 of them were suffering of an idiopathic normal pressure hydrocephalus and 1 of a secondary hydrocephalus after a subarachnoid haemorrhage. In two patients a subdural collection was observed and treated surgically despite valve adjustment. Another eighteen patients needed reintervention for infection (15 times) or dysfunction (21 times). Only one patient underwent finally a third ventriculostomy.

*Conclusion* : Only six percent of all patients benefited from an adjustable valve for their hydrocephalus, all for underdrainage. In this serie of patients placement of an adjustable valve did not eliminate the need for additional surgery. All three subdural effusions created by overdrainage had to be surgically removed despite valve adjustments. We suggest that in the future a cost-benefit analysis and further investigation in the use of an adjustable valve will be necessary.

**Molecular imaging-guided gene therapy of experimental gliomas.** Y. WAERZEGGERS, M. A. RUEGER, A. WINKELER, L. LI, W. D. HEISS, A. H. JACOBS (Laboratory for Gene Therapy and Molecular Imaging, MPI for Neurological Research, Cologne, Germany, 50931).

*Background* : The combination of transgenes encoding prodrug-activating enzymes serves synergistic anti-tumor activity (e.g. E. coli cytosine deaminase (cd) and HSV-1 thymidine kinase (tk)). We used positron emission tomography (PET) and magnetic resonance imaging (MRI) for imaging-guided targeted application of universal HSV-1 amplicon vectors and assessment of therapeutic efficiency.

*Methods* : Human Gli36dEGFR glioma cells were grown as s.c. tumors in 22 nude mice and transduced in vivo with HSV-1 amplicons carrying cd, HSV-1-tk39 and gfp (HSV-cdIRES tk39gfp). Non-transduced tumors served as negative controls, stably cdIRES tk39gfp-expressing Gli36dEGFR cells as positive controls. During prodrug application (5-fluorocytosine, ganciclovir), tumor sizes were measured (calipers), and growth slopes calculated. Imaging was performed for (i) localization of tumors (MRI) ; (ii) identification of viable target tissue ([18F]FLT-PET) ; (iii) assessment of tissue-dose of vector-mediated gene expression ([18F]FHBG-PET) ; and (iv) induced therapeutic response ([18F]FLT-PET). Therapeutic efficiency was quantified by differences in (i) tumor volume and (ii) [18F]FLT-accumulation.

*Results* : All positive control tumors disappeared within 10 days of treatment. 15/22 in vivo transduced tumors responded to prodrug therapy (n = 4 complete responders ; n = 11 partial responders), with growth slopes significantly different from negative control tumors (t-test ; p < 0.05). Therapeutic effects could be monitored by PET with significant differences in [18F]FLT-accumulation in 11/11 p.c. tumors ( $3.38 \pm 3.65$  %ID/g before, and  $0.06 \pm 0.19$  %ID/g after therapy ; p = 0.01) and 8/11 in vivo transduced tumors ( $1.91 \pm 1.12$  vs.  $0.42 \pm 1.31$  %ID/g ; p < 0.01). The level of TK39GFP expression as measured by [18F]FHBG-PET correlated to the therapeutic efficiency as measured by [18F]FLT-PET ( $r = 0.73$  ; p < 0.01).

*Conclusion* : These data indicate that (i) imaging-guided vector application, (ii) determination of the tissue-dose of vector-mediated gene expression, and (iii) correlation to the induced therapeutic effect is feasible using molecular imaging technology. Transduction with HSV-1 amplicon vectors in vivo causes distinct levels of therapeutic gene expression correlating to the effect of gene therapy in subcutaneous tumors. In a next step this therapeutic strategy will be tested in intracranial tumors. This type of imaging-guided gene therapy protocol will greatly facilitate the development of safe and efficient protocols for clinical application and will as a general paradigm also be applicable in protocols basing upon stem cells.

**Chordoma of the sacrum : two case reports.** S. REREMOSER<sup>1</sup>, G. ALESSI<sup>2</sup>, L. VEREECKEN<sup>1</sup>, L. F. DE WAELE<sup>2</sup> (Department of Abdominal Surgery<sup>1</sup> and Department of Neurosurgery<sup>2</sup>AZ St Lucas, Ghent).

*Introduction* : Chordoma of the sacrum is a rare malignant tumor. Incidence is 0.5 per million. Metastasis is unfrequent (in 18 % of cases) and occurs late in the pathologic process. A 5-year survival is seen in 65 % of the cases. The

tumor originates from the embryonal rests of the notochord. This classifies the tumor as a congenital tumor. The tumor is found in the axial bones, preferably in the sacrum (in 50 % of cases) and the base of the skull (in 35 %). Patients present usually with progressive low back pain. The tumor can be asymptomatic for a long period. Magnetic resonance investigation (MRI) is the first choice diagnostic examination. Fine needle aspiration is the best option to obtain a histopathologic diagnosis.

*Methods* : Two patients with sacral chordoma are presented. Resection occurred via sacral incision. Both patients were treated postoperatively with radiotherapy. The different surgical procedures and therapeutic options are presented and discussed.

*Results* : The two patients have been seen with a 2- and 3-year follow-up. One has residual urinary retention problems, the other is asymptomatic.

*Conclusion* : The larger the excision, the better the outcome. Good preoperative imaging and interdisciplinary cooperation are mandatory. In partial resections, postoperative radiotherapy is certainly indicated. The role of cryotherapy is still under discussion.

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**Surgical strategy in spinal cord hemangioblastomas. experience on 30 cases.** J. BROTCHE, F. LEFRANC (Erasmus Hospital, ULB, Brussels, Belgium).

The complete removal of spinal cord hemangioblastomas (SCH) must be a neurosurgeon's ultimate goal. We have tried to draw up a simple topographic classification in order to achieve this goal with respect to patients' preoperative neurological status. We have classified the lesions in three topographical categories : -A. Subpial posterior and posterolateral SCH (n = 15) -B. Small subpial lateral or anterior-sided SCH (9 lateral, 1 anterior) -C. Pure intramedullary SCH (n = 5) Different surgical approaches related to topographic classification were used : A. Classical "en-bloc" resection with careful dissection of the lesion from spinal cord. B. A tense syringomyelic cyst, which was present in all the cases, was aspirated with a 22G needle, so deflating the spinal cord and giving an easy access to the solid nodular tumor either when it was lateral or even anterior. C. When the hemangioblastoma was not visible we opened the posterior sulcus along the midline using the same procedure as for any other intramedullary spinal cord tumor. Complete surgical removal was achieved in all cases except in one previously operated upon twice and irradiated in another institution. Improvement was observed in 18, stabilization in 10 and worsening in 2 patients. The results were closely related to the pre-operative status. Patients with a good pre-operative neurological status or harboring a large cystic cavity had a better prognosis than others.

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**Removal and replacement of a vagal nerve stimulator electrode : a case report.** J. VANGENEUGDEN, H. E. VAN DER AA, H. HAUMAN, D. KOOLS, R. HERZ, V. DEBOIS (Department of Neurosurgery, AZ St. Maarten, Duffel, Belgium Department of Neurosurgery, Medisch Spectrum Enschede and Twente Institute for Neuromodulation, the Netherlands Department of Neurology, AZ St Maarten, Duffel, Belgium).

