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In This Issue:

Editorial

Vicki Evans
Editor

This edition brings together an array of interesting topics for the neuroscience nurse and related allied health personnel. It begins with a review of the literature regarding the sampling of cerebrospinal fluid from an external ventricular drain.

Then follows an article from Thailand that describes the on-going disability & consequences following TBI within the Thai context. This is useful information for the world neuroscience community as well.

There is a scarcity in the literature for management strategies relating to terminal ICH in the palliative care setting — what to expect and how best to deal with the imminent finality. Discussion in this manuscript centres around these catastrophic events and how best to deal with them from a staff, patient and family perspective.

A Western Australia study looking at a Neurological Integrated Care Pathway (NICP) showed that once introduced, it improved service efficiency for both the hospital system and the community neurological support service. A useful introduction to patient care.

A literature review was conducted highlighting that the neurotrauma population was at greatest risk for development of venous thromboembolism. The neurosurgical nurse remains at the forefront of monitoring patients and implementing strategies for treatment of VTE, DVT and PE. Thromboprophylaxis is discussed.

The journal begins with an interesting editorial on the topic of surgical epilepsy from Dr Mark Dexter relating to the use of SEEG evaluations in drug resistant epilepsy patients. I thank Dr Dexter for his contribution and support of the *Australasian Journal of Neuroscience.*

Guest Editorial

Dr Mark Dexter
Surgical Epilepsy Program
Westmead Adult & Children's Hospitals

Stereoelectroencephalography (SEEG) Something Old Becomes Something New – Invasive Electrode Recordings in the Evaluation of Drug Resistant Epilepsy

Epilepsy is a common medical problem in the Australian community with a prevalence of 7.5 per 1000 Australian citizens. There are approximately 52,000 people in New South Wales who suffer from epilepsy. Approximately 30% will never achieve lasting seizure control from medical therapy alone. Patients with drug resistant epilepsy require evaluation at a comprehensive epilepsy surgery program similar to the one at the Westmead Adult and Children's Hospitals. Drug resistant epilepsy is typically defined as a failure of two anticonvulsant medications trialled at an adequate dosage. Patients would typically have at least a two year period of uncontrolled seizures with an average of one seizure per month for more than 18 months and no seizure free period lasting more than three months. The presurgical evaluation involves referral to a neurologist/epileptologist who would typically perform a detailed clinical evaluation, EEG, video EEG telemetry, MR imaging, PET imaging, SPECT studies and a neuropsychological evaluation.

This evaluation would define a group of patients who will benefit from epilepsy surgery. The most common form of epilepsy referred to surgical epilepsy programs involves temporal lobe epilepsy. This is a well defined electrical and clinical syndrome that has been better defined in the PET and MR era. The majority of these patients can proceed to surgery without the need for an invasive electrode evaluation. Seizure freedom rates in the order of 70% would be standard in high volume surgical epilepsy centres. There has been a randomised clinical trial of surgery for temporal lobe epilepsy published by Wiebe et al (2001) in the New England Journal of Medicine. This demonstrated a significant benefit of surgery over medical therapy for temporal lobe epilepsy. Excellent out-

comes for surgery have been demonstrated in a variety of other conditions, particularly those where a lesion can be defined on anatomical imaging.

There are however a group of patients with drug resistant epilepsy where no lesion is visible on MR imaging and the pre-surgical evaluation suggests that the seizures begin outside of the temporal lobe. These patients are often referred for an invasive epilepsy evaluation at the Westmead Hospitals. For more than 20 years we have been implanting subdural grid electrodes to evaluate patients with non-lesional drug resistant epilepsy. There remained a group of patients where despite implanting multiple subdural grid electrodes, we were unable to delineate the site of seizure onset. In 2011 we began to study the technique of stereoelectroencephalography. The SEEG technique had been common in France and Italy for more than 40 years, having originally been published by Talairach and Bancaud in 1965 at the Sainte-Anne Hospital in France. Initially this technique was performed with formal cerebral angiography as the only imaging modality. Over subsequent decades, complex three dimensional MR, CT angiography as well as formal digital subtraction angiography, has been incorporated into the technique.

Over the last few years the technique has become more common in Europe and also in the United States. We performed our first SEEG case at Westmead Hospital only three years ago and have gone on to perform a further 30 cases. Increasingly, it is replacing the implantation of subdural grid electrodes as our preferred technique for investigating non lesional drug resistant epilepsy.

The SEEG technique involves implanting multiple depth electrodes through twist drill holes thereby avoiding the need for a craniotomy. We have found that the SEEG technique allows three dimensional definition of the epileptogenic zone. The procedure is well tolerated by patients and it is significantly less invasive than the craniotomy required to implant subdural grid electrodes. If an epileptogenic zone can be defined through the SEEG technique, then patients would typically return for craniotomy and resection of the epileptogenic tissue six weeks following the SEEG procedure.

We use invasive monitoring in epilepsy surgery to clarify discrepancies identified in the pre-surgical epilepsy evaluation. It is very important in patients with drug resistant epilepsy who have a normal MRI scan. It allows us to precisely localise multi-lobar discharges, evaluate early involvement of functional cortical areas and helps us define seizure onset zones in patients with non lesional epilepsy who have a normal MRI scan. We also occasionally use invasive electrode monitoring in patients with lesions that involve or are adjacent to functional areas of brain cortex or where the lesion is likely to be surrounded by a structurally normal epileptogenic region.

We have found that subdural grid electrodes allow precise superficial two dimensional definition of the epileptogenic zone. The subdural grid technique allows highly precise mapping in eloquent cortex but provides very poor mapping of deep foci of epilepsy, particularly those involving the insular cortex. Similarly it has a high potential for morbidity. The SEEG technique which is a relatively new technique on our campus allows more precise three dimensional definition of the epileptogenic zone. Although we have only performed a little over 30 cases at Westmead, the technique has been widely utilised in Europe for 50 years. It has some minor drawbacks in that it allows less precise mapping of the eloquent cortex. However it does allow us to perform detailed electrical evaluations of deeply located lesions, the insular cortex and the mesial surface of the hemisphere. We have found that it is certainly less invasive and patients tolerate the procedure very well. Complication rates are significantly lower than subdural grid electrodes. This (old) technique has significantly enhanced our ability to evaluate the many patients in our community with drug resistant non-lesional epilepsy.

Yesterday, Today & Tomorrow: Best Practice for CSF Sampling of an EVD to Minimise Patient Risk

Ruby Crane, Nicole King

Abstract
Managing raised intracranial pressure (ICP) with the use of an external ventricular drain (EVD) is a common occurrence in a neurosurgical setting. A central role of the neuroscience nurse in managing that EVD is to monitor the patient for signs and symptoms of infection otherwise known as ventriculitis. Cerebrospinal fluid (CSF) sampling from an EVD has historically been completed as a daily routine specimen to monitor for any signs of infection. However, in more recent times there has been evidence to suggest that specimens should only be collected when infection or ventriculitis is suspected to minimise the interruption of the closed system. Different practices have been identified related to the frequency of sampling, the best solution for decontamination of the sampling site/port and preferable port for obtaining the specimen. Our aim was to complete an integrative literature review. Medline Complete and CINAHL were searched and articles were screened. Nine articles were used to form the integrated review. The main findings were collated and found that daily sampling is no longer recommended. The proximal port was the most popular choice for sampling. Decontaminating solutions used for accessing an EVD varied with no evidence to support the choice of solution. Findings of the majority of papers were focussed on sampling frequency and other associated ways to minimise infection rather than choice of sampling site or the use of specific decontaminating solutions.

Keywords: *External ventricular drain, cerebrospinal fluid, ventriculitis, sampling.*

Introduction

In the clinical setting, sampling cerebrospinal fluid (CSF) from an external ventricular drain (EVD) is a skill required of a neuroscience nurse. Neurosurgical ward guidelines and hospital policies often conflict with what is perceived as common practice by neurosurgeons. This impacts on the consensus of what would be considered best practice for sampling CSF, including from which port the sample should be obtained and which solution should be used to decontaminate the access portal. The insertion of a ventricular catheter interrupts what is normally a closed ventricular system inside the cranium, which in turn places the patient at significant risk of complications. One of the most common complications is ventriculitis (Kitchen, Singh, Hulme, Galea, Patel & King, 2011).

Interest in the topic began when nursing staff were asked to obtain a CSF sample by the medical staff. The hospital policy was obtained from the intranet. Accessing and reviewing of the policy was followed by a discussion with the medical staff about what is best practice for CSF sampling. Several neurosurgeons were questioned about best practice for CSF sampling from an EVD. From the discussions it was clear there was a lack of consensus amongst them. Some neurosurgeons stated they tended to follow what other medical staff preferred due to the lack of evidence available. Following these discussions a brief review of current data regarding best practice was completed and four other metropolitan hospitals were benchmarked for their practices in CSF sampling. There was no consensus on what was best practice according to other major hospitals and credible resources. It was obvious that an integrated review was necessary to be able to establish a best practice guideline for CSF sampling.
The following paper will attempt to integrate the literature findings relating to best practice for CSF sampling including which port should be accessed, the frequency of sampling and which decontaminating solution should be used.

