Worldwide Traumatic Brain Injury Programs


- Traumatic brain injuries (TBIs) are a leading cause of morbidity, mortality, disability and socioeconomic losses in India and other developing countries. Specific topics addressed in this paper include magnitude of the problem, causes, context of injury occurrence, risk factors, severity, outcome and impact of TBIs on rapidly transforming societies. It is estimated that nearly 1.5 to 2 million persons are injured and 1 million succumb to death every year in India. Road traffic injuries are the leading cause (60%) of TBIs followed by falls (20-25%) and violence (10%). Alcohol involvement is known to be present among 15%-20% of TBIs at the time of injury. The rehabilitation needs of brain injured persons are significantly high and increasing from year to year. India and other developing countries face the major challenges of prevention, pre-hospital care and rehabilitation in their rapidly changing environments to reduce the burden of TBIs.


- On the basis of accurate statistical reports in regard to traffic accidents and safety in Japan, it is clear that traffic accidents on the road, injured victims and all other losses due to these accidents have been increasing since around 1980. Nevertheless, the number of deaths due to traffic accidents has been gradually declining over the last six years. More detailed analysis of data revealed that the most significant factor for the recent reduction of traffic accident deaths was the marked reduction of deaths related to head injury. From the neurosurgical viewpoint, the Japanese Data Bank Committee for Traumatic Brain Injury began its formal activity in 1998. Although the registered number of severe head injuries is statistically too small at present to arrive at conclusions, some interesting points draw our attention. As for intracranial pathology diagnosed by the image of cranial CT scans, two thirds of nontraffic cases have focal brain lesions alone. On the other hand in traffic cases one third of patients have focal lesions alone and one fourth have diffuse brain lesion exclusively. In this study, in 23% of traffic accidents and 12% of nontraffic accidents, consumption of alcohol led indirectly to head injuries. The schedule and details of countermeasures taken against traffic accidents are discussed from an international viewpoint.


- The management of neurotrauma in Australia has been one of the significant public health triumphs during the last 30 years of the last 30 years of the 20th century. State and national government agencies act in a coordinated fashion to collect data and to promote research on how to manage neurotrauma patients. Between 1970 and 1995, fatalities from road accidents decreased by 47%. Hospital admissions have decreased by 40% despite a 40% increase in the population and a 120% increase in registered vehicles. Fatalities per 10,000 registered vehicles were 8.05% in 1970 and they fell to 1.84% per vehicles in 1995, while fatalities per 10,000 population were 3 in 1970 falling to 1.11 in 1995. Hospitalization from road crashes decreased 23% between March 1988 and March 1997. Public education has steadily improved, backed by the state public health sources. A uniform code of road safety laws has been adopted, backed by legislation and legal penalties and increasing police enforcement. Clinical care of patients has improved as a result of faster, communications, tele-medicine, trauma systems, the CT scanner, intensive care units, and improved
monitoring. Patient rehabilitation and counseling are now carried out at units accredited by the Australian Council on Health Care Standards.


Neurotrauma is a major public health problem. The incidence varies from 67 to 317 per 100,000 and mortality rates are in the range of near 1% for minor injury, 18% for mild injury, and 48% for severe head injury. It is the main cause of death and disability in people under 40 years old. Several problems appear when outcome measurements, rehabilitation programs and treatment options are considered. In order to solve these problems a worldwide campaign is outlined. It focuses on epidemiology, prevention, education, treatment, rehabilitation, social reinsertion, and outcome measurements. The goals of such a program are to take into account realities in both developed and developing countries, to develop worldwide acceptable programs and guidelines, and to test those guidelines and programs and diminish mortality and morbidity, improving quality of life. We describe the concept of Centers of Excellence and an educational program, Advanced Brain Life Support. Such a program is a moral obligation because mortality and morbidity tend to decrease in Centers of Excellence.