*Objective* : Vagal nerve stimulation to improve the control of intractable seizures has become a wellknown procedure since the mid-nineties. So technical failures of the hardware can become more apparent in the time to come. Putting a new electrode on the vagal nerve, cranial or caudal of the previous one and leaving the previous one on the nerve too, is not the only option. One could consider complete removal and replacement of the vagal nerve stimulator electrode.

*Materials and methods* : This is the report of a 34 year old female patient who had a vagal nerve stimulator for 6 years. Recently a technical failure at the level of the electrode was diagnosed. Replacement of the electrode was considered. The electrode and vagal nerve were found easily between the carotid artery and jugular vein in the scar tissue of the previous operation. There was a dense perineural scar around the helices of the electrode and the vagal nerve. At the proximal and distal end of the electrode, this scar tissue went over in normal perineural tissue ; a dissection plane could not be found at this transition. So an incision of the scar tissue over the middle helix of the electrode was made in a longitudinal way. A dissection plane was created between the middle helix and the scar tissue with straight microscissors. The two other helices were exposed the same way. The three helices were cut along the axis of the vagal nerve using the same microscissors. Only at that time the proximal and distal perineural scar tissue could be removed too. A new electrode was positioned at the same level. There was a normal stimulator function postoperatively.

*Conclusion* : This case report shows that removal and replacement of a vagal nerve electrode can be performed with preservation of the vagal nerve and with a return to prior stimulation response and seizure control. This case report also shows that vagal nerve stimulation can be called a reversible procedure.

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**Two stages total vertebrectomy : about a series of 16 patients.** J. LENELLE , F. COLLIGNON, A. DUBUISSON, B. KASCHTEN, D. MARTIN, P. ROBE, F. SCHOLTES, M. SCHOLZEM (Service de Neurochirurgie – ULG CHU Sart-Tilman, 4000 Liège).

We analyzed retrospectively the data of 16 patients all carrying of an isolated tumor of the spine and treated by complete vertebrectomy in two stages. The series include 9 men and 7 women. The youngest was 14-year old. The oldest 75 years. In 10 cases, it is about an isolated metastasis of a known and treated cancer (kidney / urinary tracts : 4 patients, breasts : 5 patients, lung : 1 patient). Among other cases, we found 2 giant cell tumors, 2 aggressive hemangiomas, 1 Ewing's sarcoma. One isolated case of Paget's disease is included in the series. Three cases are located in the cervical spine ; 13 others arised at the thoraco-lumbar spine. In every case, a complete vertebrectomy is achieved in two operative sessions : posterior approach, as a first step, allows complete excision of all the elements of posterior arch followed by reconstruction and osteosynthesis to insure the stability of the spine. The second procedure is carried out some days later through anterior approach. The aim of this second stage is to resect and reconstruct (fibula and/or iliac crest) the anterior column without any additional hardware. Of course, as the case may be, additional therapies (chemotherapy and/or radiotherapy) are associated to the surgery. The favorable results, without important complications, speak for a surgery which appears aggressive but perfectly practicable as far as the techniques of osteosynthesis as well as the procedures of reconstruction are mastered. All the approaches of the spine must be also well known by the surgeons.

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**Percutaneous Pedicle Screw Fixation (PPSF) : indications and surgical technique.** G. ALESSI, G. BESSEMANS, B. NOENS, B. D'HAEN, H. COLLE, L. F. DE WAELE (Department of Neurosurgery, AZ St Lucas, Ghent).

*Introduction* : The wide exposure required for a standard posterior lumbar interbody fusion (PLIF) can cause unnecessary trauma to the lumbar musculoligamentous complex. A novel, minimally invasive, percutaneous technique (SextantAE) was developed to minimize such iatrogenic tissue injury and thus to minimize the approach related morbidity.

*Methods* : Three patients underwent placement of percutaneous pedicle screws and rods. With this technique the tissue is bluntly split and not divided which minimizes the paraspinous tissue trauma. All three patients had different indications. One had a non displaced but unstable and compressed fracture of the L1 vertebra. The second patient had a severe spondylosis with degenerative instability who had an anterior fusion in a first stage followed by the PPSF. The third patient had a grade 1 spondylolisthesis.

*Results* : The initial clinical results when using the Sextant system for percutaneous posterior fixation of the lumbar spine are promising. This is a new procedure and the results are only preliminary. The average operative time of these first procedures was still 2 hours due to the learning curve. Bloodloss was minimal. Postoperative mobilization was possible after 48 hours. Several difficulties and limitations have been encountered. No distraction or compression of the pathologic level is possible. The system is restricted to the lumbar spine. Exceptionally the twelfth thoracic vertebra can be involved, depending on the dorsolumbar angle. No complete reduction of grade II or III spondylolisthesis is possible in our opinion. The pelvic anatomy can also be a limiting factor. Early clinical results of the three patients were very satisfactory and promising.

*Conclusion* : minimal invasive spine surgery offers a good alternative for a limited number of cases. Our results are comparable with the small series in literature. Minimal invasive spine surgery offers a safe and elegant alternative for a number of indications. Strict indications are the key of success. Among the advantages we retain a shorter hospital stay and shorter recovery period.

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**Anatomical repercussions of neurosurgical approaches to the mesial temporal lobe demonstrated by fiber dissection.** D. PEUSKENS, J. VAN LOON, F. VAN CALENBERGH, R. VAN DEN BERGH, J. GOFFIN, C. PLETS (Department of Neurosurgery UZ Gasthuisberg Leuven, Laboratory of Experimental Neurosurgery and Neuroanatomy).

*Objectives* : The white matter structure of the anterior temporal lobe is complex and not well appreciated from the available neurosurgical literature. The fiber dissection method is an excellent means of achieving thorough knowledge of the three-dimensional structure of the white matter tracts. This study was performed to demonstrate the usefulness of the dissection technique in understanding the white matter anatomy and the effects of current surgical approaches on the subcortical structure of the region.

*Methods* : Seventeen brain specimens, obtained at routine autopsy, were dissected using the Klingler's fiber dissection technique after preparation by fixation and freezing. The dissections were carried out using an operating microscope and followed an stepwise pattern of progressive white matter dissection.

*Results* : An insight is gained in the course of the anterior loop of the optic radiation, the temporal stem, the anterior commissure and the ansa peduncularis with respect to current neurosurgical approaches to the mesial temporal region.

*Conclusions* : The anterior temporal lobe contains several important white matter tracts that are uniquely understood by performing white matter dissections of the region. Surgical procedures on the anterior temporal lobe differ substantially as to their repercussions on the subcortical white tract anatomy as shown by the findings in this study.

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**European multi-centre, prospective, clinical investigation to delineate the clinical results, benefits and optimal use of total disc replacement at the cervical spine with PRODISC-C : preliminary Belgian results.** B. NOENS, G. BESSEMANS, G. ALESSI, B. D'HAEN, H. COLLE, L. F. DE WAELE (Dpt. Neurosurgery, St Lucas Hospital, Ghent).

