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Editorial

If you haven't submitted an abstract for the 2006 scientific meeting It is time to be thinking ahead to. the 2007 annual scientific meeting. The next edition of the journal will feature some of the papers from the 2006 meeting and you can get a taste of them in the abstracts from the last meeting featured in this edition.
Since the last edition, where the care and support that people require in order to live with the results of neurotrauma or neurologic disease was mentioned, the government has made some commitments to funding for young people who find themselves in this circumstance.

This edition features a review of literature related to the use of hypothermia in management of raised intracranial pressure that poses questions for us to consider. In these days of evidence based practice it reminds us that although it can be difficult to carry out strictly controlled research studies on the vulnerable population this group comprises, we can ensure that neuroscience nurses provide the best . care based on current knowledge.

This edition also features a case study of a child with an arteriovenous malformation and provides an in depth description and discussion of the knowledge underpinning the management that was required in this case. The importance of good communication skills and education of a child and their family by all members of the health care team in contributing to a good outcome is obvious in this study.

Also within this edition is a review of the neuron, the basic physiological processes that enable transmission of impulses, as well as a brief mention of other neuronal theories.

Jennifer Blundell

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Treating Head Injured Patients with Induced Hypothermia: Review of the Literature and Recommendations for Current Practice.

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ABSTRACT

Induced hypothermia has been used as a means of treating head inured patients for over half a century, although it's popularity in practice has fluctuated over the years. A multitude of studies have been conducted during this time to investigate the effects of induced hypothermia in head injured patients with mixed results. Induced hypothermia has been proven to reduce intracranial pressure however its effect on in benefiting patient outcomes is questionable. Despite the lack of clear evidence that supports the practice of induced hypothermia for improving the outcomes of patients with traumatic brain injury (TBI) it continues to be used in current practice.

Key Words; hypothermia, ICP, traumatic brain injury

Background

Patients who have suffered from traumatic brain injury present a challenging situation for clinicians worldwide. There is little doubt that care for these patients has improved extensively over the years, however, there remain much that is still unknown about the brain and its recovery mechanisms. The aim of treatment following traumatic brain injury (TBI) is to prevent secondary injury and improve the outcome for patients. Some treatments used in the current practice of head injury, whilst seemingly beneficial, have not yet been fully proven. One of these treatments is the use of therapeutic induced hypothermia. This paper critically analyses the use of induced hypothermia for patients with TBI using evidence from the current literature. Research, reviews and discussions are used to examine if induced hypothermia is an effective practice in improving the outcomes of patients with cerebral metabolism and cerebral blood flow uncoupling after TBI (Marion, Obrist, Carlier, Penrod & Darby 1993). In animal models with TBI, moderate hypothermia has shown to reduce secondary brain injury by reducing cerebral ischaemia and related cerebral oedema and by preserving the blood brain barrier (Smith & Hall 1996).

TBI. Finally recommendations for nursing practice and for further research are presented.

Review of Literature

Therapeutic hypothermia has been used as a means of reducing elevated refractory intracranial pressure (ICP) and limiting the cascade of biochemicals following TBI (Clifton 2004), although the exact mechanism by which this occurs remain unclear. Possible explanations include a reduction of apoptotic cell death and inhibition of the inflammatory response including a decline in the release of glutamate, nitric oxide and free radicals related to injury of the brain tissue (Xu, Nakamura, Nagoa, Miyamoto, Osamu, Toyoshima, Tetsuhiko & Itano 1998; Chatzipanteli, Alonso, Kraydieh & Dietrich 2000). It is also thought that hypothermia reduces cerebral oxygen and glucose demands, thereby, easing The use of therapeutic hypothermia for the treatment of TBI began in the early 1940s by Fay, who reported the use of hypothermia to be beneficial in improving patient outcomes (Alderson, Gadkary & Signorini 2005). There were, however, no comparisons to control groups at this time. Worldwide, the treatment of induced hypothermia in patients with severe TBI became routine for many hospitals by the 1960s. This was due to results from early uncontrolled studies such as by Sedzimir (1959), Lazorthes and Campan (1958), and Drake and Jory (1962) (cited in McIntyre, Fergusson, Hebert, Moher & Hutchison 2003), which all suggested that induced hypothermia may improve the outcomes of patients with severe TBI. The favourability of induced hypothermia declined after this time due to recognised complications such as infection and coagulopathies with prolonged use (Bernard 1996). However, the depth of hypothermia induced was greater in these earlier years and this may account for the prevalence of such side effects.

There was renewed interest in therapeutic hypothermia in the early 1990s, with many clinical studies of that time reporting favourable effects of hypothermia in TBI (Clifton, Allen, Barrodale, Plenger, Berry, Kosh, Fletcher, Hayes & Choi 1993; Marion et.al 1993; Shiozaki, Sugimoto, Tandeda, Yoshida, Iwai, Yoshioko & Sugimoto 1993;). These studies consisted of small randomized trials that reported reductions in ICP, a decrease in metabolic oxygen demands, and similar or improved outcomes compared to control groups when mild hypothermia was used. It is believed that a better understanding of the pathophysiology and treatment of TBI also helped clinicians to achieve better results with the use of hypothermia than when used in earlier times (Bernard 1996). Larger randomized trials then followed.

A randomised control trial involving eighty-two patients, conducted by Marion, Penrod, Kelsey, Obrist, Kochanek, Palmer, Wisnieski and DeKosky (1997), cooled a total of forty patients to 33 degrees Celsius for a period of 24hrs. An assessor who was unaware of the patients' treatment group evaluated patients at three, six and twelve months post injury. Marion et al. (1997) reported that patients with a Glasgow Coma Score (GCS) of 5-7 following TBI improved significantly with the use of moderate hypothermia. In patients with a GCS of 3-4, however, hypothermia was found to be ineffective.

A study by Jiang, Yu and Zhu (2000) involved eighty-seven patients of whom forty-three were cooled to 33-35 degrees Celsius for a period of 3-15 days. Patients in the hypothermic group were rewarmed only after their ICP had stabilised. Patients were assessed after one year using the Glasgow Outcome Scale. The results of this study indicated more favourable outcomes in the hypothermic than the control group in the one-year follow-up assessment.

Shiozaki, Hayakata, Taneda, Nakajima, Hashiguchi, Fujimi, Nakamori, Tanaka, Shimazu & Sugimoto (2001) conducted a multi-centre study involving ninety-one patients and reported that patients with severe TBI and a low ICP did not benefit from mild hypothermia. Further practice of induced hypothermia for this group of patients was, therefore, not recommended (Shiozaki et al. 2001).

Shiozaki, Nakajima, Taneda, Tasaki, Inoue, Ikegawa, Matsushima, Tanaka, Shimazu & Sugimoto (2003) later completed another study to explore if moderate hypothermia could improve the outcomes of patients with severe TBI and high intracranial pressures whom had not benefited from mild hypothermia. The authors concluded that outcomes did not improve with moderate hypothermia and complications were actually more pronounced when moderate rather than mild hypothermia was induced (Shiozaki et al. 2003).

A large multi-centre study by Clifton, Miller, Choi, Levin, McCauly, Smith, Muizelaar, Wagner, Franklin, Marion, Luerssen, Chestnut and Shwartz (2001) set out to determine if induced hypothermia was effective in improving the outcomes of patients who had sustained acute brain injury. The study involved three-hundred and ninety-two patients between the ages of 16 and 65 years of age, all with closed head injuries with a GCS of 3-8 post-resuscitation. One hundred and ninety-three patients received standard treatment for acute brain injury, maintaining a body temp of 37 degrees Celsius, while one hundred and ninety-nine patients received standard treatment and hypothermia of 33 degrees Celsius, which was initiated within 6 hours after injury (Clifton et al. 2001).

Standard treatment for both groups included the use of ICP monitoring, an intravenous morphine infusion for at least 72 hours, intravenous vecuronium for ventilation management (and to prevent shivering in the hypothermic group) and blood pressure support to maintain a cerebral perfusion pressure (CPP) greater than 70mmHg. An ICP, which was found to be greater than 20mmHg, was treated by other means, such as IV vecuronium, ventricular drainage, and mannitol, without the use of induced hypothermia. Hypothermia in the selected group was maintained for 48hrs (Clifton et al. 2001). Patients were assessed by people who were unaware of the patients' treatment assignment group using the Glasgow Outcome Scale at six months after injury (Clifton et al. 2001).

While study findings indicated that induced hypothermia is effective in reducing ICP, it was not however found to be effective in improving patient outcomes. In fact, patients in the hypothermia group were found to have more hospital days with associated complications (Clifton et al. 2001).

The authors of this study believed that success in previous studies may have been the result of aggressive rewarming of initially cold patients – worsening the outcomes of those in the control groups, rather than actual improvements in outcomes of those in the hypothermic group (Clifton 2000; Narayan 2001). Clifton et al. (2001) believed that patients who are hypothermic on admission should not be rewarmed, as this may be detrimental to their outcomes. Clifton and colleagues (2001) also recommended that patients over 45 years of age should not undergo induced hypothermia as this age group had particularly poor outcomes in their study.

During attempts to find evidence to support the use of hypothermia in reducing ICP and improving the outcomes of patients with TBI, many of the studies also reported the incidence of complications.

While it is suggested that hypothermia is beneficial in reducing ICP by inhibiting the inflammatory response intracerebrally, the systemic effect of hypothermia appears to be the cause of an increase in the risk of infection. Ishikawa, Tanaka, Shiozaki, Takaoka, Ogura, Kishi, Shimazu and Sugimoto (2000) explored the infection complications and leukocyte counts in patients who underwent hypothermia treatment against patients who received barbiturate or standard treatment. They found that those patients treated with mild hypothermia had more severe infectious complications and lower leucocyte counts. Studies conducted in the early 1990s did not report any serious side effects or a significant increase in the incidence of infection in patients receiving induced hypothermia (Clifton et al. 1993; Marion et al. 1993; Shiozaki et al. 1993). However, the severity of infective complications between those who received therapeutic hypothermia and those in the control group was not analysed in these studies.