In order to describe and analyze the development of the incidence of traumatic brain injury (TBI) in Denmark for different age groups of the two genders from 1979-1993 (for fatal injuries through 1996), a computerized search corresponding of diagnoses ICD 8th ed., 800, 801, 803, 850-854 from 1979-1993 was carried through in the national hospital register. Each person was counted only once, according to the most serious injury during the study period. For fatal cases, the search was extended till 1996. From 1979-1981 to 1991-1993, the fatal age-adjusted incidence of persons hospitalized under diagnoses ICD 800, 801, 803, 850-854 decreased 41% from 265 to 157 per 100,000 of the population per year. Decreases were 42% for ICD 850, brain concussion, 56% for ICD 800, 801, 803, cranial fractures, and 16% for ICD 851-854, structural brain injury. The percentage of cases with ICD 851-854 increased from 8.4 to 11.7% of the total. From 1979-1981 to 1985-1987 there was a 2% decrease in fatal TBI in and outside hospital (from 14.68 to 14.35 per 100,000), against a total 27% decrease to 10.67 in 1994-1996. For diagnoses ICD 851-854 and for fatal cases, significantly accelerating decreases from 1985-1987 were found only for the younger age groups. Consequently, in the period from 1979-1993, the mean age at injury increased by 10 years for persons hospitalized under diagnoses ICD 851-854. Decreases may be explained partly by the effect of comprehensive national preventive programs launched at the middle of the study period, the effect which seemed to vary by age group and gender.


This chapter emphasizes some aspects of the Brazilian Guidelines for the Assessment of Head Injury Patients, written based on the experience of the Emergency Service, Neurosurgical Division of the University of Sao Paulo Medical School Hospital, and sponsored by the Brazilian Society of Neurosurgery. These guidelines approach the management of head-injury patients from their initial assessment in the Emergency Room until the final suggested clinical or surgical management. The Brazilian Guidelines represents our efforts to provide the basis for a common unified data collection system, which may allow cooperative studies in the future.

- Exact epidemiology data on head injury in Germany are limited and based on data from death certificates, the Federal Board of Statistics, small regional cohort studies, and health insurance. With a population of 82 million people there had been 279,029 head injuries admitted to hospital in Germany in 1996. The majority had the diagnosis, concussion, which refers to completely reversible lesions. Head injury caused the deaths of 9415 patients in 1996, which amounts to a mortality of 11.5 per 100,000 inhabitants. At the same time there were 135 independent neurosurgical units, all of which had a computerized tomography scanner available. Of all fatal cases, however, 68.4% died before they ever reached a hospital. The exact cost is difficult to assess, because head injury causes more costs than only the hospital stay and rehabilitation.


- This paper reviews aspects of head injury management and research in the United Kingdom (UK). We discuss evidence about the scale and etiology of head injury in Britain and how this information has supported a triage-based approach, incorporating risk analysis. A Cohesive organization based upon nationally accepted, yet regionally flexible head injury management guidelines is important. Research in the UK has clarified the effect of head injury on the brain and how this can be reduced. This clarification follows from improved understanding of the neurobiology of injury, of secondary damage and recovery, and information gained from new techniques aimed at investigating events in patients. Outcome is an important perspective and we highlight the increasing focus upon recovery and the extent of disability after so called mild head injury. Although we retain a UK perspective, comparisons with aspects of European head injury emphasize the increasing importance of an international approach in the future.


- Traumatic brain and spinal cord injuries continue to pose serious challenges for physicians around the world. In North America, the annual number of serious head and spinal injuries has decreased over the past two decades, and of those patients who reach the hospital, the mortality and long-term morbidity have also declined. The two major reasons for this reduction in death and disability after craniospinal trauma in the US and Canada appear to be (1) widespread implementation of prevention measures, safety legislation, and public education initiatives; and (2) further improvements in and wider availability of emergency medical systems and regional trauma centers. Improvements in neurosurgical care and implementation of evidence-based treatment guidelines for severe head injury victims may also, in part, be responsible for improved survival rates and reduced disability rates. Unfortunately, numerous clinical trials of putative neuroprotective agents conducted in North America and elsewhere during the 1990s have failed to demonstrate efficacy in head-injured patients. However, methylprednisolone does appear to confer some benefit to a select population of spinal cord injury patients. These advances in the areas of prevention, regional trauma systems, treatment guidelines, and neurocritical care that have influenced survival rates and recovery of function are discussed.