*Introduction* : Total disc replacement seems to be a valid therapeutic option in the treatment of degenerative disc disease (herniated disc, uncarthrosis with radicular and/or medullar compression ) as an alternative to interbody fusion. Nevertheless further investigation is needed to delineate the ideal indications for cervical arthroplasty. The PRODISC-C implant is a semi-constraint prosthesis with a ball and socket design, one surface being metal and the other an ultra-high molecular weight polyethylene. The sister prosthesis, being the PRODISC-L, has a satisfying long term clinical outcome in treating degenerative lumbar disc disease.

*Methods and Materials* : Based on clear in- and exclusion criteria patients entered the trial and were followed up with registration of clinical and radiological status, medication use, Neck Disability Index(NDI), Short Form-36, Visual Analogue Score for pain and Satisfaction percentage. Over a period of one year ( February 2004- January 2005) 40 prostheses were implanted in 32 patients. The predominant indications were degenerative unc- and discarthrosis and soft disc herniations. We operated only 3 patients with a pure degenerative disc disease without neural compression and 2 patients with myelopathy. The follow period ranges from 2 to 13 months.

*Results* : The postoperative pain relieve was significant in all cases, predominantly in the soft herniated disc group. VAS score for neck and arm pain declined from resp. 5/10 and 6/10 (mean preop) to 1/10 and 0/10 (mean 6 months postop). NDI diminished from 44/50 to 9/50 at 6 months postop. The recovery period is longer in patients with a preoperative important reduced disc height. We report a high percentage of patient satisfaction (mean satisfactionrate of 9,5/10 at 6 months postop) and all patients would have decided again for this surgery. No complications related to the implant procedure are reported. Nevertheless there's a learning curve in implanting this type of prosthesis to prevent the prosthesis ending up in a postoperative kyphotic position. No spontaneous fusion or ossification of the longus colli muscle was seen.

*Conclusions* : This preliminary results are very encouraging in treating degenerative pathology of the cervical spine with PRODISC-C total disc replacement. The implant technique is easy, not destructive and with a steep learning curve, although specific attention have to be taken in the angulation of insertion. Further follow up is needed in differentiating the ideal indication for cervical arthroplasty.

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**Use of 5 ALA-induced porphyrin fluorescence guidance in resection of high-grade gliomas.** H. COLLE, B. NOENS, G. ALESSI, B. D'HAEN, L. DE WAELE (Dpt of Neurosurgery, St Lucas Hospital, Ghent).

*Background* : The extent of tumour removal seems to be the most important therapeutic factor determining outcome in malignant gliomas. However, intraoperative identification of tumour tissue, differentiating it from normal or oedematous brain tissue is usually based on subjective evaluation. The ultimate goal remains to determine on objective criteria the boundary between non-functional tumour tissue that has to be removed and normal , particularly functional areas.

*Methods* : Preoperative administration of 5-aminolevulinic acid (5-ALA), a metabolic precursor of protoporphyrin IX ( PpIX), accumulated in neoplastic tissue induces an intra-operative fluorescence in the tumour, except in its necrotic parts, when illuminated with violet-blue light (375-440 nm) provided by the operative microscope. A prospective study in 52 glioblastoma multiforme (GBM) patients by W. Stummer e.a. compared pre- and early postoperative contrast enhancement on MRI, with relation to patient's characteristics, survival, Karnofsky Performance Scale KPS) and residual enhancement ; the completeness of resection seemed related to postoperative MRI-findings and to survival.

*Results* : Since June 2004, 25 patients were treated in our department with resection of suspected high grade glioma after administration of 5-ALA .Intra-operatively, the metabolic most active parts, usually where contrast enhancement on MR-T1 or on SPECT-scan is prominent, are coloured intensely red, as glowing charcoal. A pink-coloured transition area to normal blue tissue can occur. There seems to be a remarkable correlation between the degree of the contrast enhancement, the intensity of fluorescence and the degree of malignancy on biopsy specimens. Immediate postoperative MRI confirmed the completeness of tumour resection as expected from the remainder of intra-operative fluorescence or not. The toxicity of 5-ALA is very low at the used dose of 10 mg/kg body weight. The phototherapeutic properties of fluorescence are still under investigation.

*Conclusion* : 5-ALA-Fluorescence guidance provides a safe and effective method for visualisation of high-grade glioma -tumour tissue, supplying control of completeness of the resection at the end of the procedure.

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**Extensive epidural and paraspinal follicular Non-Hodgkin lymphoma.** F. SCHOLTES, M. SCHOLSEM, G. MATUS, P. DEFÈRE, J. F. TSCHIBANDA, M. F. FASSOTTE, D. MARTIN, J. LENELLE (Dept. of Neurosurgery, Liège University Hospital, Sart Tilman B35, 4000 Liège).

A 61 year-old patient, who had a history of several months of back pain, was admitted with severe progressive paraparesis and paresthesia in the lower limbs and genitalia, associated with slight sphincter dysfunction, which had appeared over several days. At admission, the patient was unable to walk by himself. Neurological examination showed paraparesis with bilateral Babinski's sign and hypoesthesia below level T12. General physical examination was unremarkable, including the absence of enlarged lymph nodes or spleen. MRI revealed an extradural abnormal process filling the spinal canal, encompassing segments T6 to T10 and compressing the spinal cord. It extended through the intervertebral foraminae and infiltrated the paraaortic soft tissue. Bony structures including vertebral bodies were spared. Among different therapeutic approaches, including radiotherapy, the option of surgical decompression was chosen : laminectomy T6-T11 with resection of the intraspinal portion of the tumor. Significant neurological recovery occurred over the days following surgery ; the patient is currently able to walk. Pathological analysis of the excised tissue showed grade 1 follicular non-Hodgkin lymphoma. No other localization could be found in extensive investigations. The patient was treated with standard chemotherapy ("CHOP"). The unusual imaging data (including MRI and intraoperative photography) is presented. Primary epidural lymphoma and the exceptional follicular phenotype in this location are briefly discussed, as well as the role of surgical spinal cord decompression in the setting of subacute paraparesis.

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**Mesial temporal lobe disconnection without resection for epilepsy surgery.** N. MASSAGER, D. MORELLI, B. LEGROS, P. VAN BOGAERT, P. TUGENDHAFT, J. BROTCHE, M. LEVIVIER (Dept. of Neurosurgery and Neurology, University Hospital Erasme, Brussels, Belgium).

*Objective* : To define the results of a surgical procedure of mesial temporal lobe disconnection without resection for patients with intractable temporal epilepsy.

*Material & Methods* : Between April 2002 and July 2004, 9 patients (median age, 30 yr ; range 15-48 yr ; male/female ratio, 5/4) were operated on for drug-resistant mesial temporal lobe epilepsy. The surgical procedure consisted of a functional disconnection of the mesio-temporal structures from the rest of the brain parenchyma using neuronavigation and peroperative MR control ; the temporal parenchyma was left in place. A postoperative MRI was performed 2 days and 2 months after surgery. Patients were followed clinically in order to assess seizures outcome and complications related to this procedure.

*Results* : The follow-up period ranged from 6 to 30 months (median, 18 months). Nine patients (78%) were seizure-free after surgery (Engel class Ia), and 2 patients had worthwhile seizure improvement (Engel class IIIa). One patient developed post-operative hemiparesis due to vascular injury involving perforators supplying the internal capsule ; no other complication occurred. Early postoperative MRI showed complete disconnection of the mesio-temporal structures and slight edema of the temporal lobe ; no temporal ischemia developed.

