Pakistan Journal of Neurological Sciences (PJNS)

Volume 2 | Issue 1 Article 8

4-2007

Neurosurgery

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NEUROSURGERY

COMMENTARY

Just over three decades ago, in a special article entitled “Neurosurgery may die”, published in New England Journal of Medicine (Bergland RM: Neurosurgery may die. N Engl J Med 288:1043-1046, 1973), Bergland commented that “Neurosurgery has stopped evolving.” He could not have been more wrong. With better understanding of human body and the mysteries of human mind, aided with the advent of microneurosurgery and phenomenal advances in neurodiagnostics, especially neuroimaging, we can now boast of being the most rapidly evolving and the most complex surgical specialty. This month's selected abstracts are just a glimpse of how far we have come, not as neurosurgeons, but as neuroscientists who can operate.

This month we have selected six articles from recently published neurosurgical journals, all from different areas of neurosurgery. The first is a basic sciences research conducted by Nishio et al which looks into the prospects of recovery following spinal cord injury. No specific disease has aroused so much interest and funding as complete Spinal Cord Injury (SCI), ever since the American movie star Christopher Reeve's accident. In this study, Nishio et al transplanted CD34-positive fraction from hemopoietic stem cells, derived from human umbilical cord blood, and noticed improved functional recovery, reduced area of cystic cavity at the site of injury, increased volume of residual white matter, and sparing of axons in the injured spinal cord. These surely are promising results. In the next Neuro-oncology case series, Sindou et al have reported their experience with intracranial meningiomas involving major venous sinuses and have also presented a practical classification of such meningiomas. This is a large series, comprising of one hundred cases, with mean follow up of eight years, showing a recurrence rate of just four percent. The authors have attempted sinus reconstruction in 45 patients and report overall better outcomes in these patients advocating venous flow restoration. In the next selected article concerning Neurotrauma, Stiefel et al have challenged the conventional parameters of brain injury monitoring and management. Although their findings are based on a small sample size of 25 patients, the authors have shown, using brain tissue oxygen levels, that brain resuscitation based on control of ICP and CPP may not prevent cerebral hypoxia in some patients. The authors question whether the definition of adequate brain resuscitation after TBI requires reconsideration.

In the next article, Mocco et al have studied the pre and post operative CT scans of patients with idiopathic normal pressure hydrocephalus undergoing ventriculoperitoneal shunts. The authors have observed statistically significant change in the diameters of the midbrain at the pontomesencephalic junction, implicating a possible mechanism for post-operative gait improvement. In the next selected article, Burkhard et al have reviewed the literature for synthetic nerve implants and have presented their recommendations based on their observations. The last article is an interesting, very well researched, and equally well written article on the history, evolution and current status of surgical treatment for neuropsychiatric disorders. An extremely difficult topic effectively addressed by the authors Chris et al, including Michael LJ. Apuzzo.

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Journal of Neurosurgery Spine. 2006 Nov;5(5):424-33

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THE USE OF HEMOPOIETIC STEM CELLS DERIVED FROM HUMAN UMBILICAL CORD BLOOD TO PROMOTE RESTORATION OF SPINAL CORD TISSUE AND RECOVERY OF HINDLIMB FUNCTION IN ADULT RATS

OBJECT: The use of human umbilical cord blood (HUCB) cells has been reported to improve functional recovery in cases of central nervous system injuries such as stroke, traumatic brain injury, and spinal cord injury (SCI). The authors investigated the effects of hemopoietic stem cells that were derived from HUCB and transplanted into the injured spinal cords of rats. METHODS: One week after injury, an HUCB fraction enriched in CD34-positive cells was transplanted into the experimental group. In control animals, vehicle (Matrigel) was transplanted. Recovery of motor functions was assessed using the Basso-Beattie-Bresnahan Locomotor Scale, and immunohistochemical examinations were performed. Cells from HUCB that were CD34 positive improved functional recovery, reduced the area of the cystic cavity at the site of injury, increased the volume of residual white matter, and promoted the regeneration or sparing of axons in the injured spinal cord. Immunohistochemical examination revealed that transplanted CD34-positive cells survived in the host spinal cord for at least 3 weeks after transplantation but had disappeared by 5 weeks. The transplanted cells were not positive for neural markers, but they were positive for hemopoietic markers. There was no evidence of an immune reaction at the site of injury in either group. CONCLUSIONS: These results suggest that transplantation of a CD34-positive fraction from HUCB may have therapeutic effects for SCI. The results of this study provide important preclinical data regarding HUCB stem cell-based therapy for SCI.

J Neurosurg. 2006 Oct; 105(4):514-25.