- According to the statistics compiled by the Institute for Traffic Accident Research and Data Analysis, the total number of head trauma patients has stayed virtually the same for the last 10 years in Japan, although a fraction of people suffering minor head trauma has shown a trend to increase.
The Japan Society of Neurotraumatology is in the process of establishing a guideline for head trauma management. No major difference is noted in surgical procedures selected by neurosurgeons in Japan as compared to those in other countries. It appears, however, that the ventriculostomy may be less frequently employed to control elevated intracranial pressure, and barbiturate to morphine as sedatives. Two drugs are currently available in Japan for promoting the recovery from disturbance of consciousness after head trauma: cytidinediphosphate choline (CDP)-choline (Nicholin, Takeda Chemical Industries, Ltd., Osaka) and protirelin tartrate (Hirtonin: thyrotropin releasing hormone (TRH) analogue, Takeda). Another TRH analogue, NS-3 (monarelin hydrate), is currently submitted to the Ministry of Health and Welfare for approval. A multi-institutional controlled study to examine the efficacy of therapeutic hypothermia for head trauma management is now in progress in Japan. The Japan Neurotrauma Data Bank System was inaugurated 2 years ago, enabling joint statistical processing at 10 major neurotrauma centers. Utilizing such a system, more detailed analysis of head trauma management will be possible, and clinical trials will be conducted systematically and more promptly in future.


- In recent years neurological and neurosurgical intensive care (NNICU) has evolved into a well-recognized subspeciality world over. However it is still a novel concept in the developing world. The admission criteria are variable and flexible. The pattern of disease in the NNICU varies according to the admission policy. In the west, cerebrovascular diseases account for a significant proportion of admissions. In a few studies from the developing countries infections of central nervous system are additional causes requiring intensive care. At our center the disease admission pattern was similar to the pattern reported from the developed countries. Predictors of outcome of neurointensive care have not been systematically evaluated. Limited available data concerns patients of neurotrauma. In addition to the disease severity indices, pre-existing chronic illness, adverse events during ICU stay, and the 24-hour presence of a physician also influence patient outcome in the NNICU.


- The incidence of head and spinal injury is on the rise in developing countries. The number of deaths and burden of disability may be reduced, if not completely stopped, through preventive measures after an epidemiological survey on trauma. The goal can be achieved to a significant extent through the use of guidelines from the countries that have achieved a reduction in the incidence of neurotrauma. To determine the incidence and outcome of neurotrauma in developing countries, a study was necessary using standardized assessment parameters for global interpretation. Such a study was conducted to determine the sociodemographic characteristics, morbidity, and mortality of patients with head and spinal injury admitted to various neurosurgical centers in Pakistan from July 1, 1995 to June 30, 1999. A total of 260,000 patients were admitted with head injury over a 4-year period. The majority of patients presented during second decade (i.e., 33.2%) followed by first and third decade. There were 195,000 (75%) males, and 65,000 (25%) females with a ratio of 3:1. Road traffic accident was the commonest cause of head trauma. Mild, moderate, and severe head injury was observed in 135,200 (52%), 78,000 (30%), and 46,800 (18%) patients, respectively. Conservative management was carried out in 176,800 (68%) patients. Surgery was required in 83,200 (32%), 50% of which had depressed skull fracture, simple or compound. Follow-up period varied from 2 months to 2 years with a mean of 11 months. Patients outcome was assessed according to Glasgow Outcome Scale (GOS). Good outcome was observed in 174,200 (67%). The total mortality was 46,800 (18%). In this study, 2654 patients ranging in age from 5 to 70 years had spinal injuries. There were 1922 males (72%) and 732 (28%) females. British Medical
Research Council Scale was used for assessment of motor power of patients with spinal trauma. Of these, 780 patients (29%) had complete spinal cord injury. Surgical intervention was performed in 1800 patients (68%) and the rest were managed conservatively.