Questions or comments about this article should be directed to Ruby Crane, Neurosciences Clinical Coach, St Vincent's Private Hospital, Melbourne.
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Aim

To formulate an integrated review to answer the questions:

1. Which port should be accessed?
2. Which is the best cleansing solution to be used?

3. How often should a CSF sample be taken?

Method

In March 2014 the bibliographic databases Medline Complete and CINAHL were searched (see Figure 1) using the following keywords, external ventricular drain, cerebrospinal fluid, infection, ventriculitis, specimen, sampling. There were no date limits set for the search. The inclusion criteria were original quantitative research papers that had been peer reviewed and related to EVDs, sampling CSF and minimising infection. The exclusion criteria were articles not written in English. Medline Complete returned 30 articles and CINAHL returned 3. After two duplications were removed and title screening complete, the abstracts of the final 10 were reviewed. Nine full text articles were used to form the integrated review.

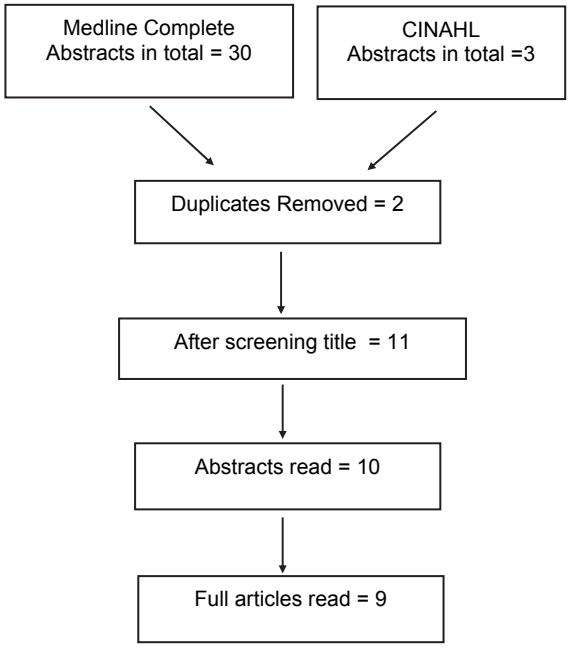

Figure 1: *(Above) Process for selection of articles*

Results

From 33 articles only nine papers were included in the review. The main findings of these papers were collated. Findings showed that there were varied recommendations and opinions about the frequency of CSF sampling. Daily sampling is no longer recommended (Williamson, Phillips-Bute, McDonagh, Gray, Zomorodi, Olson & James, 2014; Williams, Leslie, Dobb, Roberts & van Heerden, 2011) in most articles but the optimum frequency for sampling remains unclear. The sampling site was discussed in very few papers. The proximal port was the most commonly used site for sampling (Muttaiyah, Ritchie, Upton & Roberts, 2008; Hoefnagel, Dammers, Ter Laak-Poort & Avezaat, 2008; Korinek, Reina, Boch, Rivera, De Bels & Puybasset, 2005). Only one paper by Wong (2011) discussed alternate sampling sites in view of minimising infection. Many papers did not state the decontaminating solution used for accessing the port to sample CSF. The main findings of the papers focussed on sampling frequency and associated ways to minimise infection and not sampling site or the use of specific decontaminating solutions (Hoefnagel et al., 2008; Kitchen et al., 2011; Korinek et al., 2005; Lwin, Low, Choy, Yeo & Chou, 2012; Muttaiyah et al., 2008; Pfisterer, Muhlbauer & Reinprechtet, 2003; Williams et al., 2011; Williamson et al., 2014).

Discussion

Frequency of sampling

CSF samples are taken breaking the seal of a closed system. The technique must be done aseptically and only by trained medical or nursing staff (Kitchen et al., 2011). Every sample taken and each manipulation of the system is associated with increased risk of introducing infection into the closed system (Williamson et al., 2014). Frequency of sampling required for a patient with an EVD is often a conflict between whether it is appropriate to sample daily so that samples can be tested for infection or that frequency should be reduced to only when patient is showing signs of sepsis as CSF sampling increases the risk of infection such as ventriculitis (Lwin et al., 2012).

Within the nine articles chosen for review, the preferred frequency of sampling was not always evident but the findings generally led to a discussion regarding whether increased frequency of sampling lead to the increased risk of ventriculitis. In a retrospective study by Muttaiyah et al., (2008), a daily sample of CSF was taken and an analysis was conducted looking mainly at clinical parameters predicting infection. From the pathology results of the CSF samples collected, Muttaiyah et al., (2008) indicated that a change in Glasgow Coma Scale (GCS) score and/or a change in temperature of a patient with an EVD was not a reliable link to indicate daily CSF sampling rather, it increased the risk of ventriculitis. They also noted that these neurological and metabolic changes were not a reliable indicator for early prediction of ventriculitis. However, they did conclude that further evidence would be required and larger

prospective study would provide more reliable results.

A prospective study by Pfisterer et al., (2003) used daily CSF sampling as a method in their study to examine early diagnosis of EVD infection. They concluded that there was no correlation between drainage time and a high CSF cell count which would indicate infection. They also concluded that samples that had a high CSF cell count were more likely to be contaminated specimens rather than EVD related infections. Their prospective methodology tends to yield more accurate results given the ability to control certain points and variables. Pfisterer et al., (2003) concluded as did Muttaiyah et al., (2008) that patients were generally very unwell and unable to communicate signs and symptoms of an infection and therefore daily specimens were required. The focus of Pfisterer's et al., (2003) study was mainly looking at the association of drainage time and infection. Despite this they did conclude that daily CSF sampling of an EVD did not increase the risk of ventriculitis.

Hoefnagel et al., (2008), used a retrospective single centre study design that investigated complications such as meningitis and ventriculitis occurring in patients with EVDs. The neurosurgical department protocol was to sample CSF from the EVD three times a week as well as on removal of the EVD. In contrast to the previous studies, Hoefnagel et al., (2008) found that there was a significant increase in infection rates with CSF sampling as well as the duration of EVD drainage. They found that the more the EVD had CSF samples taken the higher the risk of infection such as ventriculitis. The authors concluded that CSF samples should only be taken when infection is suspected and should be based on other predictors of infection such as a meningism and fever. However, there are limitations with the study design as single centred retrospective studies left information uncontrolled. EVDs were also flushed when blocked and other issues were indicated that may have increased infection rates.

A similar study by Williams et al., (2011) showed a significant link of increased infections such as ventriculitis with increased CSF sampling of an EVD. Their study showed that reducing the frequency sampling to every third day, as well as sampling when clinically indicated, would significantly reduce the percentage of reported proven cases of ventriculitis. Again limitations are noted with the study by Williams et al., (2011) as EVD treatment varied and their control group was previously admitted patients, which had less control over data alterations and collections.

Other studies such as Lwin et al., (2012) looked at reducing rates of infection such as meningitis and ventriculitis by reviewing techniques of how often CSF samples were taken, EVD insertion techniques and how long EVDs stayed in place. A retrospective audit was used in which they introduced a different type of EVD system as well as thorough nurse education. Their study had other significant factors which could explain why infection rates were decreased in their sample results and would not necessarily be a reliable indicator for CSF sampling frequency. These factors were staff education, a hand hygiene regime for staff, multiple testing on positive CSF samples to rule out external contamination and the use of a silver coated EVDs rather than the commonly used system in the retrospective data. It still showed that sampling only when there were clinical signs and symptoms of sepsis had a substantially reduced infection rate among the patient samples they tested. It needs to be noted that in the study by Lwin et al., (2012) they had omitted useful data such as information about sampling, temperatures of patients and GCS decline which are all important indicators of infection. Another study by Korinek et al., (2005) had a similar conclusion but a different way of obtaining the result. Their study initially compared second daily sampling of an EVD to related results of increased infection rate. They also discussed the seemingly evident issues of whether the incidence of true ventriculitis was actually a correct diagnosis as most studies that have been reviewed here have been retrospective and usually only rely on a positive CSF culture without taking into account the clinical and CSF biochemical data. They concluded that changing from 2nd daily sampling of CSF to sampling only when signs and symptoms of sepsis were indicated, reduced the amount of EVD infections.

Interestingly, the integrated review conducted here highlighted two articles that had a different approach to frequency sampling and associated EVD infections. A retrospective study by Williamson et al., in 2014 specified that sampling was only taken at the medical team's discretion. The study aimed to determine the predictors of bacterial ventriculitis. They concluded that EVD related bacterial ventriculitis generally occurred after the 3rd

daily sample of CSF. From further review of the article it was evident to Williamson et al., (2014) that there was an associated link between CSF sampling and EVD-related bacterial ventriculitis and that specimens should only be taken at the medical team's discretion when clinical evidence of sepsis is noted. Kitchen et al., (2011) also conducted a study that initiated the sampling of CSF from a patient's EVD at the medical team's discretion. It was a prospective study that determined that frequency in sampling did not increase the risk of EVD associated infections as long as the clinicians had adequate experience and used theatre-standard aseptic technique. However, this study did remove and reinsert the EVDs when blocked which would alter the data.