Certainly, varying lengths of hypothermia may impact on the incidence and severity of infection. When patients were cooled for no longer than 24 hours, Marion et al. (1997) reported no significant increase in the rate of infection in the hypothermic group in their study. Other studies, however, which aimed at cooling patients for longer than 24 hours reported an increase in the number and severity of infectious complications in the hypothermic group (Clifton et al. 2001; Shiozaki et al. 2001; Shiozaki et al. 2003).

Therapeutic hypothermia has also been shown to cause a reduction in platelet count and cause platelet dysfunction (Tateishi, Soejima, Taira, Nakashima, Fujisawa, Tsuchida, Maekawa and Ito 1998; Watts, Trask, Soeken, Perdue, Dols and Kaufmann 1998). While this is a significant complication, no reports of serious haemorrhage have been made in any of the recent studies mentioned. Most studies, however, exclude patients whom are or may potentially become with a bleeding risk.

Tokutomi, Morimoto, Miyagi, Yamaguchi, Ishikawa and Shigemori (2003) conducted a study involving thirty-one patients with severe TBI (a GCS equal to or less than 5) and evaluated the effect of temperature level on intracranial pressure during induced hypothermia to 33 degrees Celsius. They found that at 35.5 degrees Celsius, a decrease in ICP and improvement in CPP was greatest. Adverse affects such as cardiac dysfunction were minimal at this level of hypothermia. Although this study had a relatively small sample size, it questions the use of hypothermia to less than 35 degrees Celsius on patients with severe TBI. If such a small drop in temperature is required to decrease ICP and improve CCP, then surely this may reduce the risk of complications involved with the use of therapeutic hypothermia.

Harris, Colford, Good and Matz (2002) completed a meta-analysis of seven randomised control studies. They found an increase in the incidences of pneumonia, cardiac arrhythmias and coagulation abnormalities and came to the conclusion that hypothermia is ineffective and therefore, not suitable for the routine treatment of patients with severe head injury (Harris et al. 2002).

Many of the studies included in the systematic review by McIntyre et al. (2003) were single-centre trials, indicating a possible bias. This potentially limits the general utilisation of these results. These findings also conflict with those of a large multi-centre random controlled trial by Clifton et al. (2001).

A recent systematic review of the use of hypothermia by Alderson, Gadkary and Signorini (2005) concluded that hypothermia was not beneficial in improving the outcomes of patients with TBI. Alderson, Gadkary and Signorini (2005) also noted that there was a statistically significant increase in the rate of pneumonia and other potential complications when hypothermia was used as a treatment for head injured patients. The authors concluded that hypothermia should only be used in limited situations (Alderson, Gadkary and Signorini 2005)

Alderson, Gadkary and Signorini (2005) identified conflicting evidence amongst reviews of hypothermia studies. They suggest that the statistical significance of the overall result could vary depending on which studies are chosen to be included in the review (Alderson, Gadkary & Signorini 2005).

Despite various trials, which have taken place, there are no specific guidelines on optimal hypothermia parameters. There still remains conflict regarding time to hypothermia, depth of hypothermia and length of time of hypothermia to achieve beneficial outcomes in patients with head injury. Much of what has been experimented with in terms of head injury and induced hypothermia has mainly involved animal trials (Shann 2003).

Narayan (2001) believes that the timing of inducing hypothermia could be a major factor in why studies have not proven it to be a beneficial treatment. Shann (2003) has recommended that optimal hypothermia needs to be achieved within 2-6 hours post injury. To achieve an optimal level of hypothermia within this time frame, however, presents clinical difficulties that may require more aggressive cooling therapies.

The length of time of hypothermia has also been an area of debate. Shann (2003:1950) argues that many of the random controlled trials (RCT) of hypothermia in TBI commenced rewarming at either 24 or 48 hours and this is often when cerebral swelling and oedema is greatest. Rewarming periods can be a hazardous time as metabolic needs may exceed oxygen delivery and result in further brain injury. Schwab, Schwarz, Spranger, Keller, Bertram and Hacke (1998:2465) recognised that during rewarming, the increase in ICP might suggest that hypothermia only delays the adverse effects of brain injury and it therefore does not result in any substantial improvement.

From this review of the literature there is no overwhelming evidence that demonstrates that induced hypothermia is beneficial in improving the outcomes of patients with traumatic brain injury. Whilst induced hypothermia has shown to decrease ICP, this finding suggests that ICP may not be a dependable guide in determining the value of treatment and the future outcomes of patients (Narayan 2001).

Discussion

Hypothermia is a treatment that continues to be used in practice despite the evidence. Discussion with clinicians at five major hospitals in the Sydney region, who care for head injured patients, revealed that treatment with hypothermia continues. For the majority of cases at these hospitals the aim of cooling patients is to achieve normothermia. The cooling techniques utilised in these practice settings are produced in the main by the use of cooling blankets. Other measures used include cold packs to the groin and axilla, intravenous cooling, fans and cold washes. However practice at four out of the five hospitals involved inducing hypothermia to approximately 35 degrees Celsius for elevated ICP when other measures had failed. In the author's experience, hypothermia is generally induced to decrease ICP when other simpler measures have failed.

It appears it would not be advisable for clinicians to treat head injured patients with hypothermia, given the evidence Of the research. Slow and careful rewarming of patients who are hypothermic on admission is recommended due to the potential detrimental effects of rapid rewarming. Cooling head injured patients is therefore only advised for the maintenance of normothermia.

Whilst many studies have demonstrated little benefit of induced hypothermia as a general therapy for all patients with TBI, there is, perhaps, a sub-group of patients who may benefit from induced hypothermia. In the study by Clifton et al. (2001), an interesting and promising finding was established in patients who were under the age of 45 years and whom were hypothermic on admission. The incidence of severe disability, vegetative state, and mortality among patients in this group was lower when hypothermia was maintained for a 48 hour period rather than allowing these patients to rewarm (Clifton et al. 2001).

Recommendations

The limitations of studies conducted so far present recommendations for future research:

Firstly, the criteria of patients that are accepted in hypothermia studies usually exclude those with secondary insults such as other organ failure. There is a possibility that these patients could benefit from hypothermia therapy, however, this needs to be explored.

Secondly, to create consistency within and amongst trial centres, protocols need to be identical for the standard treatment of both the hypothermic and control groups. This should include the use of intravenous fluids, intracranial pressure, cerebral perfusion pressure and hypotension management, as well as cooling techniques and monitoring (Ginsberg 2002). This would provide more consistent results and reduce the limitations of the findings.

Finally, as suggested earlier, the time of initiation, the depth and duration of induced hypothermia needs to be explored, taking into account the evidence that has already been provided. Varying these factors may demonstrate more positive results.

Conclusion

There are many aspects yet to be explored in relation to the use of induced hypothermia in the treatment of patients with traumatic brain injury before it can be abandoned as a beneficial therapy altogether. However, further investigation is needed before clinicians can be assured that induced hypothermia is actually beneficial in improving the outcomes of patients following TBI. The evidence from large and well-designed studies, such as Clifton et al. (2001), provide a solid case for health professionals to re-evaluate current practices of using induced hypothermia in the treatment of patients with head injury.

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Basic facts about neurons

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Abstract

Neurons are the specialised cells of the Central Nervous System (CNS) that communicate with other neurons and sensory or effector organs. This review of the literature provides an overview of thought about the role of the neuron and a brief description of the physiological processes of impulse conduction.

Key words: Neuron, neurotransmitter, synapse, nerve impulse, sodium potassium pump

The neuron, the functional unit of the nervous system, is a specialised cell with the ability to receive and transmit electrochemical impulses. The basic structure of a neuron consists of a cell body, a nerve fibre, known as the axon, which carries impulses away from the cell body, and processes or dendrites that carry impulses to the cell body. Impulses are transmitted between cells at synapse by chemical substances neurotransmitters. Variations to this occur in relation to the site and /or special function of a neuron, such as a motor neuron may have along axon if it transmits impulses over a distance in the body (Nolte, 2002). Impulses are transmitted between neurons and organs by chemical substances called neurotransmitters.

The adult human brain contains approximately 100 billion neurons (Kalat, 1995). In the late 1800s, Santiago Ramon y Cajal, a Spanish neurobiologist stated that the brain is made up of individual neurones which communicate with each other at a specific point (Mitchell, 1999). He demonstrated that a single cell or neuron does not merge with its neighbour, each cell being distinct with a small gap separating them from their neighbour.

Neurons differ from other cells in their capacity to communicate rapidly with one another (Nemeroff 1998). The cell membrane plays a paramount role in this, being specialised to control the exchange of chemicals between the inside and outside the cell. It also maintains an electrical gradient necessary for neural signalling (Marieb 1998).

At rest, in the absence of any outside disturbance, the inside of the cell membrane of the neuron has a slightly negative electrical potential in comparison to the outside (Starr 1994). This electrical polarisation, called the resting potential, is produced by the unequal distribution of sodium and potassium ions between the inside and outside of the neuron. This difference between the electrolyte distributions across the cell membrane is the concentration gradient. Sodium is approximately ten times more concentrated outside the membrane than inside, while potassium is more than twenty times the concentration inside than outside the cell. (Fawcett 1994). This concentration gradient is maintained by the mechanism of the sodium potassium pump whereby potassium ions are moderately free to flow across the membrane of the neuron while the flow of sodium is restricted (McCance & Huether 2004).

Unlike the passive flow of other ions across the cell membrane the sodium potassium pump actively transports sodium ions out of the cell while simultaneously allowing potassium ions into the cell (Starr, 1994). The pump ejects three sodium ions for every two potassium ions that it brings in to the cell. Since both sodium and potassium ions carry a positive electrical charge of one the result is a net movement of positive ions out of the cell thereby maintaining the negative electrical potential within the cell (Marieb 1998).