*Conclusion* : A surgical procedure of functional disconnection of the mesio-temporal lobe structures seems to be a safe and effective therapy for intractable temporal epilepsy, similar to the standard surgical resection. This procedure may reduce complications of temporal lobectomy such as postoperative subdural hematoma or oculomotor nerves palsy by avoiding temporal lobe removal and extensive microdissection of the hippocampus-fornix complex closed to the brainstem.

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**Spinal meningeal cysts : are they fully understood ?** R. RASSCHAERT, D. VAN ROOST, J. CAEMAERT (Universitair Ziekenhuis Gent).

*Introduction* : Extradural meningeal cysts, occult sacral meningoceles, Tarlov's perineurial cysts, spinal nerve root diverticula, and intradural arachnoidal cysts are related entities, for which the common term "spinal meningeal cysts" (SMCs) was coined. SMCs can be classified into 1) an extradural type without spinal nerve root fibers contained in it, 2) an extradural type with spinal nerve root fibers, and 3) an intradural type. They are actually diverticula of the spinal meningeal sac, the nerve root sheath, or the arachnoid, that originate from a leak or from a partial or complete obstruction of the spinal CSF compartment. Frequently a valve mechanism is involved in building up a pressure gradient. Therapy may consist respectively in closing an ostium, resecting or marsupializing the cyst, or shunting.

*Patients and Methods* : During the last year we treated four patients with large sacral SMCs. In one case a cysto-intrathecal catheter was placed using a puncture technique, with good result. In two cases a cysto-peritoneal shunt was installed, followed in one by an endoscopic exploration. The fourth patient had already been operated on elsewhere, with cyst resection and duraplasty, but the complaints of low back and sciatic pain recurred. Endoscopic exploration revealed quite large a connection between the lesion and the normal CSF compartment above, and this connection was still

widened with an inflatable balloon. As the complaints persisted, repeated endoscopy confirmed the patent CSF pathway and moreover showed that the nerve roots fibers were stretched against the cyst wall. These findings led us to install a cysto-peritoneal shunt, which indeed stopped the lumbosacral pain, but caused a new resistant headache, suggestive of CSF overdrainage. Increasing the resistance of the programmable shunt valve did not solve the problem. Finally the shunt was removed, the headache subsided, and the original lumbosacral pain recurred.

*Conclusion* : Apparently, merely the widened lumbosacral meningeal sac, in absence of any CSF obstruction or hydrocephalus, can cause complaints. Hydrostatic pressure acts not differently in such an ampullary dilatation of the meningeal sac and in a normal sac. We infer that also the dynamic and pulsatile features of CSF play a decisive role in generating these complaints.

### **Connexin 30 expression in high grade gliomas : correlation with survival and resistance to ionizing radiation.**

P. A. ROBE<sup>1,4</sup>, M. NGUYEN-KHAC<sup>1</sup>, M. DEPREZ<sup>2</sup>, F. PRINCEN<sup>4</sup>, I. RUTTEN<sup>3</sup>, D. MARTIN<sup>1</sup>, A. STEVENAERT<sup>1</sup>, A. BOURS<sup>4</sup> (Departments of <sup>1</sup>Neurosurgery, <sup>2</sup>Pathology, <sup>3</sup>Radiation therapy and <sup>4</sup>Human Genetics, University Hospital of Liège, Liège, Belgium).

The records of a series of 50 patients with anaplastic astrocytoma or glioblastoma treated at our institution were reviewed. Sufficient information and residual surgical specimen were available for 45 of these 50 patients. Pathological diagnostic was anaplastic astrocytoma in 2 patients and glioblastoma multiforme in 43. Connexin 30 (Cx30) expression was assessed in all tumor specimen by immunohistochemistry and found in 31 patients only. The influence of Cx30 expression on survival was first assessed by Kaplan-Meier univariate analysis and found to differ significantly between Cx30+ and Cx30- patients ( $p = 0.0076$ , Mantel-Cox test). A Weibull model was then created and found appropriate to assess the contribution of Cx30 expression, age, pathological diagnostic, Karnofsky performance score, tumor localization, age and extent of resection on survival. In this model, using a backward stepwise elimination of covariates, Cx30 expression, age, pathology and tumor localization were found to significantly affect survival. Some correlation was however found by Chi square analysis between young age (< 50 years) and the absence of Cx30 expression ( $p = 0.0422$ ,  $\chi^2 = 4.127$ ), suggesting that Cx30 loss could occur preferentially in younger patients and thus influence the outcome. These results however contrast with our previously published observation that Cx30 restoration in C6 or 9L gliomas acts as a tumor repressor (Princen et al., *Carcinogenesis* 2001, 22 : 507-13). We have thus assessed the effect of Cx30 expression on the resistance of C6 and 9L cells to gamma-irradiation. In both cell lines, clones stably expressing Cx30 were found by clonogenic assay to better resist the inhibitory effect of single low dose irradiation (4Gy) than vector-transfected and wild-type cells. In conclusion, Cx30 expression appears as an independent marker of poor prognosis of high grade glioma patients and can protect these tumors from the effects of conventional radiation therapy.

### **Intracranial hypertension in proteus syndrome : a case report.** J.-B. DANDINE, S. JAMES, A. VAN GARSSE, J. D. BORN (CHR de la Citadelle – Liege).

*Introduction* : Proteus syndrome, described for the first time by Cohen and Hayden in 1979, is a sporadic congenital poly-malformation syndrome named for its highly variable manifestations. The disease causes particularly craniofacial overgrowth and central nervous system abnormalities

*Case Report* : We report the case of a 36-year-old male patient with several malformations including skull hyperostosis and huge frontal sinus hypertrophy crushing the brain. He complained of increasing = headache since 5 years. A cerebrospinal fluid pressure measurement was performed by lumbar puncture during several hours, showing a severe hypertension with A and B waves. The patient underwent a fronto-parietal = craniectomy, which allows a partial decompression. Postoperatively headaches decreases and intracranial pressure was normalized.

*Discussion* : Proteus syndrome is a genetic disease in a mosaic pattern. = Only hundreds cases are reported, mostly in childhood. Many authors think that Joseph Merrick, the Elephant Man, reached by the Proteus. Common manifestations include disproportionate overgrowth of the limbs = and the skull, various subcutaneous tumors, vascular malformations and facial phenotype. Brain abnormalities are not common in this syndrome. When present, hemi-megalecephaly and migrational disorders are typically seen, commonly with an associated backwardness (20 %) or seizure disorder (13 %).

*Conclusion* : Intracranial hypertension is described for the first time in this syndrome. A decompressive craniectomy, limited by particular anatomical structures, allows intracranial pressure normalisation and clinical improvement.

**Symptomatic pituitary metastasis.** M. SCHOLSEM, A. DUBUISSON, P. ROBE, M. DEPREZ, A. STEVENAERT, D. MARTIN (Neurosurgery department, C.H.U. Liège, Belgium).