Sampling site

To sample CSF from a patient with an EVD, the sample can be obtained from multiple sites. These include - directly from the EVD, a specifically designed CSF port, and a three way tap or from the collection chamber or drainage bag. In general the sample ports are referred to as a proximal port (closest to the patient's head) or a distal port (further away from the patient's head).

Wong (2011), completed a quasi-experimental study using a convenience sample looking for a safe and easy port to obtain accurate results, whilst minimising opening of the closed system. The 47 patients involved in the study had a pair of CSF samples removed at midnight, daily from the proximal port first, followed immediately by a distal port sample. The findings revealed that proximal port sampling may increase the risk of infection due to proximity of the patient's head and being less secure than the distal port. However many of the study limitations included varied indications for EVD insertion, the length of insertion time varied from 1- 23 days and there was a low infection rate in the study. CSF specimens containing blood were also not analysed in this study by Wong (2011). In addition, distal port samples included only some of the CSF from the collection chamber at the time. The writer indicates the possibility for white blood cells (WBC) to sit on the bottom of the collection chamber giving a false high if the whole collection chamber was not sampled.

The retrospective study by Muttaiyah et al., (2008) stated that samples were obtained from a proximal port. No rationale for port selection was discussed, despite concluding that larger studies are required to identify if reduced frequency of sampling is safe.
Hoefnagel et al., (2008) did not identify that sampling from the proximal port increased infection despite the study discussing risk factors for EVD-related infections. Again the rationale for port selection was not discussed. The small retrospective study did state frequent sampling appeared to be a risk factor for EVD infection.

An abnormal CSF result obtained from the drainage collection bag was used as a prompt for a second sample to be drawn proximally in a prospective study by Korinek et al., in 2004. Changes in neurological state or a fever of unknown origin were the only indicators for CSF sampling. Korinek et al., (2004) did not discuss the rationale as to why a sample from a collection-bag was taken first and why then if that specimen was abnormal a second sample was then taken from the proximal site. Despite the sampling order, Korinek et al., (2004) did conclude that inappropriate or routine sampling be avoided. Comparison of the two samples obtained from patients requiring CSF analysis, were not evaluated in the paper by Korinek et al., (2004).

Around half of the articles reviewed did not indicate or provide enough evidence to ascertain from where the CSF sample was retrieved. An EVD has several sample sites as discussed depending on the drainage system attached. Whilst most articles focus on infection related to sampling frequency and other contributing factors, further research into specific sampling sites may contribute to decreasing EVD-related ventriculitis as indicated by Wong (2011).

Decontaminating Solution

Decontamination solution was the last question to be answered relating to best practice for EVD sampling of CSF specimens. Unfortunately the majority of the articles reviewed did not elaborate on what solutions were used. When decontamination of the port was discussed the specific decontaminating solution was omitted.

Muttaiyah et al., (2008) and Pfisterer et al., (2003) both stated they used a chlorhexidine 2% alcohol combination to swab their chosen EVD port or sample site. Pfisterer et al., (2003) used chlorhexidine ethanol solution, stating a meticulous disinfection of the port site was completed when manipulating the EVD system. The detail of the specific solu-

tion was not mentioned.

Hoefnagel et al., (2008) indicated an alcohol solution was used on the chosen port. Lwin et al., (2012) used a type of antiseptic that was not directly identified but stated the ports were thoroughly cleaned prior to sampling.
Four articles out of nine chose to mention what cleansing solution was used. Five of the articles did not discuss what decontaminating solution was used. The integrated review of all articles found that the decontaminating solution was not discussed as a risk factor in relation to EVD-related infections or CSF sampling. Potentially one solution may be better than another but further research is required.

Limitations

The studies reviewed did not provide a consensus and there were limitations in study design, sample size and data collection. Retrospective studies tended to have missing data as well as lack of control over information. Lack of past health history of patients was also noted. No information was given on whether patients had infections prior to the EVD insertion and few studies discussed why the patient required an EVD. EVD protocols were not discussed in the majority of papers, so there was uncertainty and lack of information around who took the specimen, what type of aseptic technique was used, what equipment they used and whether or not it was protocol to have prophylactic antibiotics while the EVD was insitu.

Conclusion

An EVD breaks what is normally a closed ventricular system, increasing the risk of infection regardless of the frequency, port and decontaminating solution used to obtain a CSF sample.

This integrated review found that daily CSF sampling from an EVD is not recommended due to the increased chance of developing infection or ventriculitis. The preferred access port utilised for sampling is the proximal port. However, this was not the focus of the majority of studies and articles reviewed. Unknown sample sites and a lack of discussion of the risks of sampling sites, indicates an area for further inquiry.

A lack of discussion of decontaminating solution throughout the review indicates that there are no evidence-based preferences or conclusions as to what solution is recommended for decontaminating access ports to minimise infection such as ventriculitis.

Based on the integrative review conducted, a large prospective study over multiple sites is needed. Rigid and detailed protocols for EVD management and CSF sampling would be required to provide evidence for best practice for EVD management and CSF sampling.

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Mild Traumatic Brain Injury: Adapting to Consequences

Nutthita Petchprapai

Abstract
Mild traumatic brain injury (mTBI) affects more than 28,000 individuals annually in Thailand; however, little information about outcome after mTBI is known. This investigation aimed to explore consequences of mTBI among Thai adults who experienced mTBI in the previous 3-12 months.

A sample of 135 adults was interviewed. Subjects were typically men, middle aged and approximately half were married. All completed the compulsory level of education in Thailand and were in the low income bracket. Subjects had Glasgow Coma Scores 14/15 at 30 minutes after injury and 15/15 (full score) after 3 days. Subjects reported low post-concussion symptoms scores and few depressive symptoms. All subjects worked or studied before the injury and almost of them returned to normal lives at the time of interview. However, 18% did experience moderately severe disability and 1.5% suffered severe disabilities.

Future studies with longitudinal, comparison, or predictive methodology with reduced but relevant variables are suggested. Measures used in this study demonstrated reliability, supporting their use in Thailand. Providing health education and printed information regarding outcomes and disability after mTBI is recommended. Further study of the small but clinically important percentage of subjects who experience ongoing disability after mTBI is needed.

Keywords: *mild brain injury, post-concussion, adaptation, mild head injury, traumatic brain injury*

Introduction

Injuries and deaths from motor vehicle acci-dents (MVA) have become a major public health and socio-economic concern in Thailand (Suriyawongpaisal & Kanchanasut, 2003). For more than a decade, the incidence of MVAs has ranked among the five leading causes of injuries and deaths of Thai people especially during the traditional Thai New Year holidays (mid-April). The incidence of traffic related injury has been reported at al-most 4,000 people per week (Narenthorn Trauma Center, 2014). Head injuries are a major cause of death and disability related to MVAs (Mock, Maier, Bolye, Pilcher, & Rivara, 1995), and 77% of traffic related injuries in Thailand are to the head and brain (Suriyawongpisal & Kanchanasut, 2003). Despite medical developments and accident prevention campaigns, the number of injured has nearly doubled in the last 10 years. The majority of adults with head injuries (83.7%) have mild to moderate severity (Phuenpathom, Tiensuwan, Ratanalert, & Saeheng, 2000).

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Mild traumatic brain injury (mTBI) is a stressful life event that may impact various dimensions of a person's physical, psychological, social and environmental background. It may cause a person to react by exhibiting complex adverse behaviours (Martelli, Zaster, & MacMillan, 1998). Challenges to daily activities after mTBI may produce significant effects on quality of life (QOL), leading to maladaptation. In order to understand the phenomena of mTBI recovery, contribute to a more coherent and comprehensive body of knowledge and to advance the science of nursing, the use of nursing conceptual and theoretical work is recommended (Fawcett, 2000, 2002). The Roy Adaptation Model (RAM) was used to guide this study. According to Roy (2005), a person is an adaptive system, responding to internal and external stimuli (input) through behaviour. The goal of nursing is to promote adaptation for individual(s) in four adaptive modes, thus contributing to health, quality of life, and dying with dignity (Roy, 2005 ; Roy & Roberts, 1981). This is done by assessing

behaviour and factors that influence adaptive abilities and by intervening to expand those abilities and to enhance environmental interactions (Roy, 2005).

As a practice discipline, the goal of nursing is to promote adaptation by enhancing human system and environment interaction. Using information from this study to build a predictive model will help nurses in assessing adaptive behaviours and the stimuli that influence adaptation behaviour. This information will be useful for nursing interventions, plans to manage stimuli and enhance coping processes of mTBI adults.

Objective

The purpose of this cross-sectional descriptive, predictive study was to explore the extent of post-concussion symptoms after mild traumatic brain injury (mTBI) among Thai adults.

Method

Setting

The setting of this study was the Maharat Nakhon Ratchasima Hospital (MNH), a 1000 bed tertiary hospital in the Nakhon Ratchasima province of Thailand. Mild head injury was the most common inpatient diagnosis in this hospital into which approximately 1,102 mTBI adults were admitted each year (Maharat Nakhon Ratchasima Hospital, 2014).

Sample Selection

Sample selection was purposive. The potential subjects were defined through the MNH's database. Subjects included patients who had mTBI between three and twelve months.