Neurons transmit signals between each other to effector cells. This nerve impulse, known as an action potential, is a positive electrical charge within the cell. This is caused by an increase in permeability of the cell membrane in response to stimulation of the cell that results in the sudden flow of sodium ions down the concentration gradient into the neuron followed by the flow of potassium ions out of the neuron. This sets up a chain reaction along the axon (depolarisation) (McCance & Huether 2004). This action potential occurs in the axon and dendrites. As a rule, dendrites produce action potentials that are proportional to the magnitude of their stimulation. Therefore, all action potentials are approximately equal in size and amplitude under normal circumstances. This is known as the "all or none" law (Kalat, 1995). At the peak of the action potential sodium ions cease to enter the cell, as potassium ions exit to return the neuron to the resting state (repolarisation) (Kalat, 1995)

The ability of the sodium potassium pump can be impaired. For example scorpion venom attacks the neurons keeping the sodium channels open and closing the potassium channels, thereby causing prolonged depolarisation and inability of the neurons to communicate (Nicholls, Martin & Wallace, 1992).

Local anaesthetic agents such as lignocaine act by attaching to the cell membrane and preventing sodium from entering. Thus blocking action potentials in the afferent region. If anaesthetics are applied to sensory nerves, such a carrying pain sensation, they block the transmission of the pain impulse from reaching the cerebral cortex (Nicholls et.al.,1992). General anaesthesia may decrease brain activity by promoting the flow of potassium ions out of the neurons, causing hyperpolarisation and decreased action potentials, thereby causing the central nervous system to become unresponsive to stimuli.

Nerve impulses are transmitted between neurons via the synapse. Sherrington (1906) was the first to use this name, derived from the Greek meaning "to fasten together". He also predicted most of what we know today following development of the electronic microscope in the 1950s, which led to identification of the synaptic structure (Nicholls et.al., 1992).

There are two types of synapses, electrical and chemical (Starr, 1994). Electrical synapses are found in parts of the brain stem, the retina and cerebral cortex. Electrical current generated by an impulse in the pre-synaptic nerve terminal spreads passively between neurons through direct ionic flow (Fawcett, 1994).

Chemical synapses are more common, and have been estimated to number one hundred quadrillion in the human CNS (Kalat, 1995). The pre-filled gap between the presynaptic and postsynaptic membrane prevents the direct spread of electrical current. The terminal of the presynaptic neuron secretes a chemical, known as a neurotransmitter. Neurotransmitters are synthesised within the cell body and transported down the axon to storage in synaptic vesicles at the presynaptic terminal for release. The speed of transport varies, depending on the diameter and length of the axon, with some neurotransmitters taking hours or days to reach the area of the terminal. Consequently neurons may take a period of time, following release of their neurotransmitter, to replenish their supply (Kalat, 1995). Neurotransmitters when released diffuse across the synaptic cleft and bind to specific receptors on the postsynaptic membrane, activating the ion channels in that membrane causing a secondary current flow (Nicholls et.al.,1992). Chemical synapses may be inhibitory or excitatory depending on the specific neurotransmitter and it's length of stay in the synaptic cleft (Starr, 1994).

There are a number of neurotransmitters identified to date and these include: acetylcholine (Ach), monoamines, Biogenic amines: serotonin, histamine, and catecholamines (adrenalin, noradrenaline and dopamine); excitatory amino acids (glutamate, aspartate) inhibitory amino acids (gamma-aminobutyric acid-GABA, glycine, taurine), certain amino acids (neuropeptides) and gases (McCance & Huether,2002; Nemeroff, 1998).

Calcium has long been known to provide an essential link in the process of synaptic transmission (Starr, 1994). Release of acetylcholine is reduced or abolished when the extracellular concentration of calcium is decreased. The role of calcium has been generalised to other secretory processes, such as the liberation of hormones by the cells of the pituitary gland, release of adrenalin from the adrenal medulla and secretion from the salivary glands (Marieb, 1998). It has also been postulated that some epilepsy may occur due to impairment of the sodium and calcium ion channels (Celesia, 2003).

The events that occur at a synapse can be summarised as follows: the arrival of the action potential causes opening of voltage gated ion channels that permit calcium ions to enter the terminal. This influx almost instantly triggers the release of neurotransmitters that diffuse across the synaptic cleft to bund to specific receptors on the postsynaptic membrane. In turn ion channels open due to increased membrane permeability. The result is either depolarisation and excitation of the target neuron or hyperpolarisation and inhibition (Kalat, 1995).

Neurotransmitters do not remain long at the postsynaptic membrane, as if they did the neuron would continue to be excited or inhibited indefinitely (Nicholls et.al., 1992). They are inactivated by being broken down to their components and reabsorbed or recycled by being taken up by again by the presynaptic neuron for reuse. For example acetylcholine is broken down by the enzyme acetylcholinesterase into acetate and choline. The choline diffuses back to the presynaptic membrane, which takes it up to connect with acetate and form acetylcholine (McCance & Huether, 2994). If this process did not occur the acetylcholine would stay at the postsynaptic membrane and continue to excite it. Certain disorders such a Myasthenia Gravis are associated with a defect in acetylcholine transmission and one drug used inhibits acetylcholinesterase production thereby increasing the levels of acetylcholine (Nemeroff, 1998).

Serotonin and catecholamines are not broken down into inactive components at the postsynaptic membrane but detach from their receptor (Starr, 1994). The molecules are then taken up for reuse by the presynaptic neuron for reuse. This process is called the reuptake. Some of the serotonin and catecholamine molecules may be converted into inactive chemicals that cannot stimulate the receptor. The enzymes that convert the neurotransmitters into inactive substances are catechol-o-methyltransferas4e and monoaminoxidase. These enzymes and their inhibition are of a major importance in designing antidepressant drugs (Nemeroff 1998).

Even though chemical transmission via the synaptic cleft is widely accepted and supported by research, scientists are realising that it does not rule out a slower but more global alternative (Mitchell1999). For instance, a new theory was proposed by Fuxe from the Karolinska Institute in Stockholm, Sweden and Agnati form the University of Modena, Italy (Mitchell1999). They suggested that not all nerve signals follow the synaptic route. They stated that the brain is a foamy like substance rather than a solid mass, with neurons interspersed with a convoluted network of fluid filled spaces and cavities. Fuxe and Agneti proposed that neurons use this fluid filled space to communicate in a broader and extended way, a process they named “volume transmission”. Despite the fact this theory is supported only by a few studies (Nicholson 1999, Zoli 1998), it is difficult to ignore. Moreover, it is backed up by Golgi’s way of thinking that the brain is a continuous network with impulses covering longer distances. Whatever the truth, the study of neural impulses transmission and particularly the nature and physiology of neurotransmitters is fascinating.

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Arteriovenous Malformation: A Paediatric Case Study.

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Abstract

An Arteriovenous Venous Malformation (AVM) is best described as a twisted mass of arterial and venous blood vessels that shunt blood from the arterial side into the venous side of the circulation, bypassing the capillary system, and are congenital lesions that develop between the fourth to eighth weeks of the foetal stage. Symptoms depend on the size and the localisation of the AVM, but in the majority of cases the haemorrhage is the most frequent symptom. AVMs can be small focal lesions or large lesions occupying almost an entire hemisphere. The vessels may leak a small amount of blood into the subarachnoid space of the brain (of all subarachnoid haemorrhages, 10% are caused by AVMs) as they (AVMs) have a higher tendency to bleed in younger patient than in older patients.

Key words: Arteriovenous malformation; Cerebellum; Embolisation

Case study

Ben was a 13-year-old boy who was transferred to this author's ward via the Newborn and Paediatric Emergency Transport Service (NETS) from a peripheral hospital in Sydney. Ben had presented at the peripheral hospital with a 2-3 day onset of headaches, with associated nausea and vomiting. Both Ben and his mother reported that, at times, he was experiencing some unusual drowsiness and over the last 24 hours had developed an ataxic gait and a slight facial palsy.

On examination, his Glasgow Coma Scale (GCS) score was 15. Ben had walked into the ward with his mother, and when assessed he was alert, orientated to time and place, and was able to participate with the giving of information with regards to his presenting problems.

Neurological assessment tools provide an objective means of measuring neurological status and symptoms. A standardised tool, such as the GCS, is essential to enable nurses to make precise comparisons between the data collected at different times. (Ferguson-Clarke and Williams, 1998). Nursing staff should be aware that vital signs are also an important part of a neurological assessment as they reflect the body's haemodynamics and its ability to maintain a sufficient blood flow to the Central Nervous System (CNS) (The New South Wales College of Nursing, 2003). Neurologists on Ben's arrival to the hospital also performed a thorough neurological assessment, the main components of this being the assessment of the following: mental function; cerebellar function; motor function; sensory function; reflex; and cranial nerves.

It was whilst at the peripheral hospital that Ben underwent a Computerized Tomography (CT) scan of his head. The results of the scan showed what appeared to be a 3 centimetre x 2-centimetre lesion, located in the left cerebellar region of the brain. On further review of the scans it was identified as a subarachnoid haemorrhage. It was with this diagnosis that Ben was transferred from the peripheral hospital. On arrival at this author's hospital Ben underwent a Magnetic Resonance Imaging (MRI), these results confirming the haemorrhage and also showing an Arteriovenous Malformation (AVM) in the cerebellum region of the brain, with associated hydrocephalus.

Cerebellar structure and function

The cerebellum is the second largest portion of the brain and occupies the inferior and posterior aspects of the cranial cavity. It is posterior to the medulla and pons and inferior to the occipital lobes of the cerebrum. It is separated from the cerebrum by the transverse fissure and by an extension of the cranial dura mater called the tentorium cerebelli (McCance and Huether, 2001). The cerebellum is shaped like a butterfly, the central constricted area is the vermis and the lateral wings are termed cerebellar hemispheres. Each hemisphere consists of lobes (anterior, posterior, and flocculonodular) that are divided by deep and individual fissures. The anterior and posterior lobes of the cerebellum are concerned with involuntary movements of skeletal muscles, and the flocculonodular lobe is concerned with the sense of equilibrium (Tortora and Grabowski, 1993).

The cerebellum functions to compare the intended movement determined by motor areas of the brain (cerebrum and basal ganglia) with what is actually happening. The cerebellum continuously receives sensory input from proprioceptors in the muscles, tendons, and joints, as well as receptors for equilibrium, and visual receptors in the eyes (Tortora and Grabowski, 2001). If skeletal muscles are not attaining the intent of the motor area, the cerebellum detects the variation and sends feedback signals to the motor areas to either stimulate or inhibit the activity of the skeletal muscles. Besides coordinating skilled movement, the cerebellum is the region of the brain that regulates posture and balance (McCance and Huether, 2001).