Pituitary metastasis are rare. Less than 1% of pituitary tumor resections concern metastasis. They usually occur as a complication of systemic cancer typically seen in elderly patients with diffuse malignant disease. The involvement is frequently microscopic, clinically silent and without radiological modifications. We present three patients where a pituitary metastasis was the first manifestation of either a cancer or the metastatic dissemination of a previously diagnosed neoplasm. Case 1 : A 71-year-old man, with no history of malignancy, presented with recent onset of diabetes insipidus and progressive anterior hypopituitarism. MRI revealed a large intra- and suprasellar mass. A transsphenoidal resection was performed and pathology disclosed a metastasis of a pulmonary adenocarcinoma. Case 2 : A 52-year-old man, with no medical history, presented with asthenia and a polyuropolydispsic syndrome. An ophthalmologic evaluation revealed a bilateral deterioration of visual acuity and visual fields. MRI showed a large intra- and suprasellar mass with sellar destruction. Transsphenoidal and transcranial surgeries were performed and revealed a mucus-producing adenocarcinoma. No primitive tumor was found on postoperative investigation. Case 3 : A 55-year-old woman presented with ophthalmoplegia and visual loss one year after having been diagnosed with a breast cancer. MRI showed a large intra- and suprasellar mass compressing the optic chiasm. A transsphenoidal resection was performed and pathology disclosed a metastasis of the breast carcinoma. Pituitary metastasis should be considered in the differential diagnosis of pituitary masses especially for patients with symptoms such as rapidly evolving diabetes insipidus, ophthalmoplegia or anterior pituitary dysfunction.

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**Compressive ulnar neuropathy by a giant lipoma of the arm.** V. SCORDIDIS<sup>1</sup>, E. URBAIN<sup>1</sup>, M. GOBERT<sup>1</sup>, B. LILOT<sup>2</sup> (Services des Neurosciences<sup>1</sup> et Radiologie<sup>2</sup>, Clinique Reine Fabiola).

*Introduction* : Compressive ulnar neuropathy is a well know phenomenon in the neurosurgeon practice as entrapments at different levels of the nerve are possible. Extrinsic compression by tumours is relatively rare and even more when lipomas are concerned. Some reports mention Guyon's canal lipoma causing ulnar neuropathy. We report a very unusual case of proximal ulnar neuropathy related to compression by a giant brachial lipoma.

*Case report* : In September 2004, a 51 year-old man complained of progressive weakness in the left hand, since many years. Clinical examination showed a typical severe motor ulnar neuropathy. A large mass in the median third of the arm was palpable in the posteromedial quadrant of the limb. The mass was present for many years. Electromyography confirmed axonal sensorimotor neuropathy of the ulnar nerve with conduction block between Erb's point and the elbow, correlating the compressive effect of the mass. Echography of the arm revealed a huge mass of the posteromedial lodge of the arm, firm, hypovascular, in the medial bundle of the triceps muscle. The mass is homogeneous and well circumscribed and significantly displaces the ulnar nerve. MRI showed a 53x80x120 mm tumour. First diagnosis mentioned a voluminous benign lipoma. Surgery was performed with electrostimulation monitoring of the nerve trunks. The mass was totally removed sparing all neurovascular structures. Histology confirmed the diagnosis of a benign lipoma. The postoperative course was uneventful and the patient began motor recovery next day after surgery.

*Discussion* : As no cases have been reported, we discuss the possible mechanisms of occurrence, diagnosis and management in our case.

*Conclusion* : Lipoma of the arm is a very rare cause of proximal ulnar neuropathy. When the clinical syndrome is clearly attributable to the lesion, treatment is surgical removal for decompression of the nerve. It can be safely done with electrophysiological monitoring. Functional improvement is rapidly obtained after surgery.

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**Surgical approach to glomus jugulare tumors. The primary treatment.** G. BESSEMANS, L. F. DE WAELE (Gent).

Glomus jugulare tumors (GJT) are rare, normally benign, paragangliomas located in and around the jugular foramen at the base of the skull. Because of their location, treatment may be necessary to relieve symptoms. Although radiotherapy is used to control the majority of these tumors, disadvantages are a prolonged therapy interval and exposition of adjacent brain tissue to irradiation. Initially, the patient had been correctly diagnosed with GJT in 2001, which resulted in a conservative treatment. In 2004 this 64 year old woman was admitted to our hospital because of pulsatile tinnitus and tongue atrophy. MRI provided evidence for exceptional growth of the GJT. Therefore she was treated by the "extreme-lateral inferior transcondylar-transstercular exposure" (ELITE) approach. Postoperative outcome revealed only one complication ; a minor facial paresis. Resection, while frequently difficult, is the primary treatment for GJT. The most common complications are caused by nerve damage, persistent leakage of cerebrospinal fluid from the ear and palsy of one of the cranial nerves. For those GJT which cannot be totally removed by surgery, or when surgery is not possible, radiotherapy or radiosurgery may be recommended.

**Cavernous malformations in the University Hospital of Leuven, 1992-2005.** M. VAN DEN HOUT, J. VAN LOON, F. VAN CALENBERGH, J. GOFFIN (University Hospital of Leuven).

*Introduction* : This review presents the results of a retrospective study of all cavernous malformations treated in the University Hospital of Leuven in the period from 1992 until 2004.

*Patients and Methods* : In total there were 95 cases of cavernous malformations during this period. In sixteen cases there were multiple cavernomas. In fifty-two cases the cavernoma presented with neurological symptoms caused by intracerebral or intraspinal haemorrhage. Of these, twenty-seven (52%) were found supratentorially, thirteen (25%) in the brain-stem, nine (17%) in the cerebellum and three (6%) were found in the spinal region. In twenty-five cases the cavernoma presented with epilepsy. All of these were situated supratentorially. Seventeen cavernomas were found because of their mass effect, headache, or incidentally. In fourteen patients (15%) there was an associated venous malformation. For every patient an individual therapeutic decision was made based on the clinical situation, localisation of the lesion and estimated risk of future haemorrhage. For the cavernomas associated with haemorrhage, we used the Modified Rankin Scale (MRS) to evaluate the surgical outcome.

*Results* : Seventy-two (76%) of all cavernous malformations were operated on. Of those, forty were diagnosed because of haemorrhage and twenty-three had epilepsy as the presenting symptom. For the cavernous malformations which presented with haemorrhage the outcome after surgery was excellent : the MRS improved in twenty-four (60%) patients. In fifteen (38%) the scale stayed the same and only in one patient the outcome was worse. The mean follow-up period for this group was twenty-six months. For the epilepsy-related cavernous malformations the outcome after surgery was also very good : in fourteen cases (61%) there were no reported seizures after surgery at all, and in eight cases (35%) the seizure rate was significantly lower. Only in one case surgery had no beneficial effect on the seizure rate. The mean follow-up period for this group was thirty-three months. There were no patients treated conservatively who showed a major bleeding during follow up.

*Conclusions* : The results after surgical treatment of cavernous malformations in selected patients were very satisfactory. Both epilepsy and the prevention of haemorrhage seem to be good indications for surgical resection.

**Correlation between fiber dissection and diffusion tensor imaging of the anterior temporal lobe and the frontotemporal region.** H. ARDON<sup>1</sup>, S. SUNAERT<sup>2</sup>, D. PEUSKENS<sup>1</sup>, J. GOFFIN<sup>1</sup>, J. VAN LOON<sup>1</sup> (Departments of Neurosurgery<sup>1</sup> and Radiology<sup>2</sup>, University Hospital Leuven, Belgium).