- AIMS: To investigate the accuracy of admission and discharge coding of traumatic brain injury (TBI) in a New Zealand hospital. METHOD: Prospective study of all patients over fifteen years of age admitted to Hutt Hospital over a six-month period with an actual or potential diagnosis suggesting TBI. RESULTS: During the six month study period of study, 65 patients with the diagnosis of TBI were admitted to Hutt Hospital. Of these, 21 (32.3%) met the criteria for diagnosis of TBI ("Definite TBI"). A further eighteen patients, not admitted with a diagnosis of TBI, met the TBI criteria. Only 14/39 (35.9%) of Definite TBI cases were identified at both admission and discharge. Discharge diagnosis of TBI identified correctly 26/39 (66.7%) of definite cases, with 34/60 (56.7%) cases with a discharge diagnosis of TBI not meeting our criteria for the diagnosis of TBI. Six out of 39 "Definite TBI" cases (15.4%) were not identified by either admission or discharge diagnosis. Thirty of the 65 patients (46.2%) admitted to hospital with the diagnosis of TBI showed clinical evidence of having taken alcohol, although only 12 had blood alcohol concentration measured. CONCLUSION: The admission and discharge diagnoses of TBI were not accurate when compared to a standard definition of TBI. For hospital discharge data to have any value, agreement on an operational diagnosis of TBI needs to be made, which should include measurement of the blood alcohol concentration. A suggestion for a diagnostic strategy is presented, along with ICD-10-AM codes that could be used to improve the current situation.


- Survived traumatic brain injuries (TBI) are one of the most serious challenges to the patients future life. Recent literature increasingly questions the long believed protective effects of functional cerebral plasticity in children. Although TBI in children and adolescents is frequent, they are less frequently admitted to rehabilitation centers as in-patients than adults. This emphasizes the role of out-patient treatment. The progressing study described here aims to achieve a contribution to a comprehensive approach in TBI-rehabilitation for youngster. A two-stage multimethodal program, starting with stimulation in coma while the patient is on the intensive care unit, and neuropsychological therapy after regaining consciousness is to be evaluated in a controlled, prospective and randomized study. After including nearly 50% of the planned sample (100 persons), some preliminary results can be mentioned with all applicable caution. The effectiveness of the applied therapy can be stated here with respect to the posttraumatic-development of intellectual abilities in the 6 and 12 months follow ups. Moreover, in the control group development of psychopathological alterations was found to a considerable degree and also lower rating in a quality of life questionnaire, compared to the experimental group. It is expected to prove these differences statistically, after the total sample has been included, and thus equal distributions have been achieved in all predictive variables.


- Using an independent data set, the utility of the Glasgow Head Injury Outcome Prediction Program was investigated in terms of possible frequency of use and reliability of outcome prediction in
patients with severe head injury, or haematoma requiring evacuation, or coma lasting 6 hours or more, in whom outcome had been reliably assessed at 6 to 24 months after injury. Predictions were calculated on admission, before evacuation of a haematoma, or 24 hours, 3 days, and 7 days after onset of coma lasting 6 hours or more. Three hundred and twenty four patients provided 426 predictions which were possible in 76%, 97%, 19%, 34%, and 53% of patients on admission, before operation, 24 hours, 3 days, and 7 days respectively. Major reasons for non-feasible predictions were that patients were paralyzed/ventilated as part of resuscitation or management. Overall, 75.8% of predictions were correct, 14.6% were pessimistic (outcome better than predicted), and 9.6% optimistic (outcome worse than predicted). Of 197 patients (267 predictions) whose eventual outcome was good or moderate, 84.3% of predictions were correct. For death or vegetative survival (96 patients with 110 predictions), 83.6% of predictions were correct but for severe disability (31 patients with 49 predictions), only 12.2% were correctly predicted. The utility of the Glasgow Head Injury Outcome Prediction Program compares favorably with other outcome prediction algorithms for patients with head injury.


- The Glasgow Outcome Scale (GOS), two decades after its description, remains the most widely used method of analyzing outcome in series of severely head-injured patients. This review considers limitations recognized in the use of the GOS and discusses a new approach to assessment, using a structured questionnaire-based interview. Assignments can be made to an extended eight-point scale (GOSE) as well as the original five-point approach in each case, with a high degree of interobserver consistency. The assignments are coherent with the principles of the World Health Organization classification of impairments, disabilities, and handicaps, and their validity is supported by strong associations with the results of neuropsychological testing and assessment of general health status. The need to allow for disability existing before injury, issues concerning the time of assessment after injury, and subdivisions of the scale into "favorable" and "unfavorable" categories are discussed. It is concluded that, in its improved structured format, the Glasgow Outcome Scale should remain the primary method of assessing outcome in trials of the management of severe head injury.