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RESULTS OF ATTEMPTED RADICAL TUMOR REMOVAL AND VENOUS REPAIR IN 100 CONSECUTIVE MENINGIOMAS INVOLVING THE MAJOR DURAL SINUSES

OBJECT: Radical removal of meningiomas involving the major dural sinuses remains controversial. In particular, whether the fragment invading the sinus must be resected and whether the venous system must be reconstructed continue to be issues of debate. In this paper the authors studied the effects, in terms of tumor recurrence rate as well as morbidity and mortality rates, of complete lesion removal including the invaded portion of the sinus and the consequences of restoring or not restoring the venous circulation. METHODS: The study consisted of 100 consecutive patients who had undergone surgery for meningiomas originating at the superior sagittal sinus in 92, the transverse sinus in five, and the confluence of sinuses in three. A simplified classification scheme based on the degree of sinus involvement was applied: Type I, lesion attachment to the outer surface of the sinus wall; Type II, tumor fragment inside the lateral recess; Type III, invasion of the ipsilateral wall; Type IV, invasion of the lateral wall and roof; and Types V and VI, complete sinus occlusion with or without one wall free, respectively. Lesions with Type I invasion were treated by peeling the outer layer of the sinus wall. In cases of sinus invasion Types II to VI, two strategies were used: a nonreconstructive (coagulation of the residual fragment or global resection) and a reconstructive one (suture, patch, or bypass). Gross-total tumor removal was achieved in 93% of cases, and sinus reconstruction was attempted in 45 (65%) of the 69 cases with wall and lumen invasion. The recurrence rate in the study overall was 4%, with a follow-up period from 3 to 23 years (mean 8 years). The mortality rate was 3%, all cases due to brain swelling after en bloc resection of a Type VI meningioma without venous restoration. Eight patients-seven of whom harbored a lesion in the middle third portion of the superior sagittal sinus-had permanent neurological aggravation, likely due to local venous infarction. Six of these patients had not undergone a venous repair procedure. CONCLUSIONS: The relatively low recurrence rate in the present study (4%) favors attempts at complete tumor removal, including the portion invading the sinus. The subgroup of patients without venous reconstruction displayed statistically significant clinical deterioration after surgery compared with the other subgroups ($p = 0.02$). According to this result, venous flow restoration seems justified when not too risky.

J Neurosurg 2006 Oct; 105(4):568-75.

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CONVENTIONAL NEUROCRITICAL CARE AND CEREBRAL OXYGENATION AFTER TRAUMATIC BRAIN INJURY

OBJECT: Control of intracranial pressure (ICP) and cerebral perfusion pressure (CPP) is the foundation of traumatic brain injury (TBI) management. In this study, the authors examined whether conventional ICP- and CPP-guided neurocritical care ensures adequate brain tissue O2 in the first 6 hours after resuscitation. METHODS: Resuscitated patients with severe TBI (Glasgow Coma Scale score < or = 8 and Injury Severity Scale score > or = 16) who were admitted to a Level I trauma center and who underwent brain tissue O2 monitoring within 6 hours of injury were evaluated as part of a prospective observational database. Therapy was directed to maintain an ICP of 25 mm Hg or less and a CPP of 60 mm Hg or higher. Data from a group of 25 patients that included 19 men and six women (mean age 39 +/- 20 years) were examined. After resuscitation, ICP was 25 mm Hg or less in 84% and CPP was 60 mm Hg or greater in 88% of the patients. Brain O2 probes were allowed to stabilize; the initial brain tissue O2 level was 25 mm Hg or less in 68% of the patients, 20 mm Hg or less in 56%, and 10 mm Hg or less in 36%. Nearly one third (29%) of patients with ICP readings of 25 mm Hg or less and 27% with CPP levels of 60 mm Hg or greater had severe cerebral hypoxia (brain tissue O2 < or = 10 mm Hg). Nineteen patients had both optimal ICP (< 25 mm Hg) and CPP (> 60 mm Hg); brain tissue O2 was 20 mm Hg or less in 47% and 10 mm Hg or less in 21% of these patients. The mortality rate was higher in patients with reduced brain tissue O2. CONCLUSIONS: Brain resuscitation based on current neurocritical care standards (that is, control of ICP and CPP) does not prevent cerebral hypoxia in some patients. This finding may help explain why secondary neuronal injury occurs in some patients with adequate CPP and suggests that the definition of adequate brain resuscitation after TBI may need to be reconsidered.

Neurosurgery 2006 Oct;59(4):847-851.