*Objective* : In recent years diffusion tensor imaging (DTI) has provided information about the structural organization and orientation of white matter fibers, and different connections between the temporal, frontal and occipital lobes have been revealed through the technique of 'tractography'. Almost all studies use tractography in the living human brain and therefore the correlation between the results of the DTI and the 'real' three-dimensional structure of the white matter tracts, as shown by fiber dissection, has never been described. This study was performed to evaluate this correlation and to demonstrate the usefulness of both techniques in understanding the white matter anatomy of this region.

*Methods* : Six hemispheres obtained at routine autopsy were examined using magnetic resonance imaging (MRI) with DTI at 3.0 T. Following the MRI the specimens were dissected by use of Klingler's fiber dissection technique after preparation by fixation and freezing. The dissections were performed with an operating microscope in a stepwise pattern of progressive white matter dissection.

*Results* : The different fiber tracts of the anterior temporal lobe and the frontotemporal region are visualized by DTI revealing the three-dimensional courses of these tracts. The dissection, described in an orderly fashion, reveals the same tracts and there is a relatively good correlation between the two for the major tracts. However, visualization of the smaller white matter tracts, especially at the crossing of different fibers, is difficult with the current DTI technology.

*Conclusion* : The anterior temporal lobe and the frontotemporal region contain several important white matter tracts that can be very well demonstrated by performing a white matter dissection, but also by performing a 'virtual' dissection by means of DTI. Since there is a good correlation between the results of both techniques, DTI probably is a useful tool for preoperative visualization of the white matter anatomy of this region, which can have its benefits for surgical procedures on the anterior temporal lobe.

**Choroid plexus neoplasms. Experience at a single neurosurgical centre.** S. JAMES, J. B. DANDINE, C. HOYOUX, J. M. REMACLE, J. D. BORN (CHR de la Citadelle, Liège).

*Objective* : Choroid plexus tumors (CPT) account for fewer than 1% of all brain tumors. Most cases present in children less than 2 years of age. While choroid plexus carcinomas (CPC) are reported to have an extremely poor prognosis, choroid plexus papillomas (CPP) are generally regarded as benign tumours with a very favourable long-term outcome. The objective of this study was to review our experience with this rare tumour.

*Methods and Patients* : We performed a retrospective review of 6 patients with choroid plexus neoplasms between October 1995 and August 2004. Two children had CPC based on pathologic criteria and 4 patients had CPP. A retrospective review of clinical symptomatology, radiological imaging, operation reports and pathology was performed.

*Results* : The mean age at presentation was 7 years (5-9) for CPC and 23 years (1-39) for CPP. All of them were females. All children had hydrocephalus (3/3) whereas in adults only one had hydrocephalus. Patients with CPP were initially treated with surgery alone whereas patients with CPC were treated with postoperative therapy that included chemotherapy, alone for one patient, and craniospinal irradiation and radiosurgery with Leksell gamma knife C for the other. All of the patients with CPP are alive with no evidence of disease. For the CPCs we gave them association of Carboplatin and Procarbazine, VP16 and Platinol, Vincristine and Cyclophosphamide each 1 week over 3, during one year. One of these patients is alive with no evidence of disease (111 months). The other one had further surgery, craniospinal irradiation, and two Gamma knife treatments for small brain metastasis.

*Conclusion* : In adults, hydrocephalus is not always the clinical sign of CPT whereas in younger patients progressive hydrocephalus is not uncommon, usually with rapid development. With modern neurosurgical practice, a cure should be the aim for all patients with CPT. However, CPC still has an extremely poor prognosis, and the efficacy of adjuvant therapy remains to be established.

### **A simplified extra-intracranial revascularization procedure with multiple burr holes in moyamoya disease.**

R. NDIKUMANA, E. FOMEKONG, M. C. NASSOGNE, PH. CLAPUYT, C. RAFTOPOULOS (Neurosurgery, Neuropaediatrics and Neuroradiology, Cliniques Universitaires Saint-Luc, Brussels).

*Objective* : Presenting our results about three extra intracranial revascularization procedures with multiple burr holes for the treatment of moyamoya disease in two patients.

*Observation* : Case one : A 23 year old woman experienced episodes of Transient ischemic attack with left side hemiparesis. A SPECT scan demonstrated a decrease of the vascular reserve in the territory of the right sylvian artery. Cerebral angiography revealed a right M1 occlusion with development of collateral termination vessels . Case two : A two year old boy presented 2 episodes of right hemiparesis. The CT scan and MRI showed a cerebro-vascular ischaemic attack (CVIA) in the left and right hemisphere. Cerebral angiography revealed a bilateral stenosis of A1 and M1. Operative Technique : Under general anesthesia, we realize 18 burr holes in the right fronto-temporo-parietal area in our first patient. The temporal muscle was not dissected and the superficial temporal artery was preserved. The dura matter was then opened in star shaped manner without coagulation. The flap was thereafter closed. Our second patient was operated on firstly on the left side, using the same technique, secondly 35 burr holes were made on the right side because of the extend of the CVIA.

*Results* : In both patients, clinical stability were observed 2 months following surgery. The angiography showed an important revascularization network from the external carotid artery, 9 months after surgery. The SPECT scan and MRI perfusion confirmed a good restoration of vascular reserve.

*Discussion* : The moyamoya syndrome is characterized by the progressive occlusion of the intracerebral portion of one or both internal carotid arteries or their terminal branches. Different techniques of revascularization have been described. Some of them are difficult and their effectiveness is still discussed. We used a simple technique creating a disruption of the osteodural envelopes to favor the development of an extra-intra cranial revascularization.

*Conclusion* : The treatment of the moyamoya syndrome by burr holes is an easy technique which gives good results.

### **Sacrococcygeal tumor arising in a tethered cord : case-report.** J. DECKERS, S. VAN GOOL, I. DE WEVER, F. VAN CALENBERGH (Department of Neurosurgery, Pediatric Oncology and Surgical Oncology, UZ Gasthuisberg, Leuven).

*Introduction* : Sacrococcygeal tumours are rare diseases, usually diagnosed in childhood, and histologically most often teratomas. Spinal dysraphic lesions in the form of lumbosacral lipomas are also rare, and present as a tethered cord syndrome or a subcutaneous mass. We encountered an exceptional case of an ependymoblastoma arising in a lumbosacral lipoma.

*Case presentation* : We present the case of a 4-year old girl who was coincidentally diagnosed with a large sacrococcygeal mass after having undergone abdominal CT-scan for septic peritonitis (perforated appendicitis). Clinical examination demonstrated a child with facial dysmorphism, psychomotor retardation and signs of lower and upper motor neuron disease in the lower limbs. MRI of the spine revealed a heterogeneous, contrast-enhancing and partially cystic tumor with spinal invasion at the S3-level, in continuity with a lipoma with tethering of the cord and partial sacral agenesis. The girl underwent 2 separate operations (neurosurgical untethering of the spinal cord and dural closure followed after 2 weeks by total en-bloc resection of the mass). Pathological examination identified a highly malignant primitive ependymoblastoma. She subsequently underwent adjuvant radio- and chemotherapy (HIT 2000 AB4-protocol).