Damage to the cerebellum, in Ben's case, was characterised by loss of balance and some loss of motor coordination. Ben also presented with a slight facial palsy, which is related to the VII cranial nerve. The brain gives rise to 12 pairs of cranial nerves, some being sensory, some motor, and some containing both sensory and motor neurons (Sherman and Sherman, 1983). The VII cranial nerve is a mix of both sensory and motor fibres, with the motor fibres relating to the facial muscles (Grimes and Burns, 1992). Ben's facial palsy could be directly related to the insult to the cerebellum, as it is the centre for motor function. Also, changes in the Cerebrospinal Fluid (CSF) pressure due to associated hydrocephalus can be directly and simultaneously transmitted to the facial nerve, resulting in Bell's palsy (Kishimoto, 1998).

Hydrocephalus

Hydrocephalus refers to excessive accumulation of CSF within the cerebral ventricles that leads to a rise in intracranial pressure (ICP). Its aetiology arises from a number of acquired or congenital disorders whereby normal CSF pathways are obstructed, with subarachnoid haemorrhage being a known cause of hydrocephalus (Christiansen, 2002). Patients with acute hydrocephalus often present with a depressed level of consciousness (Ben described this as unusual drowsiness); headache, with associated nausea and/or vomiting; and gait or walking difficulties. Ben presented with all of these signs and symptoms.

Arteriovenous Malformation (AVM)

An AVM is best described as a twisted mass of arterial and venous blood vessels that shunt blood from the arterial side into the venous side, bypassing the capillary system (Thelan, Davie, and Urden, and Lough, 1994; Palladino and Laskowski-Jones, 1993). They are congenital lesions that develop between the fourth to eighth weeks of the foetal stage (Barker, 1993). Symptoms depend on the size and the localisation of the AVM, but in the majority of cases haemorrhage is the most frequent symptom (Hernandez-Gutierrez and Rocha-Rivero, 2002; Palladino and Laskowski-Jones, 1993). AVMs can be small focal lesions (as in the case of Ben) or large lesions occupying almost an entire hemisphere, (Thelan, et al 1994). The vessels may leak a small amount of blood into the subarachnoid space of the brain, hence Ben's subarachnoid haemorrhage. Of all subarachnoid haemorrhages, 10% are caused by AVMs as they (AVMs) have a higher tendency to bleed in younger than in older patients (Locksley, 1995).

Ben's AVM was fed by one cerebral artery, which in doing so, became enlarged and thus increased the volume of blood being shunted into the malformation. As a result of this shunting of blood through the AVM and away from the normal cerebral circulation, poor perfusion occurs in the underlying cerebral tissue, resulting in atrophy (Black and Matassarin-Jacobs, 1993). Headaches are a common symptom in a patient with an AVM, occurring as a result of the increased mass effect of the lesion or associated with the vascular changes in response to the shunted blood. Other symptoms include motor/sensory deficits, aphasia, dizziness, or fainting (Thelan et al, 1994). These symptoms (all of which Ben had) are similar to that of a haemorrhage and of hydrocephalus, and could make diagnosis difficult without the use of diagnostic evaluation including CT scan, MRI, and angiogram. Barker (1993) states that CTs and MRIs are used to determine the complex vascular architecture of an AVM. They are able to define feeding arteries and are used to develop a plan for surgery. Headaches alone would not trigger the suspicion of an AVM because of the wide variety of reasons for headache, some of which have been previously given (Thelan, et al, 1994).

Medical Management

Following Ben's diagnosis the medical team established an intravenous access route and obtained specimens for laboratory studies, including full blood count, serum electrolytes, osmolality, and urinalysis. In a meeting, which included the medical/surgical, team, the family and a member of the nursing staff, the doctors explained that the subarachnoid bleeding had stopped and that no abnormalities had been detected. The doctors also explained that the best course of action to take at this time was to wait for 5 days and observe Ben on the ward. The fact that his AVM was accessible, and he was young and otherwise healthy, meant that he was a good candidate for delayed surgery.

It was also explained that, even though there had been no seizure activity witnessed at this point, Ben was at risk of seizure activity due to the ischemia and cellular alterations in his brain (Rafferty-Mitchell, Scanlon and Laskowski-Jones, 1999). Ben and his family were informed that prophylactic anticonvulsant therapy would be commenced to reduce the risk of seizure activity, and that the risk would diminish following surgery. It was suggested that Ben reduce his activity and where possible remain on bed rest for this period. The nursing staff were asked to assess and record neurologic status as well as vital signs 4^{th} hourly during this period. The surgical team explained that following the 5-day period, they would embolise the AVM, wait a week, and then surgically removing it, explaining to the family and Ben that embolisation alone would not be a cure.

Interventional radiology refers to a group of procedures, which, despite having their origins within diagnostic radiology, have wide application to clinical medicine and surgery. The basic concept is keyhole surgery with X-ray vision (Thomson, 1997). One such treatment therapy to reduce the size of an AVM is embolisation via a cerebral angiogram (Thomson, 1997; Johnston, Dudley, Gress, and Ono, 1999).

Embolisation is an interventional technique, similar to an angiogram, where a catheter is threaded up the internal carotid artery from the femoral artery under fluoroscopic control (Bruni, 2001). The use of a guide wire allows pinpoint placement with a very small initial site of entry (Tseng, Narducci, Willing and Sillers, 1998). Silastic beads or coils are introduced into the catheter (Thomson, 1997), and are carried by the increased blood flow to the AVM. The purpose of this procedure in Ben's case was to block the feeding arterial portion of his AVM and therefore reduce the size of the lesion, before excising the lesion via a craniotomy. Tseng et al (1998) state that embolisation before surgery allows more effective treatment of deep intracranial arteriovenous malformations than either surgery or radiotherapy alone. This procedure was successful in blocking the feeding artery into Ben's AVM, thus stopping the expansion of the lesion, and possible further complications were avoided due to Ben's compliance with the therapy.

Nursing management

Nursing management of the procedure requires that the nurse have a thorough knowledge of the pathophysiology of the disease process as well as a good understanding of the treatment plan. An accurate nursing assessment is essential to ensure a safe environment for patients like Ben before, during and after the procedure. To perform such an assessment, the nurse must have the ability to communicate effectively, observe systematically, and interpret data accurately. Having good communication skills provides an opportunity for the patient and the family to share views and feelings openly. Having already established a professional relationship during Ben's previous period of hospitalisation, this author provided a platform for open communication.

Prior to the procedure the nursing staff reinforced the education that had been given by the doctors caring for Ben. The importance of being nil by mouth prior to the procedure was emphasised. Having had an operation before, Ben could relate his latest experience back to that event, and was able to relate his understanding of this by stating that drinking now could make him sick later. It was again also explained to Ben that during the procedure, although he would be slightly sedated, he might have a hot flushed feeling through his body and head, and that this was normal and would be caused by a special fluid that goes into the blood stream, to help the doctors see where the bleed was.

Ben was commenced on intravenous fluids to maintain hydration and to promote excretion of the contrast used during the procedure. Hourly fluid requirements where calculated based on the following guide: 100ml/kg/day for the first 10kg body weight; 50ml/kg/day for the second 10kg and 20ml/kg/day for each additional kg (Willock and Jewkes, 2000). Ben's daily fluid requirements were calculated as 1860mls per day (77.5mls per hour). Following the completion of preoperative preparations, Ben was escorted to the radiology department to undergo the procedure. At this stage Ben and his parents were a little anxious but stated that due to the education and information given to them they where confident about undergoing the procedure.

The most important nursing responsibility according to Demello (2001) and Anderson (2001) is to ensure a safe environment for a patient post procedure in the observation of the following for signs of complications by checking of: pulses especially below the puncture site, for equality and symmetry; temperature and colour of the affected extremity, as cooling may indicate arterial obstruction; the occlusive dressing for evidence of bleeding or haematoma development; as well as ensuring the affected limb is maintained in a straight position to facilitate healing of the puncture site; and ensuring adequate hydration either oral or intravenously (as Ben was at a potential risk of dehydration and hypovolemia due to the diuretic action of the contrast material used during the procedure); and maintaining pressure area care, whilst the patient is on enforced bed rest.

Ben was lightly anaesthetised during the procedure, so he was placed on a pulse oximeter for the first few hours following the cerebral angiogram, to monitor oxygen saturation levels. According to Casey (2001), pulse oximetry is a useful way to monitor oxygen saturation levels, but emphasises the importance of nurses having an understanding of the principles of oxygen transport and its delivery. The nursing management of this procedure prevented Ben from enduring any complications, (although Ben had to be educated several times through the postoperative period of the importance to maintain his leg in a straight position, which was eventually achieved by putting a pillow down each side of his affected leg).

Following successful embolisation of the AVM Ben was observed on the ward for another week. During this period Ben and his family received education from the neuro-surgeons and reinforcement from the nursing staff about the impending surgical removal of the AVM. It was explained to Ben that when he woke his head would be shaved and that he would have to have a bandage around his head for several days. Ben could relate to this having observed children who had undergone similar surgery. Ben and his family were also educated on the method of surgery best suited to remove the AVM, that being frameless stereotactic neurosurgery.

Surgical Management

Interactive, image-guided, stereotactic neurosurgery systems and advanced computer programs enable neurosurgery teams to use MRI and CT scans to perform less-invasive intracranial tumour excisions. This method, also known as frameless stereotactic neurosurgery, provides accurate, precise preoperative and intraoperative patient information to neurosurgeons. According to Touboul, Al Halabi, Buffat, Merienne, Mammar, Odile, Meder, Laurent and Housset (1998) stereotactic neurosurgery is an effective technique to obliterate AVMs. Hidefumi, Kyousuke, Hiroki, Fumiya, Shinya, Yoshinobu and Kazuo (2003) note that stereotactic neurosurgery is capable of achieving complete obliteration of AVMs in 70–80% of patients.