Inclusion criteria

Medical records of subjects discharged from the hospital with ICD-10 code S.00 (superficial wound), S.01 (head wound), S.02 (skull fracture), S.06 (intracranial injury), S.07 (compression injury), and S.09 (other head injury) were accessed. Subjects discharged from the hospital with those codes and diagnoses who met other inclusion criteria (i.e., age of 18 years or older; able to communicate by speaking or writing; initial mTBI only; and absence of psychiatric or other neurological disease), were able to provide informed consent and were willing to participate in the interview were invited to participate this study.

Exclusion Criteria

Participants were excluded if they had a history of multiple head injuries, congenital or organic learning disorders, premorbid psychiatric disorders or neurological disorders unrelated to mTBI such as Alzheimer's, multiple sclerosis, Parkinson's disease, stroke or other central nervous system diseases. Patients who had a documented GCS score < 13 during first 72 hours after admission were excluded. Patients who had mTBI for less than three months or more than one year, or patients with multiple head injuries were also excluded.

Measures

Translation was originally performed by a medical-surgical nurse fluent in English/Thai. Another bilingual medical-surgical nurse reviewed both the completed Thai and English versions to determine the appropriateness of their meaning and the equivalence between the Thai and English versions. Finally, a bilingual person checked the original and back-translated versions for the equivalence of the translations. All Thai version measures were piloted with five Thai adults, 18 years of age or older. Adjustments were done as needed, mostly adding clarification of the instruction and repeated instructions for at least three times throughout the interview.

Post-concussion symptoms were measured by the Post-concussion Symptoms Checklist (PCSC) (Gouvier, Cubic, Jones, Brantley & Cutlip, 1992; Gouvier, Uddo-Crane & Brown, 1988). The PCSC is a self-reporting questionnaire that allows subjects to rate the frequency, intensity and duration of ten symptoms by using a Likert-type scale (1 = not at all, 5 = constant or crippling). Four sets of scores were derived for each subject: frequency, intensity, duration and total. Range of PCS total scores and each subscale scores were 10-50. The PSCS has high concurrent validity with other post-concussion symptoms checklists (r = .77) (Gouvier et al.,1992). The accuracy rate of discrimination between persons with and without PCS is 70% in a normal healthy population and 56% in head-injured persons (Sawchyn, Brulot & Strauss, 2000).

Depressive symptoms were assessed using the Thai version of the Center for Epidemiological Studies Depression Scale (CES-D Thai-version) (Trangkasombat, & Likanapichitkul, 1997). The CES-D Thai version, a modification of the CES-D, is a frequently used depressive symptoms screening measure among several Thai populations such as spinal cord injury (Kuptniratsaikul, Chulakadab-

ba, & Ratanavijitrasil 2002) and teenagers (Trangkasombat, & Likanapichitkul, 1997). It is a self-reporting 20-item questionnaire used for evaluating perceived mood and level of functioning in the past 7 days. Scores range from 0-60, Scores of 22 or higher are considered indicative of depressive symptoms (Trangkasombat, & Likanapichitkul, 1997). The CES-D yields high internal consistency when tested among Thai teenagers (α = .86) and spinal cord injured (α = .92). The sensitivity of this measure is 72-93%, its specificity is 85-94%, and the predictive value is 82%.

The Extended Glasgow Outcome Scale (GOS-E) was developed from the traditional Glasgow Outcome Scale to address limitations, to be more sensitive, and reliable. Jennett, Snoek, Bond & Brooks (1981) extended the GOS-E from five categories to eight categories which are: dead, vegetative state, lower severe disability, upper severe disability, lower moderate disability, upper moderate disability, lower good recovery and upper good recovery (Sander, 2002).

The GOS-E was originally developed for assessment of severe brain injuries; therefore, some categories such as dead or vegetative state might not be appropriate to use with mild traumatic brain injury people. In this study, only six of eight categories were included, and the structured interview from Wilson, Pettigrew & Teasdale (2000) was used to guide the assessment. Those structures were:

0 = Upper good recovery
1 = Lower good recovery
2 = Upper moderately disabled
3 = Lower moderately disabled
4 = Upper severely disabled
5 = Lower severely disabled

The GOS-E consists of two domains: independence and difficulty. For an independent domain, the questions consist of ability to be independent in the home and ability to be independent outside the home (including shopping and travelling). If the mTBI person could not do at least one of these independent tasks, he/ she was considered as in the severely disabled group. For the mTBI person who could not stay home alone for at least eight hours, he/ she was also be considered as in the lower severely disabled group. For a difficulty domain, the questions consist of ability to work (or study), social and leisure activities, and family and friendships. The mTBI person who reported at least one difficulty in these questions was considered as in the moderately disabled group. The mTBI person who could not return to work or study at the same level as before brain injury was considered as in the lower moderately disabled. The last question in the GOS-E was about return to normal life after brain injury. This question referred to the symptoms that might occur after mTBI that might bother mTBI people and made them feel that their lives were changed. The mTBI person who did not have independence or difficulty issues but could not return to normal life was considered as in the lower good recovery group while mTBI person who did not have any issue and returned to his or her normal life was in the upper good recovery group (Wilson, 1998 ; Wilson, Pettigrew & Teasdale, 2000). Questions for the GOSE were integrated in demographic data worksheet.

Procedures

Invitation Procedures

After the human subjects review board at the Maharat Nakhonratchasima Hospital (MNH) approved the study, the principal investigator (PI) identified potential subjects from the hospital database. The PI determined inclusion criteria from each medical record and mailed the consent form package to all potential subjects. The PI waited for two weeks for the subjects to review and consider participating in this study. If the subject mailed the opt-in postcard, the PI made a call to the subject to introduce herself, explain the study and confirm the subject's willingness to be part of the study. After two weeks, a reminder postcard was sent to subjects who did not return the initial postcard or informed consent. The PI waited for another two weeks for the subjects to make decision. If the informed consent was not returned within seven days, the PI made one last phone call to again invite participation and provide instructions.

Interview Procedures

All subjects were interviewed by telephone at a time and place of the subject's choosing. After receiving the signed consent, the PI scheduled a time for the interview either by —1) the subject provided the date and time in an opt-in postcard or 2) the PI called the subject, using the telephone number shared by the subject during the follow-up phone call. The interview consisted of 100 questions and lasted approximately 30 minutes. The interview questions were the same for each subject (same order, same words), specifically; demographic form, the PCSC, the GOS-E (questions were included in the demographic data worksheet) and the CES-D.

Medical Record Reviewing Procedures
Chart data was collected after the interview by a research assistant (RA) who was trained by the PI. After the interview, hospital number and study number were assigned and given to the RA by landline (secure) telephone initiated by the PI. The RA used the hospital number to obtain each subject's medical record and completed data collection, returning the forms to the PI by registered mail with signature required.

Data Analysis
To explore the consequences after mTBI, frequencies, percentage, means, standard deviation, median, and tests that provide inferential statistics on normality: skewness, kurtosis, P-P plots, outliers, histogram and Kolmogorov-Smirnov tests were computed to describe the extent of stimuli, coping process and quality of life among Thai mTBI patients.

Protection of Human Subjects
This study underwent review by the institutional committee from the Maharat Nakhonratchasima Hospital. All subjects were informed about the purpose of this study. Participation in this study was voluntary and each subject could withdraw from the study at any time. There were no direct benefits to participating in this study. There were no substantial risks involved in this study, although subjects may become uncomfortable by the type or quantity of questions. Subjects could participate even if they do not wish to answer specific questions. No subject declined to answer isolated questions. No forms had subjects' name or other information that could be used to link responses to one individual. Results were reported as aggregates only. If there was any information specific to an individual in a report on the study, an alias was used.

The subjects' decisions regarding participation did not affect services that they received from the MNH. Only the PI and members of her committee could access the original questionnaires.

Results

Approximately 461 invitation letters and consent forms were sent to eligible subjects. From the hospital's database, most patients had been involved in motor vehicle crashes, falls, or physical assaults. There were 363 men (78.7%) and 98 (21.3%) women. The overall age ranged from 18 to 82 years. The majority were younger than 29 years (41.4%) and the average age was 36 years. Over a period of four months, 135 consent forms were returned yielding return rate of 29%. All of the 135 subjects who were willing to participate, were interviewed. The proportion of men to women among 135 participants was 84% to 16%, the median age was 36 years and the mean age was 38 years. Even though only 29% of the eligible subjects were included in this study, their age and gender were not different from the original 461 eligible subjects.

Among 135 subjects enrolled, 40% had mTBI without other injuries. Another 60% had other injuries, such as extremity fracture, maxilla or mandible fracture, blunt trauma to the abdomen, or lacerated wound, with mTBI. The presence of multiple injuries was not exclusionary for this study. Length of stay in the hospital was between 3 and 90 days, with a mean of 8 days. Time post-injury was between 4 and 12 months, with the average being 8 months. Subjects spent between 3 and 180 days recovering at home, averaging about 50 days. The average duration of post-traumatic amnesia (PTA) was five minutes and the duration of loss of consciousness (LOC) was close to two minutes. The average Glasgow Coma Scores (GCS) at 30 minutes after injury was 14, and 15 at 72 hours post-injury. Post-concussion symptoms (PCS) were reported for the total scale and three subscales: frequency, intensity, and duration. The total PCS scores were between 30 and 120 and the average was 50. The average scores for three subscales were 17, 17, and 16, respectively. Depressive symptoms, as measured by the CES-D, were between 0 and 42 and the average was 21.26 (see Table 1).