*Discussion* : In the differential diagnosis of sacrococcygeal masses in childhood, both congenital and non-congenital, the congenital teratoma is the most frequent. In our case the ependymoblastoma in fact mimicked a sacrococcygeal teratoma. The association between this tumor and the sacral agenesis is not clear. However, ependymal cells are found in the tethered spinal cord up to the embryonal point of tethering : we can hypothesize that the malignant ependymoblastoma arose in these cells. The role of the unidentified dysmorphic syndrome remains speculative. To our knowledge this is the first case of an isolated sacro-coccygeal ependymoblastoma.

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**Treatment strategy in the management of brain cavernomas.** A. JANKOVSKI, N. MASSAGER, M. LEVIVIER, O. DE WITTE, B. PIROTTE, F. LEFRANC, A. LUBANSU, J. BROTCCHI (Dept. of Neurosurgery, University Hospital Erasme, Brussels, Belgium).

*Introduction* : Until a few years ago, two options could apply to the management of cavernomas : surgery or not surgery, depending on the empirically based surgical risk evaluation. Nowadays, the daily clinical use of newly available diagnostic and treatment tools has led our department to define a new treatment algorithm for cavernomas.

*Material and Methods* : Between 2000 and 2004, 58 patients were treated for cerebral cavernomas in our department. Among these, 53 were treated by surgery (including 29 patients using preoperative image-guidance), and 5 were treated by gamma knife radiosurgery. Retrospective analysis of these cases led us to define the following groups : Group 1, lesions located in non-functional areas ; group 2, located nearby a functional areas ; group 3, located in a functional area and under 3 cm diameter ; group 4, located in a functional area and over 3 cm diameter.

*Results* : Our population of patients is of 58 among which 36 females and 22 males with age ranging from 2 to 65 years old (mean = 38,9 years old). We established a treatment algorithm in cavernomas management taking into consideration available diagnostic and therapeutic tools. 1- Groups 1&2. Cavernomas located in non-functional area (24 patients) were operated without extensive pre- and peroperative investigations. For cavernomas located nearby a functional area (34 patients), functional MRI of the motor or speech areas and/or tractography were performed to determine if the lesion could be surgically removed, and peroperative image-guidance and/or MRI were used. 2- Groups 3&4. Cavernomas located in functional areas smaller than 3 cm in diameter (5 patients) were treated by radiosurgery. Cavernomas located in functional areas bigger than 3 cm (no patient in the studied population) should be followed without treatment. Thus, we had 24 patients in group 1 ; 29 patients in group 2 ; 5 patients in group 3 ; and no patients in group 4.

*Conclusions* : Surgical removal of cavernomas is the first-choice treatment. Preoperative functional MRI and tractography, and preoperative image-guidance and MRI allowed us to extend our surgical indications to areas considered at high risk for surgery. For inoperable cavernomas, GK radiosurgery may be a valuable therapeutic option.

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**Selective amygdalohippocampectomy for mesiotemporal epilepsy.** G. VAZ, C. RAFTOPOULOS, C. GRANDIN, C. GODFRAIND, K. VAN RIJCKEVORSEL (UCL, Bruxelles).

Surgical strategies for the treatment of mesiotemporal epilepsy are matter of discussion with few random and comparative data in the literature. Selective amygdalohippocampectomy (SelAH) for the treatment of mesiotemporal refractory epilepsy is considered an effective therapeutic option with a weak morbidity. We performed 29 AH with Brainlab Navigation System. This AH was selective in 26 patients for whom we show the results. These 26 patients (8 to 54 years, average 32 years, 5 males, 20 left SelAH) had all typical mesiotemporal seizures, refractory to several antiepileptic drugs. The presurgical evaluation confirmed the unilateral focus. There were no post-surgery complications. There is a mild visual field deficit in six patients, without clinical repercussion. There is no additive significant cognitive troubles post-surgery. The anatomopathological analysis confirmed a mesiotemporal sclerosis in 12 patients and various other diagnostics for the 14 other patients : 4 cases of reactive gliosis, 2 cases of microdysplasia, 6 cases of gliomas and 2 cases still in evaluation. Our results, based on Engel's classification, show that 20 patients have had either no more epileptic seizures or they had a clear improvement (class I and II). Only two patients had a poor enhancement (Class III). For the last 4 patients, though they are still seizure free, they cannot be classified in Engel's class I, because the follow up is insufficient. These results allow us to conclude that SelAH, a focused technique, is effective, and able to suppress or to strongly control mesiotemporal refractory seizures. Morbidity is weak at this time, restricted to limited visual field deficit without clinical repercussion (6 cases on 26).

**Gamma knife radiosurgery : A 5-year experience.** M. LEVIVIER, N. MASSAGER, D. DEVRIENDT, P. DAVID, F. DESMEDT, D. WIKLER, O. NISSIM, S. SIMON, P. VAN HOUTTE, J. BROTCHE (Centre Gamma Knife - Université Libre de Bruxelles, Hôpital Erasme & Institut J. Bordet).

*Introduction* : Radiosurgery is a widely used technique in neurosurgery for the management of numerous intracranial disorders. Leksell Gamma Knife<sup>®</sup> (LGK, Elekta, Sweden) is a dedicated radiosurgical tool delivering a high dose of radiation to a properly defined intracranial target in a single session.

*Methods* : In December 1999, the first world-wide commercially-delivered LGK C was installed at the Université Libre de Bruxelles (Hôpital Erasme). LGK C includes a robotic Automatic Positioning System<sup>™</sup>, allowing automatic sequential positioning of multiple isocenters during treatment. LGK treatment is performed by a multidisciplinary team ; involving neurosurgeons, radiation therapists and medical physicists, and includes a privileged collaboration with neuroradiologists. Except in pediatric patients, radiosurgery is performed under local anesthesia. Combined stereotactic MRI and CT is used in all patients. Stereotactic PET is also used in some specific indications.

*Results* : Between December 1999 and January 2005, 970 LGK treatments were performed. The most frequent indication (33%) is benign intracranial lesions, mostly vestibular schwannomas (17%) and meningiomas (16%). Local tumor control (LTC) was high (97-98%), with low side effects. This is exemplified in vestibular schwannomas, with more than 75% hearing preservation and no facial nerve injury. Brain metastases represents an increasing indication, reaching 29% of the cases. This reflects the high LTC (over 80%) with an impact on survival and quality of life. We developed an original stratification system allowing to better define patients that will benefit the most from the procedure. Trigeminal neuralgia has become the third major indication (15%) : with clinical results equivalent to those of microsurgery and percutaneous techniques, it is a first choice because of its lowest invasiveness. Other benign lesions of the skull base include schwannomas of other cranial nerves, glomus tumors, and pituitary adenomas. The latest, as well as most glial tumors, and some metastases (mostly in case of LGK retreatment) were treated with PET guidance.

*Conclusion* : The treated indications of our series reflect the current trends of the use of radiosurgery in neurosurgical disorders. Our 5-year experience confirms that LGK radiosurgery is a safe and efficient procedure ; LTC and functional benefit are high, and complications related to the treatment are very low. (Supported by the Loterie Nationale and the Ministère de la Politique Scientifique, Belgium).