In these procedures neurosurgeons use a pointing device to communicate surgical locations quickly to a computer system. Computers then provide immediate, three-dimensional displays of pertinent MRI and CT scan information on the monitor (League, 1995, Tessman, 1999, Brady, Thornhill and Colapinto, 1997). These intracranial images then served as a navigational guide to Ben's neurosurgeons before and during surgical intervention.

A potential complication of using this system is over-dependence by neurosurgeons on computer technology (League 1995). It is imperative, therefore, that neurosurgeons also utilise their full surgical knowledge and experience to guide surgical procedures when using interactive, image-guided, stereotactic neurosurgery systems.

Nursing Management

The postoperative nursing management of patients who undergo interactive, image-guided, stereotactic neurosurgery is similar to the care required by patients who undergo traditional craniotomies (League, 1995, Brady, et al, 1997, Tessman, 1999),. Ben was initially transferred to the Children's Intensive Care Unit (CICU) post-operatively. Following a craniotomy it is recommended that all patients be observed closely in an intensive care setting for between12–24 hrs. This degree of care is justified by the need to detect serious postoperative complications early, facilitate rapid intervention, and optimise the reestablishment of systemic and neurologic homeostasis allowing overall faster recovery (Ziai, Varelas, Zeger, Mirski and Ulatowski, 2003).

The nursing staff in CICU monitored Ben's neurologic status as well as his hemodynamic vital signs, taking into consideration the pre-operative physical and mental status of the patient (Black and Matassarin-Jacobs, 1993). Vital signs and neurologic status where assessed hourly until Ben was stable, and then every 2 hours. Once on the ward these observations were continued 4th hourly, as Ben had an uneventful recovery.

The nursing staff also monitored Ben closely for signs of haemorrhage and increasing cerebral oedema, an early sign for these being increased ICP. Thus Ben was nursed in a semi-Fowler's position to reduce intracranial pressure. Palladino and Laskowski-Jones (1993) and Cross (1997), state that elevating the head of the bed to 30 degrees will help reduce ICP. Another measure for controlling the ICP of a patient such as Ben, even after transfer from the CICU to the ward area, is the close monitoring of fluid and electrolyte status. Surgery causes trauma to the brain, which may affect secretion of the antidiuretic hormone, possibly resulting in either diabetes insipidus (DI) or syndrome of inappropriate antidiuretic hormone (SIADH) (Palladino and Laskowski-Jones, 1993).

Accordingly, the nursing staff administered the prescribed fluids and electrolyte replacements as well as the prescribed diuretic, which in Ben's case was Mannitol 10mg every 6 hours. Medication dosages (in this author's hospital) are always calculated in mg/kg or µg/kg. Fluids are calculated and given in ml/kg (Sydney Children's Hospital 2003).

Bereczki, Liu, do Prado and Fekete, (2004) state that Mannitol has been used in human ischaemic brain damage for over 30 years and is known to decrease ICP in several diseases. Mannitol is thought to decrease ICP by decreasing overall water content and cerebrospinal fluid (CSF) volume, and by reducing blood volume due to vasoconstriction (Qizilbash, Lewington and Lopez-Arrieta, 2004). Mannitol has a strong, immediate osmotic diuretic effect and can cause hypotension, with the most common complications of mannitol therapy being fluid and electrolyte imbalances, cardiopulmonary oedema and rebound cerebral oedema. Mannitol therapy in some cases may cause kidney failure (Jastremski, 1998). It was therefore very important for Ben's nurses to monitor his fluid input and output (Ben had an indwelling urethral catheter insitu), and monitor serum and urine osmolality. According to Willock and Jewkes (2000), monitoring and maintaining fluid balance in children, requires that nurses have a good understanding of the normal fluid requirements and losses, as well as the associated clinical complications that can occur due to incorrect fluid balance. During the post operative period and beyond, Ben maintained normal cerebral perfusion, as evidenced by: maintaining his level of consciousness and his GCS score; showing no evidence of respiratory irregularity and no widening pulse pressure.

Pharmacological Management

Drugs have the power to both help and harm a patient, and their administration is one of the most important responsibilities of a nurse. Medical practitioners have the responsibility for the diagnosis and the initiation of therapy, but nurses are the last link in the chain, making drug therapy available to the patient. Nurses assume the responsibility for the administration of the medication and for ensuring that it is actually taken by the patient (Society of Hospital Pharmacists of Australia, 1985).

Romsing (1996), states that the major responsibility for alleviating a post-operative patient's discomfort rests with the nurse, especially when drugs are ordered on an as 'needed' basis. The actual administration of these drugs is dependent on the nurse's clinical judgement, as well as his or her decision on which analgesic to administer, how much to give and when to give it.

All drugs are individual entities and, as such, the action of each drug in the patient depends on its pharmacodynamic properties (therapeutic effect), and pharmacokinetic properties (absorption, distribution, metabolism and excretion). In Ben's case the dose of a drug needed to be tailored to his individual context especially where the therapeutic dose was close to the toxic dose, as no two people respond to a drug in an identical manner.

Paracetamol is a common analgesic used for the relief of the mild to moderate pain that Ben experienced post operatively. The safety and efficacy of paracetamol in children is well established, especially in comparison with aspirin. Paracetamol affects prostaglandin production in the central nervous system, but only to a minor degree in peripheral tissues. In practical terms, that means paracetamol is unlikely to cause bleeding problems (Peterson, 1997).

As Ben was at risk of further intracranial haemorrhage caused by the arteriovenous malformation, paracetamol was an appropriate choice of analgesia. It is absorbed rapidly and completely from the gastrointestinal tract and is evenly circulated throughout most body fluids (Macintyre and Ready, 2001). Paracetamol is metabolised differently by infants and children than is by adults, with the sulphate conjugate being predominant. As a result the metabolite generally responsible for hepatic upset in adults is rarely formed, or formed to a considerably lesser extent, in infants and children. This tends to give paracetamol a higher therapeutic index in children than adults. Paracetamol is excreted in the urine mainly as the glucuronide and sulphate conjugates. Less than 5% is excreted as unchanged paracetamol with 85 to 90% of the administered dose eliminated in the urine within 24 hours of ingestion. The elimination half-life varies from one to three hours. (MIMS, 2000).

In general, the risk of developing toxic reactions to paracetamol appears to be lower in children than in adults. Despite the very low incidence of toxic effects, paracetamol toxicity remains a concern, because this drug is used widely with children (Peterson, 1997). Side effects of paracetamol include hepatic toxicity and failure, jaundice, acute kidney failure, and renal tubular necrosis (Glanze, Anderson and Anderson, 1990). It is critically important, then, that the correct dosage is administered and at the correct frequency (Ben weighed 38kg, and based on the prescribed dosage of 15mg/kg [NSW Health, 2003], was administered 570mg/QID).

When pain relief was insufficient with paracetamol alone, Ben had been prescribed codeine (38mg/6 hourly) in combination with the paracetamol. Codeine acts at several sites within the central nervous system. The rationale for combining two analgesics with presumably different mechanisms of action is the theoretical enhancement of efficacy. Combining two differently acting analgesics avoids increasing the dose of either drug used alone and therefore has a lower expected incidence of side effects. Therapeutic doses of paracetamol do not influence the pharmacokinetics and metabolism of codeine, and codeine has no effect on the metabolism and clearance of paracetamol. (de Craen, Di Giulio, Lampe-Schoenmaeckers and Kleijnen, 1996).

A holistic pain assessment of patients "…is a critical component of the nursing process" (Wong, Hockenberry-Eaton, Winkelstein, Wilson and Ahmann, 1999, p. 1148). According to Atchinson, Guercio and Monaco (cited in Caty, Tourigny and Koren, 1995), the most commonly used criteria to assess pain include verbal communication, body language, and changes in vital signs, as well as emotional responses, affect and crying. Two studies, conducted by Bradshaw and Zeanah (1986) and O'Brien and Konsler (1988), revealed that nurses use factors such as knowledge of the child's pain history, stage of illness, severity and duration of pain, and/or parental input, in their assessment process. It was with this knowledge that the nursing staff where able to maintain Ben's pain at a manageable level for him, so as to not interfere with his daily activities.

The side effects of using codeine are the same as with other opium derivatives, and include nausea, anorexia, confusion, sweating, and constipation (Society of Hospital Pharmacists of Australia, 1985). To avoid Ben becoming constipated due to the codeine he was prescribed an aperient of Lactulose 15 ml in the evening. Opioid-induced constipation is a common problem, as they (opioids) reduce gastrointestinal motility and can cause serious complications. It is widely advised that laxatives should be started concurrently with opiates (Bouvy, Buurma and Egberts, 2002).

Lactulose is a disaccharide (class of sugar), which is broken down in the colon into organic acids. These acids cause mild irritation and promote peristalsis. Lactulose also provides bacterial growth in the colon, which is necessary to maintain normal bowel function (Society of Hospital Pharmacists of Australia, 1985). It was important for Ben not to become constipated following surgery as straining to evacuate his bowels would have increased intra-abdominal and/or intrathoracic pressures which may interfere with drainage from the venous vessels of the head and brain, resulting in increased ICP.

A postoperative complication of head surgery is cerebral oedema. To reduce this swelling, Ben's neurosurgeons prescribed corticosteroids in the form of Dexamethasone 2mg/QID. Theoretically, these drugs work by preventing fluid from entering the cells and by increasing blood vessel diameter, thus increasing cerebral blood flow (Jastremski, 1998). Dexamethasone is a synthetic adrenocorticosteroid with glucocorticoid activity, which has anti-inflammatory and immunosuppressant activities. Glucocorticoids prevent the development of the inflammatory response (i.e. redness, swelling, and tenderness). The anti-inflammatory and immunosuppressant actions of dexamethasone suppress the symptoms associated with the disease. Dexamethasone penetrates into tissue fluids and cerebrospinal fluids, with metabolism occurring within most tissue, but primarily in the liver (MIMS, 2004). The side effects being: mental disturbances; headache; convulsions; increased ICP with papilloedema; and vertigo (MIMS, 2004).