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VENTRICULOPERITONEAL SHUNTING OF IDIOPATHIC NORMAL PRESSURE HYDROCEPHALUS INCREASES MIDBRAIN SIZE: A POTENTIAL MECHANISM FOR GAIT IMPROVEMENT

OBJECTIVE: Idiopathic normal pressure hydrocephalus (INPH) is characterized by a classic clinical triad of symptoms, including dementia, urinary incontinence, and gait disturbance. Recent work has demonstrated that the maximal midbrain anteroposterior (AP) diameter is significantly smaller in patients with INPH than in healthy, age-matched controls. The current study was undertaken to determine the effect of ventriculoperitoneal shunt placement on midbrain dimensions in INPH patients. METHODS: Twelve consecutive INPH patients undergoing ventriculoperitoneal shunt placement with pre- and postoperative computed tomographic scans at the Columbia University Medical Center were enrolled. Each patient's pre- and postoperative maximum AP and left-to-right diameters of the midbrain at the pontomesencephalic junction were independently measured in a blinded fashion by two of the authors. The average value of each dimension was computed by calculating the mean values of the measurements of the two observers. RESULTS: Both the mean AP diameter (preoperative mean, 2.06 +/- 0.04 cm; postoperative mean, 2.27 +/- 0.05; P = 0.0007) and left-to-right diameter (preoperative mean, 2.80 +/- 0.07; postoperative mean, 3.03 +/- 0.08; P = 0.0029) increased from pre- to postoperative imaging. The approximate cross-sectional area determined as the product of AP and left-to-right diameters also increased from pre- to postoperative images (preoperative mean, 5.79 +/- 0.22 cm2; postoperative mean, 6.90 +/- 0.25 cm2; P = 0.00049). CONCLUSION: This study provides supportive evidence that midbrain cytoarchitecture may play a role in the pathophysiology and post-ventriculoperitoneal shunt gait improvement of INPH patients.

Neurosurgery 2006 Oct; 59(4):740-748.

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SYNTHETIC NERVE GUIDE IMPLANTS IN HUMANS: A COMPREHENSIVE SURVEY

OBJECTIVE: Lesions of the peripheral nervous system result in the loss of sensory and motor function and may in addition be accompanied by severe neuropathic syndromes originating from aberrant axonal regrowth. The transplantation of autologous nerve grafts represents the current "gold standard" during reconstructive surgery, despite obvious side effects. Depending on the demands of the lesion site, various donor nerves may be used for grafting (e.g., the sural, saphenous), sacrificing native functions in their target areas. Recently, several synthetic nerve guide implants have been introduced and approved for clinical use to replace autologous transplants. This alternative therapy is based on pioneering studies with experimental nerve guides. METHODS: We present a comprehensive review of all published human studies involving synthetic nerve guides. RESULTS: Data from some 300 patients suggest that for short nerve defects of a few centimeters, resorbable implants provide promising results, whereas a number of late compression syndromes have been documented for nonresorbable implants. CONCLUSIONS: To treat longer defects, further implant development is needed, a goal that could be achieved, for example, by more closely imitating the intact nerve architecture and regulatory cell-cell interactions.

CLINICAL ARTICLES

Neurosurgery 2006 Oct; 59(4):720-739.

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SURGERY OF THE MIND AND MOOD: A MOSAIC OF ISSUES IN TIME AND EVOLUTION

The prevalence and economic burden of neuropsychiatric disease are enormous. The surgical treatment of these psychiatric disorders, although potentially valuable, remains one of the most controversial subjects in medicine, as its concept and potential reality raises thorny issues of moral, ethical, and socioeconomic consequence.

This article traces the roots of concept and surgical efforts in this turbulent area from prehistory to the 21st century. The details of the late 19th and 20th century evolution of approaches to the problem of intractable psychiatric diseases with scrutiny of the persona and contributions of the key individuals Gottlieb Burckhardt, John Fulton, Egas Moniz, Walter Freeman, James Watts, and William Scoville are presented as a foundation for the later, more logically refined approaches of Lars Leksell, Peter Lindstrom, Geoffrey Knight, Jean Talaraich, and Desmond Kelly. These refinements, characterized by progressive minimalism and founded on a better comprehension of underlying pathways of normal function and disease states, have been further explored with recent advances in imaging, which have allowed the emergence of less invasive and technology driven non-ablative surgical directives toward these problematical disorders of mind and mood.

The application of therapies based on imaging comprehension of pathway and relay abnormalities, along with explorations of the notion of surgical minimalism, promise to serve as an impetus for revival of an active surgical effort in this key global health and socioeconomic problem.

Eventual coupling of cellular and molecular biology and nanotechnology with surgical enterprise is on the horizon.