Internal consistency reliabilities were tested in all questionnaires. The Cronbach's alpha coefficients were high; all were more than 0.7 (see Table 2). These Cronbach's alpha coefficients indicated that the questionnaires were of high quality and were free from measurement errors.

In the GOS-E, this finding is categorised in the upper good recovery category. Thirteen percent of all subjects could not live their normal lives, although no issues were reported. This finding is considered to be in the lower good recovery category of the GOS-E. Sixteen per cent of all subjects reported one or more problems and could not return to their normal lives. They were categorised in the upper moderately disabled category. Three percent of all subjects were categorised as

Variables	Mean (SD)	Median	Range	95% of CI Mean Lower	95% of CI Mean Upper
Length of Stay (days)	8.24 (10.62)	5.0	3—90	6.44	10.05
Time post injury (months)	8.36 (2.15)	8.0	4—12	8.00	8.73
Recovery period (days)	48.67 (45.96)	30.0	3—180	40.85	56.50
Duration of PTA	5.74 (14.55)	0	0—60	3.26	8.22
Duration of loss of consciousness	1.53 (4.42)	0	0—30	0.59	2.48
Glasgow Coma Scores					
- At 30 minutes	14.04 (0.77)	14	13—15	13.91	14.18
- At 72 hours	14.86 (0.35)	15	14—15	14.80	14.92
Post Concussion Symptoms					
- Frequency	17.30 (6.11)	16.0	10—40	16.26	18.34
- Intensity	16.61 (5.89)	15.0	10—40	15.61	17.62
- Duration	16.34 (6.04)	15.0	10—40	15.31	17.37
- Total	50.25 (17.92)	47.0	30—120	47.20	53.30
Depressive Symptoms	21.26 (9.31)	18.0	0—42	19.67	22.84

Table 1 *(Above): Severity of Mild Traumatic Brain Injury for all subjects (N=135)*

Measures	Cronbach's Alpha	Cronbach's Alpha based on Standardised items	Number of items
Post Concussion Symptoms Checklist	0.952	0.961	30
CESD Thai Version	0.789	0.808	20
Extended Glasgow Coma Outcome Scale	0.750	0.785	5

Table 2 *(Above): Reliability statistics of the measurements.*

lower moderately disabled or could not return to work/study (see Table 3).

Discussion

Post-concussion symptoms (PCS): Possible range of each of the three PCS subscales was 10-50, and total score was 30-150 with the higher scores indicating more problems. In this study, PCS scores were relatively low; the average of the frequency was 17.30 (SD = 6.11), the intensity was 16.61 (SD = 5.89), the duration was 16.34 (SD = 6.04). The total score was 50.25 (SD = 17.92). These scores were lower than the lowest PCS scores reported in other studies (Hanna-Pladdy, Berry, Bennett, Phillips & Gouvier, 2001; Sparrow, 2002), in which PCS scores were reported at 57 and 58, respectively. The findings of low PCS in this study may result from the length

Table 3 *(Below): Description of the Extended Glasgow Outcome Scale.*

Domain/Category	All Subjects (N=135) N	All Subjects (N=135) %
Problem in the independence domain	2	1.5
Problem in the difficulty domain	25	18.6
Categories:-		
- Upper good recovery	91	67.4
- Lower good recovery	17	12.6
- Upper moderately disabled	21	15.6
- Lower moderately disabled	4	3.0
- Upper severely disabled	2	1.5

of time post injury in this study, an average of 8 months. The results of PCS from the post-concussion checklist (PCSC) used in this study were difficult to compare to other studies for several reasons. Firstly, other studies used different measures such as absence of symptoms or only the frequency of symptoms. Therefore, findings from other studies, with the exception of the frequency scores, are not comparable. Secondly, for the frequency subscale, the PCSC combined the answer for "none" and "few" in the same category (1). Therefore, it is impossible to distinguish nil symptoms from few symptoms from the PCSC. In addition, other authors have suggested that PCSC scores are not specific to mTBI (Sawchyn, Brulot & Strauss, 2000). If this suggestion is true, then other factors, such as few depressive symptoms or few stress life events in this sample, may contribute to the relatively low PCS scores.

Depressive symptoms: Few depressive symptoms were reported among the subjects with mTBI in this study (average = 21, range = 0-42). The average scores were lower than the normative scores for Thai teenagers (22) (Trangkasombat & Likanapichitkul 1997) but higher than scores reported by subjects with postpartum depression (16) (Srisaeng, 2003). As in the United States, mental health disorders are stigmatised and subjects may be unwilling to report depressive symptoms.

The finding of low depressive symptoms in this study is consistent with McCauley, Boake, Levin, Contant & Song (2001) who reported depressive symptoms among mTBI subjects at 23. Depressive symptom scores among subjects with general trauma were lower at 19. In their study, subjects rated their depressive symptoms at one month post injury and the additional passage of time in this study may help explain the differences in results. The findings in this study was in contrast with findings from Bell, Primeau, Sweet & Lofland (1999) who concluded that subjects with mTBI had depressive symptoms of 15, higher than a score of 9 among subjects with headaches. However, in their study, the use of a different depressive symptom measure and a data collection period at one month after injury, may explain the different results.

Glasgow Outcome Scale: A total of 27 subjects were categorised as moderately or severely disabled and could not return to work or school in this study. This finding contrasts with one study which reported that only 42% of adults with mTBI could return to work/study (Ruffolo, Friedland, Dawson, Colantonio & Lindsay, 1999). However, other studies have findings similar to this one, reporting that 84-88% of their subjects returned to work or study (Englander, Hall, Stimpson & Chaffin, 1992; Kay, Newman, Cavallo, Ezrachi & Resnick, 1992). The finding of unable to return to work or study after the averaged time post injury of eight months was unexpected. Subjects in this study had a low severity of brain injury as measured by a combined high GCS, short duration of PTA and short duration of LOC. With this type of mild injury, all of the subjects were expected to return to work or study 3 months after injury.

The inability of return to work or study for subjects in this study may be a result of multiple concurrent injuries at the time of mTBI. However, even among subjects with only mTBI, 18% could not return to work or study. This is a small figure but important clinically. The results were similar with one study that was conducted in Thailand in 1985. The authors found that 84% of subjects with mTBI were in the good recovery categories. However, the same authors replicated the same study in 1995 and found that there were only 3% of subjects with mTBI were still in the disability categories at six months post injury (Phuenpathom et al., 2000). Several reasons may explain for the differences of incidence of disability following mTBI. Firstly, many injuries occurred in the municipal area in which the helmet rule is successfully enforced for all riders. Helmets may alter the mechanism of injury in the brain and subsequent disability may not occur (Lam et al, 2015) Secondly, the treatment settings may have different standards of care; this study was conducted among patients who received care at a tertiary public hospital. In the other study completed in Thailand, their sample size was large (3,194 in 1985 and 4,217 in 1995); they collected data from all subjects who came to their hospital and all subjects at this University-based medical centre followed a common standard of hospital care and follow-up that evaluated function with the GOS-E at six months. In this study, GOS-E was self-reported rather than the result of a physical exam. It may be that this study under-reported disability since only volunteer participants were included. In addition, disability may vary over time and this study did not examine immediate responses to mTBI. It is recommended that the GOS-E be used at structured time intervals for all subjects with the same condition (either with or without multiple injuries but not both), to better under-

stand the incidence and prevalence of disability after mTBI.

Recommendations

Education

There were a small number of patients with mTBI that could not live their normal lives after the injury. Including information about severity of brain injury and outcomes to help students anticipate the possible recovery pathway of an individual can be incorporated when teaching about brain injury. Teaching recognition of disability in patients with mTBI is suggested as one of the assignments for students who are training in surgical or neurological departments, so that intervention is not unduly delayed.

Practice

The findings from this study revealed that there were at least 18% of the subjects with mTBI who could not return to their normal lives, even though the GOS-E is not a sensi-tive tool to capture outcome after mTBI, de-spite being easy to use and can be finished in a few minutes. Health care professionals should develop or provide an information pamphlet covering "What to expect after an mTBI". Health care assessment on admission after mTBI should include social support net-works to aid in recovery. Patients should be educated to evaluate their outcomes after 3, 6, 9 and 12 months. Patients should be ad-vised that if their symptoms or disabilities persist that they should re-contact the health care facility or health care provider.

Several measures used in this study were translated into Thai, tested and yielded high reliability coefficients. These tools can be implemented among Thai adults with mTBI to assess their outcomes.

Research

Findings from this study provided descriptive information regarding adults with mTBI. For future studies, it is recommended that concurrent data collection with a matching normal population be included to provide baseline information. Replication studies could extend the science. For example, stratifying subjects with different categories of time post injury, applying longitudinal methodology, recruiting subjects from multi-settings for a variation of demographic data and increasing sample size to gain more variations.