Technologic advances, cost containment, and managed care are contributing to a reduction in hospital length of stay and, in some ways, are adding to the increase in health care needs following discharge, as patients are at times, discharged form hospital too early. The multidisciplinary health care team played a key role in facilitating a smooth transition for Ben and his family as they moved from the hospital back into the community. Discharge plans for patients (which are initiated on admission) must be routinely reassessed and modified as needed, and initiated in a timely manner to ensure that, if necessary, appropriate continuing care services are obtained (Matt-Hensrud, Severson, Hansen and Holland, 2001). While the entire health care team was involved in preparing Ben for discharge, it was the nurse, as direct caregiver, who was in a pivotal position to provide a critical assessment of his needs, coordinate available resources, and formulate not only a nursing care plan but also a timely discharge plan.

The nursing care plan for Ben incorporated a large education component not only for him but also his family. The neurologists, the neurosurgeons and the nursing staff spent a lot of time ensuring that Ben and his family where at all times kept up to date with his progress and that each procedure was reinforced as required by their needs. An *Elective Craniotomy Care Plan* (Shannon, Gillespie and Lancero, 1992) adopted by the Tucson Medical Center Education is an ideal plan of care for patients undergoing a craniotomy, and is easily modified to meet the need of a patient like Ben. The nursing care plan for Ben and his family incorporated drug therapy as a fundamental strand. Establishing a nursing care plan in respect of drug therapy takes into account information gathered by observation of, and interviewing Ben and his family; from other sources such as patient records; and from appropriate professionals. With regards to drug therapy, short-term goals concentrated on Ben's cooperation in gaining maximum effect from drugs. Long term goals focused on the ability for Ben to self-medicate and compliance with therapy. One such drug requiring the need for education was dexamethasone. Ben was commenced on this drug post operatively and was instructed that he would be required to continue this medication for a week once discharged.

The treatment schedule and route of administration reflected the severity and aetiology of the cerebral oedema and treatment needs were tailored to Ben's response to the medication. An initial dose of dexamethasone 8 mg intravenously was administered to Ben in CICU, followed by 2 mg intravenously every 6 hours, until the symptoms of oedema subsided, which in his case was around 12 to 24 hours post-operatively. Ben was then commenced on an oral dose of 2mg every 6 hours. After four days the dosage was reduced to 1 mg and gradually stopped over a period of seven days.

Ben and his parents were advised of the importance of the medication not being suddenly stopped. They were advised that function of the adrenal cortex had been suppressed during treatment, and that by slowly reducing the dose of the medication allows time for the adrenal cortex to return to normal (Epstein, 1992). Ben and his family where also advised to report any signs of infection, for example a sore throat, to their doctor back at the hospital or their GP as an infection is not always easy to detect in patients on dexamethasone, and that the body's temperature may remain normal in the presence of infection.

One other key component of Ben's ongoing education was safety. The Brain Injury Rehabilitation Team manages the continuing rehabilitation of children with head injuries at this authors Hospital. Team members are involved in the assessment of the child's abilities, provide therapy for problems that may arise, and provide family support and school liaison. The Brain Injury Rehabilitation Team reinforced the importance of self-safety after discharge. It was explained to Ben that he had to avoid any contact sports, which included football, as Ben was an active participant in football prior to this hospital admission. They explained that there was a risk of complication should he sustain a head injury, and that all contact sports should be avoided for at least 6 months. Although most children make a full recovery, Ben's parent's where advised that they may notice some changes in Ben's behaviour and/or ability to learn and understand information at home or at school. As children often tire easily following a head trauma, this tiredness can exaggerate behavioural changes. The family were advised to look for changes in Ben's ability to: understand or follow a conversation or spoken directions; re-tell events; and find the right word for things. It was also explained that Ben might have difficulty with new schoolwork or new activities, and that he may have problems with concentration or remembering. The team informed the parents that they would follow up Ben as an outpatient as well as visit him in his school. With the parent's consent they would speak to Ben's teachers and educate them on the possible changes that Ben may experience during his recovery phase, and support them with Ben's transition.

Ben was discharged from the hospital, following a relatively uneventful recovery period. His parents knew that there was follow up support arranged and that if needed, they need only present at the Emergency Department to receive prompt medical attention. They felt comfortable with caring for Ben once home, as they had received adequate support and education whilst at the hospital.

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Abstracts from the 2005 Scientific Meeting

The abstracts for the 2005 Scientific Meeting are presented below. They provide you with a snapshot of the research and practice that neuroscience nurses are engaged in, as well as case study presentations.

Cerebral Metastases: An Update and an Overview
Rochelle Firth

Although much attention is given to primary central nervous tumours, in particular gliomas, cerebral metastases are the most common brain tumour identified clinically (Greenberg 2001). Gerrard & Franks (2004) estimates that 10-50% of patients with cancer will develop cerebral metastases. Diagnosis, management and prognosis of cerebral metastases differ from most brain tumours including a full system review to assess for a primary lesion. Greenberg (2001) suggests that 15% of patients present with no cancer history. Due to the difference in nature of cerebral metastases it is also important to consider support networks individually. The presentation will highlight considerations given when setting up support networks for this patient population.

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Gerrard, G.E. & Franks, K.N. (2004). Overview of the diagnosis and management of brain, spine, and meningeal metastases. *Journal of Neurology, Neurosurgery and Psychiatry*. 75: 37-42.

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Hereditary Schwannomatosis: A Family's Journey
Karen Morrison, Beryl Osman & Catherine Solley

Schwannomatosis is a recently defined rare and distinct clinical entity. It is an autosomal dominant disorder whose genetic background, although unclear, has a clinical picture similar to that of neurofibromatosis type 2. Whereas the most common manifestation of neurofibromatosis type 2 is bilateral acoustic neuroma, in schwannomatosis there are multiple schwannomas with no evidence of acoustic neuroma. The appearance of multiple schwannomas usually indicates hereditary disease.

Through a case study of an eighteen-year-old female and her family this paper will discuss the pathophysiology and the genetics of hereditary schwannomatosis. This case demonstrates malignant transformation and the treatment of this will be discussed.

By illustrating the complexity and the malignant transformation in this case of hereditary schwannomatosis it is hoped to heighten awareness of the effect on the family, the amount of hospitalisation incurred, the need for genetic counseling as well as the amount of energy and emotional input that is required from nursing staff when caring for such patients.

Supportive care needs of brain tumour patients and their carers
Lucy Bailey, Jeff Dunn, Liz Eakin, Monika Janda, Suzanne Steginga, Kate Troy, & David Walker

Primary brain tumours account for less than 2% of all cancers but can carry significant burden for patients and carers. Despite this, there is limited research about supportive care service needs of patients with brain tumours and their carers.

A qualitative research approach was used to assess supportive care needs and included in depth telephone interviews (6 patients and 8 carers) and focus groups (12 patients and 10 carers) with members of the Queensland Cancer Fund Brain Tumour Support Service living in Queensland. All interviews and focus groups were recorded and transcribed for analysis.

Six common themes emerged:

- Need for information and coping with uncertainty;
- Support with finances and dealing with welfare agencies;
- Return to 'normal' life versus long term care;
- Social support / respite care;
- Stigma / discrimination;
- Death and dying.

Participants were frequently unable to define and request helpful services, often due to limited awareness of these services. Participants suggested strategies to overcome this:

- Assignment of a team or case manager to each patient to provide information and emotional support;
- Proactive dissemination of information, education and psychosocial support;
- Referral to neuropsychological assessment' and education of patients, carers, welfare agencies and employers to improve understanding of restricted working ability;
- Non bureaucratic access to welfare payments, home visiting services and respite care for patients unable to return to previous roles;
- Where tumours reduced life expectancy, services facilitating communication about issues such as treatment decisions, and death and dying early in the treatment process.

PFO: A 'Stroke' of Bad Luck
Kate Pradie & Sharon Eriksson

Cardiac disorders are acknowledged as a major source of cerebral embolism. Patent foramen ovale (PFO) is one of many structural heart diseases and its presence with or without an atrial septal aneurysm (ASA) has been recognised as a potential risk factor for ischaemic stroke. The relevance of PFO in stroke and its subsequent management is still controversial, but major developments have started to emerge over the past decade.

PFO, which is present in up to 30% of the population has been increasingly implicated in the aetiology of stroke and is more prevalent among young patients (<50 years of age) in whom no other cause for their stroke is found or apparent (cryptogenic). The management of stroke patients with PFO is reliant on several factors. Along with the usual post – stroke care and investigations, treatment involves secondary prevention strategies to reduce risk of further stroke.

Caring for young stroke patients can be very challenging, especially if permanent neurological deficit results. As neuroscience nurses we need to be particularly sensitive to the psychological needs of this group, in order to better help the patient deal with their stroke and the impact on their life. To gain further insight and understanding of PFO in stroke, a case study of a young patient admitted to the Acute Stroke Unit at Prince of Wales Hospital Sydney will be presented.

Showcasing the impact of Stroke Unit Service on patient and service outcomes.

Lorinda Upton-Greer & Sam Saunders Battersby

In July 2000 a five bed Stroke Unit located within a general medical ward was trialed at the Launceston General Hospital, Tasmania. Today it has become an integral part of service provision that has progressed to an 11 bed geographically located Stroke Unit that meets criteria stated in the National Stroke Strategy.

Management guidelines, policies and clinical pathways have been developed and implemented. A stroke team has been established since 2000 with care coordinated by the Clinical Nurse Consultant. Key Liaison networks have also been established with the Aged Care Transition Coordinator, community health services and rehabilitation with nurse initiated referrals.

Automatic referral and multidisciplinary team meetings have resulted in a decrease in the average review time (day) range from1.1 to 5.2 days. This was previously up to 9.2 days.

Automatic reporting systems have been developed to enable trend analysis of clinical indicators, key performance indicators and patient and service outcomes. Average Length of Stay for Stroke Unit patients has decreased from 37.3 days to 24.88 days including rehabilitation. CT scanning time has decreased from 11 hours and 19 minutes to 3 hours and 49 minutes. There has been a 6.9% increase in the number of patients admitted to the acute rehabilitation ward, a 3.6% decrease in mortality, a 11.8%decrease in the number of patients requiring permanent residential care and a 6.7% increase in the number of patients returning to their normal place of residency.