**Spinal cord stimulation for failed back surgery syndrome : effectiveness and complications in 62 consecutive patients.** J. MASUDI, B. PIROTTE, PH. VOORDECKER, A. JOFFROY, N. MATHIEU, L. DEJONGHE, C. CHALTIN, N. MASSAGER, J. BROTCHE, M. LEVIVIER (Department of Neurosurgery, ERASME Hospital, Université Libre de Bruxelles, 808, route de Lennik, 1070 Brussels, Belgium).

*Introduction* : Spinal cord stimulation (SCS) is useful in patients with failed back surgery syndrome (FBSS). Technical advances in electrode design and patient selection have led to improve pain control. The level of evidence for the long-term efficacy of SCS in FBSS remains insufficient and the complication rate is highly variable across case series. In the present single-center retrospective analysis, we assessed the efficacy and safety of SCS in patients with FBSS.

*Methods* : 62 FBSS patients (27 males / 35 females ; mean age 52,3 years) were treated in the department of Neurosurgery of Erasme hospital, Brussels. Previous lumbar surgery consisted in a single L5S1 (n = 27), L4L5 (n = 20), L3L4 (n = 1) or L2L3 (n = 1) disc surgery, L3L4L5 laminectomy (n = 5) or multiple lumbar disc procedures (n = 8). All patients suffered from sciatic chronic pain (mean duration : 28 months ; bilateral in 9). The management criteria of Belgian Institute of Social Security were strictly respected for obtaining the implants reimbursement. Electrode (Medtronic<sup>®</sup>, Minneapolis, MA) implantation (Quad in 8, Resume II in 32 or Specify in 22) was followed by a 4-week test period during which distribution of paresthesia, level of pain relief (Visual Analog Scale) and functional benefit were recorded. A subcutaneous stimulator was thereafter implanted in good responders. For each patient, post-operative evaluations (6, 12, 24 and 48 months after implantation) were performed to assess pain relief and SCS complications.

*Results* : SCS-induced paresthesia covered the painful segment in 50 patients in whom a significant pain relief was found (> 70% pain relief in 34 ; > 50% in 16) (SCS effectiveness : 80% of pain relief > 50%). Paresthesia covered incompletely the pain distribution in 12 cases (Pain relief < 50% in 8 ; no analgesia in 4). After 24 months, mean 60% pain relief was achieved as assessed with the neuropathic pain score whereas low-back pain was moderately reduced (29%). we interviewed patients for assessing longer follow-up. Fourteen (22%) patients experienced complications (electrode migration 3, disconnection 2, infection 3, uncomfortable paresthesia 2, contralateral paresthesia 4) needing surgical exploration/withdrawal in 9.

*Conclusion* : This study confirms a clear analgesic effectiveness on neuropathic sciatalgia of FBSS (80%), and moderate attenuation of low-back pain.

**Multiple spinal metastases of a glioblastoma multiforme : a case report.** B. D'HAEN, G. ALESSI, G. BESSEMANS, B. NOENS, H. COLLE, L. F. DE WAELE (Department of Neurosurgery, AZ St Lucas, Ghent).

*Introduction* : Glioblastoma multiforme is a highly malignant tumor of the central nervous system (CNS) with aggressive histological features and an extraordinarily poor clinical outcome. However, the extraneural metastasis of glioblastoma multiforme is distinctly unusual.

*Methods* : We describe a 41-year old male patient who was initially treated for a left frontal glioblastoma multiforme with a complete resection of the tumor. Patient received postoperative radiotherapy for six weeks. Patient presented 4 months postoperatively with severe neck- and back pain. No neurologic deficit was noted at that time. Magnetic resonance imaging revealed a compressive mass at the level of the sixth thoracic vertebra. According to its aspect, the lesion was first considered wrongly as a spinal meningioma, and resection was planned. After two weeks, patient developed a complete paraplegia with urinary and stool incontinence. New MRI revealed a dramatic increase of the volume of the first lesion and other lesions were seen at level Th2, Th4 and L2. Due to the presence of multiple lesions, no surgical treatment was proposed. Local radiotherapy on the compressive metastasis did not change the mass of the tumor. Patient died two weeks later.

*Discussion* : Metastases of a glioblastoma multiforme are rare. Several explanations have been postulated. One of the important considerations is the absence of cerebral lymphatic vessels. Another is the unique vasculature of the CNS with vascular walls which are either too thick or too thin to allow metastatic penetration. Another reason for the rarity of metastases from glioblastoma multiforme may be because of the poor prognosis, which includes very short patient survival times. The number of spontaneous extraneural metastasis without previous neurosurgical intervention is very rare. Therefore, it appears that the most frequent single factor in the development of extraneural metastasis is the direct access of glioblastoma multiforme cells to the extrameningeal tissues which can be caused by surgery.

*Conclusion* : Spinal lesions in patient treated for glioblastoma multiforme should be considered as metastases until the contrary is proven. Outcome of these lesions is very poor.

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**Gamma Knife (GK) radiosurgery for small brain metastases.** O. NISSIM, D. DEVRIENDT, N. MASSAGER, P. DAVID, F. DESMEDT, O. COUSSERT, S. SIMON, P. VAN HOUTTE, J. BROTCHE, M. LEVIVIER (Centre Gamma Knife – Université Libre de Bruxelles, Hôpital Erasme & Institute J. Bordet).

*Background and Purpose* : With the advent of high resolution MRI and tighter follow up, more patients are found to harbor small and often multiple brain metastases (BM). Radiosurgery plays an important role, together with conventional microsurgery and whole brain radiotherapy, in a comprehensive treatment strategy for these patients. Here, we evaluate the efficacy of GK radiosurgery in controlling small BM while considering the potential effect of various maximal radiation doses on response rates.

*Methods* : Between January 2000 and December 2004, 281 patients harboring BM have been treated with GK radiosurgery. A subgroup of 134 small lesions (in 56 patients) measuring up to 100 mm<sup>3</sup> in volume received maximal doses ranging from 24.5 to 53.3 Gy (between 18 to 24 Gy to the 45- 85% isodose line). Changes in tumor size were evaluated by sequential MR images.

*Results* : Sixty-one lesions were available for follow up, 3-43 months (median 10 months) after treatment. Tumor control was achieved in 89% of lesions (41% reduction and 48% stabilization in size). Increased lesion volume was recorded 4-16 months post treatment in 3 patients harboring 7 lesions. Of these patients, one had two lesions that were considered inactive by PET with FDG. In another patient, one lesion that had expanded initially subsequently began to decrease in volume ; MR spectroscopy suggested inactive tumor. A second lesion continuously enlarged 7 and 10 months after treatment. In a third patient, 3 lesions were expanding, 4 months after treatment. The last 2 patients also had other lesions that responded favorably. Data analyses revealed that difference in response could not be attributed to pretreatment parameters (tumor size, nature of the primary disease) or to the maximal dose delivered. In the two cases with partial treatment response there was no distinctive pattern predictive of change per lesion treated.

*Conclusions* : GK radiosurgery for patients with small BM can achieve high tumor control rate irrespective of the maximal dose delivered. It can be administered in one session, treating simultaneously lesions of different size and location, and serves as an important adjunct to multi-modality treatment of these patients.

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