- Reviews of statewide hospital separations' summaries and medical record data from a major teaching hospital, were conducted to describe the epidemiology of traumatic brain injury (TBI) in South Australia (SA), and to document the demographics of the population affected and the nature of their injuries. The groups most at risk were defined for targeting preventive programmes, and predictions were made regarding their ongoing service needs, for more appropriate provision of care. The results indicate that SA experiences a high incidence of TBI. At 322 per 1000,000 head of population annually, it exceeds studies (with comparable methodologies) in communities in the United States and Europe. The causes, nature and severity of the injuries were similar to those found in the international literature, as were the profiles of the population most at risk. Specifically, young males living in the country and working in manual trades showed the highest incidence, and were most likely to have sustained TBI whilst driving a motor vehicle. When a formula to predict service needs was adapted using the SA data, it was apparent that hospitals in this state care for more than 4000 new cases of TBI each year and that, on discharge, over 1000 of these will have some degree of residual impairment and will therefore require some form of post-injury services.

Guidelines for the management of severe head injury in adults as evolved by the European Brain Injury Consortium are presented and discussed. The importance of preventing and treating secondary insults is emphasized and the principles on which treatment is based are reviewed. Guidelines presented are of a pragmatic nature, based on consensus and expert opinion, covering the treatment from accident site to intensive care unit. Specific aspects pertaining to the conduct of clinical trials in head injury are highlighted. The adopted approach is further discussed in relation to other approaches to the development of guidelines, such as evidence based analysis.


- OBJECTIVE: To study practice in intensive care of patients with severe head injury in neurosurgical referral centers in United Kingdom. DESIGN: Structured telephone interview of senior nursing staff in intensive care unit of adult neurosurgical referral center. SETTING: 39 intensive care units in hospitals that accepted acute head injuries for specialist neurosurgical management, identified from Medical Directory and information from professional bodies. MAIN OUTCOME MEASUREMENTS: Details of organization and administration of intensive care and patterns of monitoring and treatment for patients admitted with severe head injury. RESULTS: Patients were managed in specialist neurosurgical intensive care units in 21 of the centers and in general intensive care units in 18. Their intensive care was coordinated by an anaesthetist in 25 units and by a neurosurgeon in 12. Annual caseload varied between units: 20 received > 100 patients, 12 received 50-100, and seven received 25-49. Monitoring and treatment varied considerably between centers. Invasive arterial pressure monitoring was used routinely in 36 units, but central venous pressure monitoring was routinely used in 24 and intracranial pressure was routinely monitored in only 19. Corticosteroids were used to treat intracranial hypertension in 19 units. Seventeen units routinely aimed for arterial carbon dioxide pressure of 3.3-4.0 kPa, and one unit still used severe hyperventilation to a pressure of < 3.3 kPa. CONCLUSION: The intensive care of patients with acute head injuries varied widely between the centers surveyed. Rationalization of the intensive care of severe head injury with the production of widely accepted guidelines ought to improve the quality of care.


- The Swedish Neurosurgical school was created during the 1920s by Herbert Olivercrona, who became the first professor of neurosurgery at the Karolinska Institute. He pioneered procedures for the treatment of arteriovenous malformations and acoustic neuromas. He was among the first to make direct attacks on berry aneurysms. Many outstanding neurosurgeons in Europe were trained by him. Clinical research to refine and minimize surgical interventions has continued to be the most important feature of the neurosurgery department at the Karolinska Institute. Lars Leksell, Olivercrona's successor, was a leader in stereotactic surgery and the creator of radiosurgery. His tool, the gamma knife, is in worldwide use today. Leksell and his students have defined the indications for radiosurgery and introduced stereotactic techniques into microsurgery. Today, 3000 neurosurgical procedures are performed with the gamma knife, and at least one-third of the patients are foreign referrals. There is a strong emphasis on clinically oriented research and development. There are research programs for radiosurgery, management of pain, neurooncology, treatment of traumatic brain injury, and treatment of vasospasm after subarachnoid hemorrhage.