Project Enhancing Patient care – An organisational approach to improving care and access in a busy acute ward with conflicting demands.

Lyn Wallace & Julie Faoro

In 2004, Southern Health undertook a review of patient flow processes outside of our organisation in an attempt to improve access and patient management across the Organisation.

Previously projects undertaken in the organisation had demonstrated improvements in care in set patient groups. These included a group of general medical patients and respiratory patients such as those with asthma. Patients, families and treating teams surveyed at this time indicated that overall satisfaction was enhanced with shorter more efficient hospitalisations.

The next major step was to broaden the scope of these projects to a ward, rather than a service. Ward 54S South, a 30-bed acute neurosciences ward was chosen.

In March 2005 a data collection marathon was undertaken involving a patient journey approach looking at approximately 100 admissions from varying entry points to discharge. The data gathered encouraged us to review our process in several areas.

These included:

1. Implementing daily 0830 team meetings for each unit including medical staff, allied health, nursing, and rehabilitation assessors;
2. A chart round each afternoon to enable feedback and closure of tasks;
3. Early identification of potential emergency department patients soon after arrival to enable rapid acceptance to units with only essential tests performed in ED. (reduce LOS in ED);
4. Review of demonstrated blockages to flow i.e. delays waiting for MRI, NCS etc – where discharge was reliant on test results.

A variety of changes have been made to our practice – these are reviewed at monthly meetings and outcome measured.

This paper will describe the process, actions and outcomes of the study. It will also demonstrate the frustrations along the way.

What Standard of Professional Performance should we expect from the Postgraduate Certificate or Diploma qualified Neuroscience Nurse?
Jill Stow

With the increasing cost of postgraduate nursing education there is a need for education providers to clearly articulate the educational and professional outcomes of both postgraduate certificates and diplomas in neuroscience nursing. The recently published Professional Standards for Neuroscience Nurses (ANNA, 2004) provides a framework for neuroscience nursing practice based on eight domains of professional performance. In its introduction the authors propose that the framework may be used as a tool for both performance appraisal and curricula development. Whilst this document clearly sets out the scope of neuroscience nursing practice, the level of post graduate education and clinical experience required to achieve each performance Standard is not defined. This paper will attempt to articulate, using examples from the eight domains, what the specialty can expect from a certificate versus diploma qualified neuroscience nurse.

Reference

Australasian Neuroscience Nurses' Association (2004). Professional Standards for Neuroscience Nurses. Australia: Australasian Neuroscience Nurses' Association.

The concept of the Expert Patient: Dream or Nightmare???
Tim O'Maley

An expert patient has been defined as "people who have the confidence, skills, information and knowledge to play a central role in the management of life with chronic diseases." An observation often made by doctors, nurses and other health professionals who undertake long-term follow-up and care of people with particular chronic diseases is "my patient understands their disease better than I do." This knowledge and experience held by the patent has too long been an untapped resource. Research and practical experience in North America and the UK are showing that patients with chronic diseases need not be recipients of care: they should become key decision-makers in the treatment process. By ensuring that knowledge of their condition is developed to a point where they are empowered to take some responsibility for its management and work in partnership with their health and social acre providers, patients can be given greater control over their lives. Self-management programs can be specifically designed to reduce the severity of symptoms and improve confidence, resourcefulness and self-efficacy.

Maximising care through education and clinical support in the Neuroscience Unit.
Natalie Derry & Janine Loader

In our current health care climate it is becoming increasingly evident that organisations require innovative opportunities for clinical support and nursing environment. In 2002 St Vincent's & Mercy Private as an organisation did not embrace the culture of learning and development and as a consequence we saw both low numbers of graduate nurse applications and low retention of graduates. Expenditure rose to $9.6 million a year on agency staff and cross campus departments such as Education struggled to be owned in this structure.

Nursing and Nursing Education have taken an active role in the review of the organisation with the key initiative of retention and recruitment of staff. Such a focus requires a change in strategic direction for the new look Education and Development Unit to achieve desired outcomes.

The Neuroscience Department was chosen as a focus for such an initiative. The position of 'Clinical Coach' was created in the middle of 2002 with the aim of instilling in the learner motivation to improve performance and strive for excellence in patient care. Prior to this there was no clinical support within the unit, no post graduate education, no division two's and minimal undergraduates that rotated through the unit and very few permanent staff, all of which were grad 2 year 6 and above.

Two years after the creation of the position there has been widespread staff satisfaction both throughout the department and also with the initiative. There have been 5 graduate nurses taken per rotation with division 2 graduates and trainees prominent throughout the unit. Seven students have been retained after completing post graduate studies and both doctor and patient satisfaction along with clinical risk have had marked improvements.

Future directions in the transition of paediatric neuro developmental patients to adult services.
Rachel Coleman & Stephanie Moore

The authors will introduce the topic of paediatric transition to adult services within the specific context of neuro developmental patients. Through a literature review the authors will identify the key themes including barriers to transition and nursing considerations for practice and future roles. The authors will explore current international and local practice in order to make recommendations for future directions.

Complex Nursing Care of a Patient in a Halo Brace
Maria Moran

A case study of a patient with a cervical injury and who received treatment by the use of the Halo Brace was presented. The presentation will include discussion of the anatomy and pathology of the spine, concentrating on the cervical spine, the injuries sustained, the mechanism of the injury, investigations required to make the diagnosis and decide on the best treatment to stabilise the fracture. The treatment method will concentrate on the use of the Halo vest/brace and how it works in stabilising the cervical spine. The role of the complex and comprehensive nursing care and allied health management in planning discharge for a patient in a Halo brace will be presented. The complexity of care and the role that the case manager plays in insuring that early discharge planning is started to ensure a safe and smooth transition from the hospital environment to home that the patient in a halo brace requires will be identified.

Emerging technology and its role in the management of severe brain injury.
Sharryn Byers

Every day in intensive care units throughout Australia nurses and medical clinicians manage patients with severe brain injury. Management of these patients is dependant on expert nursing care and assessment. For many years this assessment has been limited to assessment of level of consciousness, blood pressure, cerebral perfusion pressure and in some units saturation of oxygen in jugular veins. In other words using global methods to assist us estimate what is happening within the brain. In this presentation how the modalities work, how to interpret the information and modify treatment will be discussed as well as the meaning of the information and how it can be utilised by the nurse to improve patient outcomes.
Whilst major progress in management of severe brain injury has been achieved with the use of these modalities questions remain regarding what is actually happening within the brain itself. Recently in both research and clinical settings the use of monitoring equipment has begun to answer those questions and provide clinicians with additional information to assist in the management of these patients.
Brain tissue oxygen monitoring utilising a catheter in the parenchyma of the brain and microdialysis of the brain tissue are two such monitoring modalities. Clinical use of these modalities has begun to be utilised in Australian Intensive Care Units. The introduction of any new technology has challenges for all staff involved including the challenge of learning how the technology works, the situation in which it should be used and limitations of the technology.
Nursing staff are intricately involved in the use of these technologies and therefore need to be at the forefront when introduction of these technologies is considered.

The Terror of Technology.
Danni Phillips

Since the dawn of neurological intensive care in the 1960's, monitoring of patients with a traumatic brain injury (TBI) has become increasingly complex. Initially, basic clinical examinations, formalised Glasgow Coma Scale (GCS), were used, but advances in technology lead to the introduction of such monitoring modalities as intracranial pressure (ICP) and cerebral perfusion pressure (CPP) monitoring, jugular bulb oxygen monitoring, and more recently brain tissue oxygen (PbO2) monitoring and cerebral microdialysis. GCS, ICP and CPP measurements are currently used to formulate nursing therapies and medical management of these patients, and in conjunction with CT and MRI scans, may be used to predict outcomes.
One new and exciting advance in technology is PbO2 monitoring, which allows monitoring of the oxygen levels in brain tissue. Although this technology is new in Australia, research of this tool has lead to the development of some

outcome predictors, which in cohort studies can be correlated to survival.

In a recent case, a young man who sustained a TBI had PbO2 levels in the range predictive of neuronal death and poor outcomes. Nurses caring for this man were concerned about continuing care due to the poor prognosis predicted by the guidelines. In fact the patient improved and was discharged without requiring rehabilitation. While nurses caring for these complex patients need to interpret the data collected using these new technologies assessment must incorporate 'traditional' methods. No, one assessment method currently available will provide all the answers nurses and medical staff need to manage these critically ill patients.

A drug free novel approach to facilitate memory and attention.

Krishna Murthy

A new Neuro – acoustic design of music therapy involving brain wave entertainment used in this project could provide a cost effective non-drug alternative to augment treatment of special population. Mainstream education could benefit from this by making widely available a form of brain-wave training, which makes the learning environment more enjoyable and productive.

Hypothesis one (H1) postulated a statistically significant higher mean score for the experimental group over the control group as measured by a 20 item memorising and recalling of a list of words.

Hypothesis 2 (H2) postulated a statistically significant higher mean score for the experimental group over the control group as measured by a 10 item French to English word list memorisation, recalling and recognition test.

The increase in performance of the experiment group over the control group in memory related motor tasks in this project demonstrates a secondary aspect of this task, which is 'ATTENTION'. Thus it also helps those populations who have academic difficulty due to an impaired ability to persevere at routine motor tasks, such as ADHD (Attention Deficit/Hyperactive Disorder) and LD (Learning Disability) affected children.

By using only audio stimulation the financial access to the benefit of this new therapy is also improved. This also helps the Neuroscience nurses to care for their patients easily as it increases their attention and memory capacity as indicated in the results of this study. Hence it could prove a boon for such patients to recover easily as it is also designed on the basis of music therapy, which has proven records of increasing recovery times.

Case Study review of Vasospasm as a complication in Subarachnoid Haemorrhages.

Carley Mills & Sue Day

This paper reviewed the case and literature associated with the presentation Mrs. C, a 28 year old who first presented with a Grade 2 SAH from an aneurysm, which was clipped without incident. Six days later she presented with a Basal Ganglia Infarct secondary to vasospasm.