Some future studies that compare outcomes between different groups such as between genders, age categories, diagnosis (with and without multiple injuries), time post injury and those with low social support should be conducted. In addition, the role of spirituality or religion could be added as a potential variable. Future studies that explore the same concepts but use different measures may provide different points of view.

Multiple regression models used in this study may not be the best way to examine the data. One strategy for this study is to re-examine the statistical models with transformation of data points that did not demonstrate optimal linearity. Another strategy is to enter variables into the statistical model only if there are demonstrated relationships.

Health policy

There was at least one standard of care that was different between this setting and other hospitals. It is recommended that subjects with mTBI should have follow-up appointments at least six months after the injury to identify those patients with maladaptation as measured by independence, lack of disability and quality of life. Health education regarding outcomes after mTBI should be routine prior to discharge. Printed information regarding symptoms and outcomes after mTBI should be available.

Conclusion

The findings from this study provide a basis for future studies. Several measures used in this study were reliable and can be used within the Thai context. Health education and printed information about outcomes after mTBI is recommended for both health care students and victims of mTBI. Further study to better understand why a small, but clinical-ly important percentage of subjects, experi-ence ongoing disability after mTBI is needed.

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Enquiry into Practice: Management of Terminal Catastrophic Intracranial Haemorrhage in Palliative Care.

Anna Smith

Abstract
The management of terminal catastrophic haemorrhage is a rare clinical palliative emergency for which the management is based largely on anecdotal and experiential guidelines, with no high grade evidence but rather robust contention and controversy. Whilst often rapid and deadly, inevitably dramatic and devastating for the treating health professionals and family, the key management areas include risk identification, supportive practices, the use of sedative medication and the ethical issues faced in the management of terminal haemorrhage.

Keywords: *Terminal catastrophic bleed, fatal intracranial haemorrhage, palliative care emergency, crisis medications, supportive measures.*

Introduction

Terminal catastrophic haemorrhage, including intracranial haemorrhages, in the palliative care setting is a rare clinical reality that has profound effects encompassing imminent and rapid death of the patient and distressing and dramatic implications for the health care staff and the patient's family. The management of this clinical palliative emergency is based largely on anecdotal and experiential guidelines, with no high-grade evidence, rather robust contention and controversy.

By definition, a terminal catastrophic haemorrhage is a major arterial bleed whereby death is rapid due to the significant internal or external loss of blood volume (Harris & Noble 2009). The clinical context for the purpose of this enquiry into practice is in the advanced cancer demographic in "whom invasive or interventional procedures and cardiopulmonary resuscitative measures are no longer appropriate" (Harris & Noble 2009, p 914). The goals of care are for supportive palliative care and comfort (Pereira & Phan, 2004).

With respect to the assessment task it is evident that there is a paucity of literature directly related to terminal catastrophic cerebral or intracranial bleeds. In much of the literature, it is often referenced in relation to tumours of the head and neck within the haematological cancer literature and management guidelines identified under various generic terminologies including palliative emergencies, bleeding, acute or sudden severe haemorrhage.

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Patients with large intracranial haemorrhages may be identifiable as presenting with a rapid onset of neurological symptoms, decreased consciousness related to increased intracranial pressure and a low Glasgow Coma Scale (GCS) rating (Quinones Hinojosa, Gulati, Singh & Lawton, 2003). Koji, Manabu, Osamu, Takahiro, Toshikazu, Junya & Naoyuki (2014) also identify the rare but evident cases of radiation induced intracranial aneurysms in the head and neck tumour patient population. As these aneurysms originate from arterial walls they can rupture, dissect the artery and produce catastrophic extravasation of arterial blood leading to subsequent hypovolaemia and possibly death (Koji et al., 2014). Definitive diagnosis requires radiological imaging, however in end-stage palliative management this would be unnecessary.

Harris & Noble (2009) submit that most of the figures quoted in the literature related to patients with head and neck cancers but there was no definitive data available for death by haemorrhage or type of cancer. More acutely Chen, Tai, Tsay, Chen, & Tien (2009) identified intracranial haemorrhage as the second leading cause of death in the acute myeloid leukaemia patient population and 14% of patients died of fatal haemorrhage in the in-

duction phase of treatment. Quinones-Hinojosa et al (2003) identified acute leukaemia with thrombocytopaenia and the haemophilia patient population at risk of death caused by massive intracranial haemorrhage - fatal in 50% of cases. From the literature and available guidelines it seems that irrespective of the location of the fatal haemorrhage, the planning, care, support and management appears to be largely the same.

Palliative care is the primary specialty at this Victorian small sub-acute facility comprising of an inpatient ward and community nursing service. Surprisingly, there are no written policies, procedures, clinical pathways or hospital guidelines available for the management of catastrophic haemorrharge. In separate discussions with the manager of the Community Palliative Care Service, the Nurse Unit Manager of the in-patient ward and the Clinical Director of Palliative Care, the key areas that management identified were: risk identification, supportive practices such as having dark towels to camouflage blood loss, the importance of staying with the patient, anticipatory medication orders for midazolam and morphine either intramuscularly or intravenously, staff support and advanced care planning. However, all these practices and knowledge were experientially based and historically rooted in current practice.

This did however, support much of the literature on the palliative management of terminal haemorrhage and the level of evidence available to guide practice. Harris & Noble (2009) highlight in their systematic literature review that none of the literature on the palliative management of terminal haemorrhage was above a Level 5 on the Oxford Centre for Evidence Based Medicine Level of Evidence (2009). Level 5 evidence is rated as "based on expert opinion without explicit critical appraisal or based on physiology, bench research or first principles" (Harris & Noble 2009, p 915). This similarly reflects the level of evidence rated as Level 5 in the more recent Joanna Briggs Institute (JBI) Best Practice Recommendations with particular reference to using crisis medications in the palliative care terminal haemorrhage scenarios for both inpatient and community care scenarios (JBI, 2014). McGrath & Leahy (2009) also submit that there is scant research on the topic of catastrophic bleeds during end of life care, identifying personal preference and anecdotal reports guide health professionals. Whilst the focus of their research and guidelines is end of life haematology, the broader care and supportive management overlap in both identified practices as well as the controversies.

The incidence of catastrophic bleeding is rare in the advanced cancer population and is cited by Harris & Noble (2009) to be between 3-12 % or 6-10% (McGrath & Leahy, 2009). Whilst rare, catastrophic bleeds are a significant palliative care emergency associated with certain, often imminent death. Within the literature there are 3 - 4 key areas, including identifying at risk patients, employing key supportive measures, the use of sedative medication and ethical issues faced in the management of terminal haemorrhage (Harris & Noble, 2009).

Chen et al. (2009) identify in their retrospective study prolonged prothrombin time, prior brainstem haemorrhage, subarachnoid haemorrhage and epidural haemorrhage as prognostic factors in intracranial haemorrhage in acute myeloid leukaemia patients, particularly the acute promyelocytic leukaemia sub group of patients. Quinones Hinojosa et al., (2003) cite Graus, Rogers & Posner's (1985) work that identifies the acute promyelocitic leukaemia patient population as high risk, given more than 60% die of intracranial haemorrhage. Whilst early detection of coagulopathy and swift correction can reduce haemorrhagic complications (Chen et al., 2009), Pereira & Phan (2004) suggest the benefit versus burden of anticoagulant therapy and monitoring must be considered, particularly in advanced disease.

In the head and neck cancer population the main risk factors are surgery, radiotherapy, postoperative healing issues, visible arterial pulsation, the presence of a pharyngocutaneous fistula, fungating tumours with artery invasion and other generalised factors such as being over the age of 50years, 10-15% body weight loss, malnourishment, diabetes, immunodeficiency, generalised atherosclerosis, a smaller precursor bleed and direct radiological observation of a tumour infiltrating an arterial wall (Harris & Noble, 2009). McGrath & Leahy (2009) report the possibility of identifying patients at risk of a catastrophic bleed as controversial but more relevant to the haematology patient group, identifying acute leukaemia, lymphoma and myeloma patients citing thrombocytopenia and disseminated intravascular coagulation as high risk symptoms.

Paradoxically, the distinct unpredictability of terminal haemorrhage is a clinical reality de-

scribed in the Harris, Finlay, Flowers, & Noble (2011) study when unexpected patients haemorrhaged. Therefore, awareness by all nursing staff of the potential and a clinical care pathway seems crucial to streamline care and management, particularly in relation to supportive measures and to support and educate new, less experienced staff or students within the organisation.

Much of the emphasis is placed on planning and implementation of supportive practice should terminal haemorrhage occur. Again the literature is limited to Level 5 evidence, based on a few case reports and expert opinion (Harris & Noble, 2009; Joanna Briggs Institute, 2014). In the literature review by Harris & Noble (2009) and subsequently Harris et al. (2011) qualitative research, merit was identified in the timely implementation of supportive measures. They implore the importance of staying with the patient, providing psychological support to patients and their family, applying pressure if bleeding is external, using dark coloured or green towels to camouflage blood, positioning patients in a lateral position, applying oxygen and importantly debriefing and peer support for staff. Harris et al., (2011) identify through staff interviews that staying with the patient overrode the importance of getting crisis medication. They also identified that this is not what the guidelines have previously focused on as priority.