OBJECTIVE: To study the current intensive care management of patients with severe head injury (defined as a Glasgow Coma Scale score of ≤8) in neurosurgical referral centers in the United Kingdom (UK) and Ireland. DATA COLLECTION: A questionnaire was sent to the directors of the 44 neurosurgical referral units identified from the UK Medical Directory. After 4 weeks, a copy of the questionnaire was sent to all nonrespondents, with a cover letter urging them to respond. The aim was to collect data regarding the characteristics of the intensive care units (ICU), sedation, monitoring modalities used, the treatment of intracranial hypertension, and general care of severely head-injured patients. DATA EXTRACTION: Forty completed questionnaires were returned. Only 35 (88%) centers provided care for the severely head-injured as defined in the questionnaire. Patients were managed in specialized neurosurgical ICUs in 66% of centers and in general ICUs in the remainder of the centers. The ICUs were coordinated by an anesthesiologist in 66% of instances and by a neurosurgeon in 23%. The mean number of beds per units was 7.9 (range 4 to 16), with 1:1 nurse/bed ratio and 5.5 nurses per bed (total number of nursing staff per bed) (range 2.75 to 8). Annual caseload varied between units with the majority of units (49%) receiving between 25 and 50 patients with severe head injury, 23% receiving between 50 and 100 patients with severe head injury, and 29% receiving >100 patients with severe head injury. There was considerable variability in both the nature of monitoring and therapy between centers. Although blood and central venous pressures were invasively monitored in >50% of the patients in 94% and 77% of the centers, respectively, intracranial pressure was only monitored routinely in 57% of the centers. Jugular venous bulb oximetry, transcranial Doppler ultrasonography, electroencephalography, and near-infrared spectroscopy were rarely used. Nearly all centers used propofol and midazolam for sedation, with morphine, fentanyl, and alfentanil as the main analgesics. Muscle relaxation was commonly used with 40% of the centers employing it in 100% of their patients. Atracurium and vecuronium were the most commonly used agents. Only 68% of the centers had a protocol for the treatment of intracranial hypertension. Although hyperventilation to a Paco2 of 260 torr (3.5 to 4.0 kPa) was the norm in the majority of centers (56%), two centers aimed for Paco2 values 60 mm Hg. Mild hypothermia was rarely used and 14% of the centers continues to use corticosteroids for the treatment of intracranial hypertension as a result of head trauma. CONCLUSION: We conclude that there are wide variations in the management of the severely head-injured patient in the UK and Ireland. Some of the therapies employed are not supported by available research findings. Rationalization (using rational management, i.e., based on good evidence) of the intensive care management of severe head injury with the development of widely accepted guidelines may result in an improvement in the quality of care of the head-injured patient.


- Prevention of head and spinal cord injuries is defined as a reduction in the incidence of these disabilities. Accurate incidence data are fundamental to any prevention program. The current approaches toward determining incidence rates for head and spinal cord injuries are summarized. Previous research has focused on passive surveillance systems and population-based registries. An alternative system for monitoring the incidence of head injuries is discussed that uses surveillance methodology called capture-recapture. This method employs multiple population-based sources to estimate the degree of undercount in the population. This estimate in turn is used to produce an ascertainment-corrected incidence estimate. Through the use of methods such as capture-recapture, accurate monitoring of the incidence of head and spinal injuries across developing and developed countries is indeed feasible.

Incidence studies in the developing countries present epidemiologists with unique methodological challenges for which novel solutions must be found. These challenges arise from archival inadequacies, hospital overcrowding, high violence rates, and limited research funding that necessitates low cost epidemiology. This paper describes the methods devised in Johannesburg, South Africa, in order to develop incidence estimates of determinable reliability of the morbidity and mortality arising from traumatic brain injury, and its etiology. Results are reported in Part II of the paper (p. 289).


Using the method described in Part I (p. 283), data on the epidemiology of traumatic brain injury (TBI) in Johannesburg are presented. The overall annual incidence of TBI is 316 per 100,000. Data for Africans and Whites show marked contrasts. Among Africans, incidence is 355/100,000, with a male-female ratio of 40.1, and 419/100,000 for men aged 15-24. The overall incidence of fatal TBI is 80/100,000, with a case fatality ratio of 0.20. Interpersonal violence accounts for 51% of nonfatal TBI among Africans, as against 10% for Whites, while motor vehicles accidents cause 27% of African nonfatal TBI and 63% among Whites. Some explanatory hypotheses for this race- and sex-specific skewing of the incidence and causes of TBI are developed.