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The Neurological Nurse Specialist Service South West Western Australia.

Penny Hughes

The Home and Community Care Branch of the Western Australian Health Department fund the Neurological Nurse Specialist Service of South West Western Australia. It started as a pilot program being the brainchild of the Neurological Council of Western Australia. The South West region now has 2 nurse specialists and the Great Southern region 1 nurse specialist. The service is community based and is well networked with other care providers so outcomes are improved for people with neurological conditions with the aim of keeping people well and in their own homes for as long as possible.

The principle activities of the Neurological Nurse Specialist Service are:

1. Provide advice relevant to nursing and allied care services for clients and their families, carers. Medical and nursing staff generally. This occurs in the home, office, community health centres, medical practices, clinics, hospitals, nursing homes and service provider centres.
2. Education and information on Neurological conditions likely to cause admission to hospital and techniques for the specific care of clients to all areas of the health community, advocacy for neurological clients and their families and carers in matters relevant to nursing and medical care.
3. Community education – promote community awareness of neurological conditions

4. Linking people into local services is a major role in the position.
The service is utilised by the health community and service providers. Interestingly the greatest source of referral is from specialists. I have been involved in the care of 80 different neurological conditions with a population from babies to the elderly.

New Surgical Options for the Management of Chronic Back Pain.
Suzy Goodman

To update those attending on current options for chronic back pain patients who would traditionally only be offered a spinal fusion.

Patients with chronic back pain now have more options available to them than traditional spinal fusion surgery. The new options have fewer complications and reduced recovery rates with improved patient satisfaction and physical functioning in the community in shorter time frames.
The new options that are available are the "Wallis Implant" and the "Artificial Disc" which are "Stabilisation Procedures" of the spine.
This presentation discusses the clinical outcomes between the traditional surgery and newer options available to the "Right" patient type from a nursing perspective of the current Melbourne experience. There will be a focus on the physical, emotional and social recovery of the patient from a debilitating chronic condition which prevents them undertaking normal lifestyle activities.

Immunology in MS: Important Consideration for Nursing.
Tim O'Maley

Multiple Sclerosis (MS) is a chronic, demyelinating and degenerative disease of the central nervous system, and research has suggested strong links to an autoimmune process. Symptoms of this disorder include impairment of vision, sensation, muscle strength and coordination, and cognitive processes. Each patient is affected differently by the disorder, and the physical and emotional progression of MS is unpredictable.

Understanding the POSSIBLE immunological processes that may be occurring is becoming an important issue for Nurses concerned in the care of people with MS. The treatments that we use are based on immunological theories of the disease, and with more and more people turning to complementary medicines, understanding the implications of these is an essential component to building a successful long-term patient management relationship.

Unusual Neurosurgical Presentation 12 Days Post Partum – A Case Study
Simon Latham & Jane Raftesath

'Julie' is a 38yr old woman who presents to the emergency department with a seven-day history of thoracic and lower back pain, complicated in the last 24hrs by severe bilateral lower limb weakness, urinary retention and constipation. Pre hospital treatment had been provided by her local GP and chiropractor. Interestingly to her case is that 'Julie' is 12 days post partum, who had a normal vaginal delivery with no epidural analgesia.
This case presentation will discuss the unusual disease process and subsequent diagnosis. The pathophysiology, treatment and prognosis of the patient and the challenges of looking after a paraplegic patient within a non-spinal unit setting will be discussed. The detailed involvement of the multidisciplinary team and the psychological impact this disease process had on the patient and her family will also be addressed.

Neurosurgical Step-down Unit Model of Care: An alternative to intensive care.
Jeanne Barr, Vicki Evans & Jeff Ramos.

Patients undergoing neurosurgery or neurointerventional procedures require constant observation and assessment by nurses with specialised skills in neuroscience nursing. While many patients require intensive care admission there are certain groups of patients that may be safely managed within a neurosurgical step-down unit.
Our institution is unique within NSW having for many years maintained a specialised neurosurgical intensive care unit with its own staff of neurosurgical ICU nurses. Over the years, the complexity of patients admitted to that unit continued to increase along with the demand for the service.

After a proposal for a neurosurgical step-down unit was accepted by the health service executive we began planning for that unit. This involved nursing, medical, and allied health staff from both the neurosurgical intensive care unit and ward. This paper will outline the development process and describe the step-down unit model of care including the types of patients admitted, their length of stay, the pros and cons of the model and plans for the future.

Hot, Wet, Rigid & Numb: A case study

Joanne McLoughlin

A 57-year-old man (Mr. X) presented to the Emergency Department with back pain and spasms. He had become unwell at home for the past three weeks and previously had a perforated eardrum a few weeks earlier and was taking amoxil. He was admitted to the medical ward but during the night he was given IMI Pethidine and half-Hour later he was desaturating, extremely agitated and diaphoretic. The signs and symptoms were atypical of a number of disease processes and this baffled the medical staff. What was wrong with Mr. X? The suggestions were Meningitis? Encephalitis? Tetanus? Multiple Sclerosis? Epileptic seizures?

On CT scan he had a right mastoiditis and the next day he was sent to theatre for a right mastiodectomy. His condition initially improved and was extubated but later that day there was reappearance of the previous symptoms and he required reintubation. He was transferred to St George Hospital for MRI, EEG and neurological opinion, as the diagnosis was still unclear. While at St George hospital a diagnosis was confirmed and the patient was treated accordingly and later transferred back to Wollongong. Today Mr. X hasn't been able to return to work he still has muscle spasms, muscular weakness and tires easily.

POSTER ABSTRACTS

Everest & Denali: Cerebral Syndromes

Vicki Evans

It's been over 50 years since Hillary conquered Everest. Since 1975, Mt. Everest has been climbed more than 1,600 times by over 1,200 individuals, including approx. 175 fatalities. There are many factors that the avid climber must research before any climb. Yet to climb Mt. Everest or Mt. McKinley (Denali), there are extra precautions and a realisation of the fine line between life and death.

Cerebral syndromes usually develop at altitudes above 2,500m (8,000ft). Cerebral oedema, hypoxia, hypothermia and frostbite can claim even the most experienced climber.

"Falling Head over Heels" Reducing Falls in Neurosurgical Inpatients with the implementation of a 'High Risk Falls Room'.

Kylie Wright, Jason Selmon, Kendall Neilson & The Team CB 4 West Liverpool Hospital NSW

Fall related injury in acute care facilities is a major safety concern. Our quality processes identified a high number of falls with adverse consequences were occurring on the neurosurgical ward. A multidisciplinary team was formed and brainstormed ideas to decrease the incidence of falls in high-risk patients. The team suggested cohorting high-risk patients together into a 'High Risk Falls Room' with the aim of preventing falls. A target was set of 50% reduction in 6 months and eventually to zero. Falls incidence data was collected and analysed and results reviewed after 6 months. Results showed the incidence of falls decreased from 6.5 falls per month to just 1, and within 9 months the team had achieved a zero falls incidence rate. Using this model, standards for falls prevention and benchmarking between facilities can further help decrease the incidence of fall related injury.

Neuroscience Nurses making a difference in the lives of people living with Advanced Parkinson's Disease.

Karen O'Maley

People living with advanced Parkinson's Disease (PD) face complex issues, which must be dealt with using health care professionals' assistance. Medication doses become complex and therapeutic regimens confusing. Surgery is also an option for symptom control, however many people are unable to access this option in Queensland due to financial constraints (no public funding for the procedure) or because they are poor surgical candidates. Medication side effects can often become more disabling and problematic than the symptoms of PD.

One way Neuroscience nurses are making a difference in the lives of people living with advanced PD is in education, initiation and maintenance of a novel injectable dopamine agonist. The D1, D2 agonist can improve PD symptom control in select PD patients. The treatment, however, requires intense education and strong nurse – patient relationships. The treatment is prescribed by Movement Disorder specialist neurologists but assessment, initiation and ongoing evaluation is carried out by Movement Disorder, PD Nurse Specialists.

Educating and relationship formation with the person with PD, their families, carers and other involved health care professionals is intrinsic to successful outcomes of this therapy. This poster describes the process of patient selection, trialling of apomorphine to assess appropriateness and the patient education required. Anecdotal evidence of patients currently using the treatment is described. The potential for multi-centre nursing driven research into the use of apomorphine in PD symptom control is also discussed.

Back to 'BASICS': Building A Stroke Inpatient Care Strategy: Key Performance Indicators in Stroke Nursing.

Karen Tuqiri, & Sharon Eriksson

Monitoring of the standard of health care delivered to patients is essential in the current quality-focused health care system. The need for objective key performance indicator data collection is evident as health care environments focus on improved quality of care and greater accountability. More recently the quality of nursing care received by patients and its impact on patient outcomes has received great attention. The development of key performance indicators (KPI's) sensitive to patients' nursing needs is of great importance in this indicator-oriented health care system.

This poster outlines the strategy the Acute Stroke Unit at the Prince of Wales Hospital, Sydney used to facilitate the introduction of KPI's in stroke nursing.

The aim of this strategy is to optimise patient safety and outcome by monitoring and reviewing nursing care delivery. The entire process promotes the continuation of existing good nursing practice and allows the identification of key areas requiring improvement.

This strategy included:

1. The identification of five relevant and measurable core stroke nursing indicators,
2. The development and implementation of clinical audit tools, and
3. Determining the process for collating results and providing timely feedback to the nursing staff.

The implementation of stroke nursing KPIs has been well received by the nursing team in our Acute Stroke Unit. They have recognised the importance their care has on patient outcomes and are demonstrating greater accountability for their nursing care.

Sharing the Expertise of a potential Learning Organization

Anne Macleod

A learning organization is a workplace where learning takes place at an individual and organizational level. It needs to be adaptive in its learning processes to bring about organizational change.

The Neurosurgical ward at Royal North Shore Hospital places a strong emphasis upon nursing education. The aim is to achieve the best possible care for the neurosurgical patients based upon the staff's clinical and theoretical knowledge and in doing so seek to reach the objectives of a learning organization. With the development of new technology, procedures and research there is a need to continually learn in order to provide optimal patient care.

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