These measures are reflected in the Therapeutic Guidelines in Palliative Care (Palliative Care Expert Group, 2010) and are further supported by the Yorkshire Palliative Guidelines (Yorkshire Palliative Medicine Clinical Guidelines Group, 2008) and the Scottish Palliative Care Guidelines on bleeding (NHS Scotland, 2014), which propose the assurance that someone is with the patient at all times and suggest that patient support and non-drug management might be more important than any crisis medication. The Care Management Guidelines for Emergencies in Palliative Care Tasmania denote in bold, the imperative of not leaving a patient alone if they are having a severe acute haemorrhage (Department of Health & Human Services, 2009). Nauck & Alt - Epping (2008) identify that one of the most important obligations in palliative care is being with the patient at this time.

After such an event, it is widely acknowledged that supportive debriefing and counseling of staff and family is valid. Yet Harris & Noble (2009) identify that the management of children who witness such an event is poorly recognised. The Yorkshire Palliative Medical Clinical Guidelines Group (2008) and Scottish Palliative Care Guidelines (2014) support whole team debriefing and ongoing bereavement support to families and staff members as a necessary component of care.

Whilst high profile in the literature and theoretically sound, medication administration at this time is also based on limited evidence and has never been formally assessed (Harris et al., 2011). There is no clinical evidence available to inform best route of sedative agent in the management of terminal haemorrhage (Harris & Noble, 2009). While the aim in medication administration during a terminal catastrophic haemorrhage is generic in assuaging distress and providing comfort, much contention arises across the literature in relation to the type of medication to use - benzodiazepine versus opioids or both, the route - subcutaneous (S/C), intramuscular (IM), intravenous (IV) or rectal (PR), the dosage or indeed whether to use any medication at this time.

Harris et al., (2011) conclude in their qualitative study that the use of crisis medication in the management of terminal haemorrhage due to incurable cancer rarely benefits the patient and can detract from the supportive nursing care. In fact there was “complete concordance” (Harris et al. 2011, p693) between medical and nursing staff on this point. This practice is supported by the JBI Best Practice recommendations for the use of crisis medications with palliative care patients experiencing terminal haemorrhage in both the hospital and community setting and states “providing support to the patient is the priority” (JBI 2014, p2), and unless prefilled syringes are instantly available little benefit in their use is suggested in the community setting. The JBI (2014) encourages the administration of crisis medications IV if access is available in the inpatient setting.

Although the notion of prefilled syringes is discussed variably in the literature, it is a questionable practice forbidden in some organisations for sound ethical and legal reasons. Whilst supportive measures are frontline, medication administration is thought to benefit if the dying process is not as rapid as anticipated. In the absence of PICC/IV lines, IM administration of midazolam 10mg is preferred and repeated at 10 minutely intervals if indicated.

The Yorkshire Palliative Care Guidelines (2008) for the management of bleeding for

palliative care patients with cancer, do inform and advise that if it is felt to be appropriate to have medication ordered, it should be rapid and readily available for IM or IV administration, as the S/C route is likely to be ineffectual due to peripheral shutdown and its' unpredictable absorption and metabolism. Consideration of whether the patient is opiate-naive or not, should be raised. Comprehensively, the guidelines do suggest other options such as diazepam PR, midazolam bucally and lorazepam sublingually if nursing staff were not present - such as at home.

The Tasmanian Care Management Guidelines in Emergencies in Palliative Care advocate as wise, the practice of having a crisis order where the identified risk of severe bleeding and death is "inevitable", purporting the merit of rapid sedation to avoid the anxiety and distress the symptoms of shock produce (Department of Health & Human Services, 2009). These guidelines are more focused around the intervention of medication administration at the time of haemorrhage and promote having the medications drawn up ready for use as well as some expectation that the family may need to administer them. Nowhere in these guidelines are debriefing or bereavement support outlined, rather the focus is on the merit of explanation to the family of the use of medications.

McGrath & Leahy (2009) nominate agreement by the health professionals on the issue of administering sedation and pain relief to patients having a catastrophic bleed as an important supportive strategy. Pereira & Phan (2008) cite other less recent publications in support of having rapid sedative medications available and families instructed on S/C administration. Whilst the Therapeutic Guidelines: Palliative Care (Palliative Care Expert Group, 2010), support that the unlikely effect of medications being administered in time to relieve any distress and emphasise the practice of staying with the patient, they do however propose that medications being in the home with instructions on how to administer may relieve anxiety. The local Community Palliative Care Service does not allow prefilled syringes. However there may be anticipatory medications and orders in the home of patients identified at risk.

Pereira & Phan (2004) and the JBI (2014) advocate for family members and health care providers to be sensitively informed of the risk and management plan of the potential for a terminal haemorrhage, as these events are always distressing. Individual consideration, respecting the different capacities of individuals and families is felt to be the better premise and the consensus identified by McGrath & Leahy (2009). The Yorkshire Guidelines on the management of bleeding for palliative care patients with cancer (Yorkshire Palliative Medicine Clinical Guidelines Group 2008), support that the assessment of each particular individual and family must be weighted, citing good practice offers the opportunity for patients and families to raise concerns related to management or mode of death and especially the consideration of the presence of children in the home. Nauck & Alt-Epping (2008) propose that to a greater extent in relation to impending haemorrhage than any other palliative care emergencies, good communication, explanations and the establishment of a rapport in advance with the patient and family is warranted.

McGrath & Leahy (2009) identify the importance of advanced care directives or a statement of choices, so that the appropriate course of management is adhered to should a catastrophic bleed occur, as well as preparation of the carers in the home situation. The Yorkshire Palliative Medicine Guidelines (Yorkshire Palliative Medicine Clinical Guidelines Group, 2008) advocate that discussions and decisions regarding bleeding management should be made early, documented and shared with all service providers including out of hours services. They advocate that advanced care directives for those identified as high risk for major bleeding must be individualised, reviewed and clearly documented.

The Therapeutic Guidelines in Palliative Care (Palliative Care Expert Group, 2010) emphasise that if a haemorrhage is anticipated, then planning must include preparation of the carers of the potential and how to provide comfort, which is felt to be paramount. The Tasmanian Care Management Guidelines (Department of Health & Human Services, 2009) identify the importance of planning, anticipating and having a strategy that is communicated early with balancing information to the patient and carer in a way so as not to provoke anxiety waiting for the inevitable which may never eventuate. This reflects some ethical issues raised in the literature related to informing the patient of the risk of terminal haemorrhage, timing and method of discussing patient preferences versus their right to know, the merit of outlining an event that may never occur, but potentially increasing anxiety at a time of heightened angst

(Harris & Noble, 2009; McGrath & Leahy, 2009).

With increased clinical awareness and management of this phenomenon, as well as the identified lack of policies or procedures related to the management of catastrophic bleeds, it is believed that the development of a clinical pathway and supporting hospital policy is warranted. Whilst the local practice is sound within the current national and international guidelines, formal documentation rather than the reliance on historical practice regimes would be a positive educational tool for new staff and students.

Conclusion

There is clearly a scarcity in the literature regarding the management of catastrophic hemorrhages in the palliative care populous. Several international guidelines exist to help guide practice. However there is no consensus regarding the pharmacological interventions and management strategies for these events. As this event is an inevitably dramatic and devastating for the patient, their family and the health professionals involved, potentially triggering psychological trauma for those witnessing it, further research and evidence is required to guide practice and develop clear procedures to optimise management and attain positive end-of-life outcomes.

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A Neurological Integrated Care Pathway

Kathleen McCoy, Harriet Chan

Abstract
Objective: To assess the feasibility of service integration for neurological care.
Design: Observation study
Participants: A total of 104 admissions for 92 neurological patients treated in a major region hospital and suitable for discharge home were eligible for participation.
Intervention: A neurological integrated care pathway (NICP) was trialled at a major regional hospital between July 2012 and June 2013. Objective data included patients, gender, age, diagnosis, length of hospital stay, referral dates, discharge dates, dates when patients were seen by the community neurological liaison nurse, and readmissions were collated for analyses.
Outcome measures: Targeted outcomes included the estimated service impact on the hospital in terms of reduced length of hospital stay and decreased readmissions and increased referral rate to community neurological support service, and quality of patient care.
Results: The trial saw an increase in efficiency and standard of care despite growth in patient numbers. The CNLN attended to 104 recorded referrals (more than 17 times the number of referrals in 2011), all within 7 days of their referral date (a 77.4% decrease compared to 2011 where patients were attended to up to 31 days). In addition, the average length of hospital stay had decreased significantly from 26 days in 2011 to 9 days (a 65.4% decrease) with a low rate of re-admission (approximately 11.5%).
Conclusion: The NICP improved service efficiency for both the hospital system and the community neurological support service, with high levels of patient satisfaction. In this case the NICP achieved best value from existing resources and provided a viable model of service delivery for chronic neurological conditions.

Key words: *integrated care pathway, community neurological support.*

Introduction

About 9 years ago the World Health Organisation [WHO] pronounced that "neurological disorders will be one of the greatest threats to public health" (World Health Organization, 2006). Neurological conditions including mental disorders are diseases of the brain, spinal cord, peripheral nerves, and neuromuscular tissues (World Health Organization, 2014). There are more than 600 known neurological conditions (National Institute of Neurological Disorders & Stroke, 2014) of traumatic, primary or acquired nature, and their presentations may range from episodic, progressive or relapsing states. Neurological diseases affect all ages but are more common in people older than 45 years (MacDonald, Cockkerall, Saner & Shorvon, 2000). It is a fact that most neurological conditions pose a degree of disabling impairments, functional limitations and chronic suffering on the individuals thus increased utility of hospital, health and care services. That is, a person living with a neurological condition often has numerous complex needs which tend to escalate over time and require continuous or periodic input from a wide range of health and support services (Freeman & Thompson, 2000; Boter, Rinkel, de Haan &HESTIA Study Group, 2004).

Though neurological care in Australia accounts for the second largest health expenditure (National Health Priority Action Council, 2006) service gaps exist. This is due to the increasing prevalence of neurological conditions and accumulation of needs and demand of the neurological community by large. In Western Australia (WA) a Neurocare program was developed in late 1990s as a measure to improve access to neurological support by people living within rural regions. The Neurocare program is led by community neurological nurses (CNNs) and funded by the Home and Community Care (HACC) Western Australia Department of Health. The CNN practice is supported by a postgraduate communi-

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Diagnosis	Gender	Age (yr)	No.	LOS (days)	Readmission within 28 days of separation	Days taken to be seen by CNN
Parkinson's disease	M	61	1	28	0	35
Left stroke	F	64	1	32	0	30
Right stroke	M	53	1	21	0	31
Left stroke	M	67	1	24	0	29
Parkinson's disease	M	70	1	42	0	30
Herpes simplex right eye	F	68	1	14	0	32
Mean		**63**	**6**	**26**	**0**	**31**

Table 1 *(Above): Patient Profile of Referrals to the Neurocare Program in 2011*

ty neurological nursing qualification, which emphasizes person-centre wellness principles from the International Classification of Functioning, Disability and Health framework (World Health Organisation, 2002). These CNNs have wide ranging local service knowledge and navigating skills that drive the best health outcomes for people living with a wide spectrum of neurological conditions. They guide, support and connect individuals to primary care, specialists, health care as well as many support and social services. They also provide education to the wider community and other health professionals and caregivers. More importantly this specialised nurse support service plays a vital role in managing health in all stages of a neurological disease, thus it has the potential to free up scarce health resources. The Neurocare program is gaining international standing and recognition; and evidence is mounting that many organizations are beginning to align their disease-specific service with this model of generic nurse-led neurological service. Similar programs of generic community neurology service have been cited in the literature (Jack, Kirton, O'Brien & Roe, 2009).

Nature and Significance of the Problem

In discussions with a WA Health Services senior executive (August, 2011), it was found that neurological patients account for at least one third (39%) of daily hospital bed usage. It was also noted there was an upward demand trend for neurological care which will continue to increase as the population grows and ages. In fact, in 2012 there were 31,804 hospital admissions due to primary nervous system diseases, and these admissions accounted for a total of 340,627 hospital bed-days (Government of WA, 2015).

Furthermore, current resources for neurological services in WA appear to be disproportionately distributed. This has created an inequitable access issue between the metropolitan service hub and services within the rural regions. For example, only one neurologist visit occurs in the mid-west region on a quarterly basis and recently in the great southern region; and occasional telehealth consultations on demand from south-west region. It is common knowledge that this system-wide service access issue will continue to be a challenge over the next decade.

The Neurocare program is the preferred community generic neurological support service provider within major rural regions of Western Australia (Neurological Council of WA, 2015). The provision of evidence based neurological support has up till now been limited to non-hospital involvement, precluding the community neurological nurses from participating in the vital discharge planning and community care coordination for in-hospital patients with neurological conditions. A retrospective review of the south-west region Neurocare service revealed that only 6 referrals from the local regional hospital were received in 2011 (Table 1). Of the 6 patients referred, 4 were males aged between 53 and 70 years, and 2 were females aged 64 and 68 years; 2 males and 1 female had a stroke, 2 males had Parkinson's disease and 1 female had herpes simplex infected right eye; and the average length of hospital stays was 28 days (14 and 42 days). All 6 patients had their referrals initiated on the day of separation from the hospital to home; the average time taken by the community neurological nurse to make contact with these patients was 31 days; and there was no record of any re-hospitalisation within the first month of discharge home. From this review the Neurological Council of WA identified a gap as a key priority for improvement; this gap was the root cause for low referral rate and access delay to community specialised neuro-

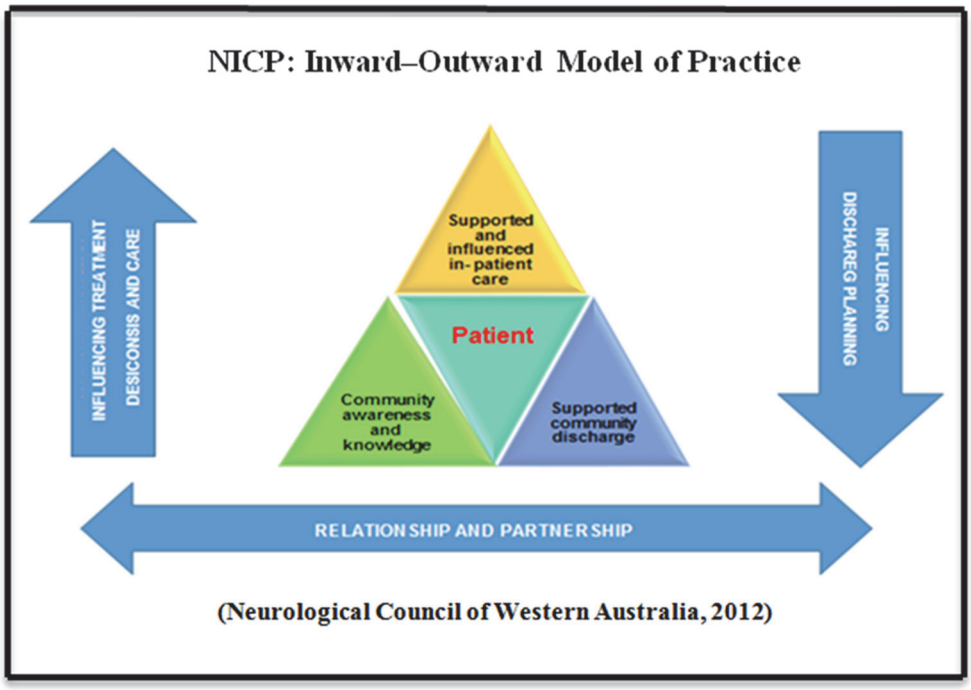

Figure 1 *(Above): NICP: Inward–Outward Model of Practice*

logical support, increased length of hospital stay and a stymied patient flow system. This gap was deemed to have significant impact on both the hospital system and the community support service delivery, and considered remediable through better utilisation of existing resources.

Setting and Project Design

Both the local regional hospital and the Neurological Council of WA's Neurocare program served to provide hospital care and community neurological support, respectively in the south-west region of WA. In 2011 a unique opportunity arose for service re-design. The local regional hospital and the Neurological Council of WA had been successful in obtaining a grant from the WA Health's Clinical Integration and Innovation Grant of the Quality Incentive Program (QUIP) for a co-design project.

This project involved a new approach to service delivery, a neurological integrated care pathway (NICP), which is based on an inward-outward model of practice (Figure 1). This model integrated acute care and community support services so to create an 'express access to community neurological support' that would improve the discharge process. Operational procedures and documents were developed to formalise this practice change, all framed in the context of what was best for patient care.

A community neurological liaison nurse (CNLN) position was created and funded by the QUIP grant. The Neurological Council of WA developed the job specification form with selection criteria, and became the governance organization for this position. The successful applicant was a community neurological nurse in the Neurocare program who had the knowledge of locally based services and neurological nursing support expertise. The role of the CNLN had been recognized as a key success factor for the day-to-day partnering and care team processes as well as the overall project.

Key Outcome Measures

The project's key outcomes included estimated service impact on the hospital system and the Neurocare program, and quality of patient care.

Method

Adult neurological patients treated in the major regional hospital and suitable for discharge home were prospectively enrolled into the NICP between July 2012 and June 2013. Nurses were asked to record on each patient's NICP when a referral to the Neurocare program was initiated. The CNLN also recorded the dates on the NICP when she saw the patients. The CNLN served as the 'express referral system', this was made possible through her regular attendance and participation in the weekly multidisciplinary team meetings. The CNLN was responsible for collection

of the project data, which included patients, gender, age, diagnosis, length of hospital stay, referral dates, discharge dates, dates patients first seen by the CNLN, and readmissions. This dataset was analysed to ascertain the service impact on the hospital system and the Neurocare program, and quality of patient care including patient satisfaction ratings. Patient satisfaction was assessed by asking the patients or their carers to complete a survey form at 3 months after the initial referral date. All information was treated in a way that complied with ethical requirement of anonymity and confidentiality.

Results and Outcomes

There were 104 admissions for 92 patients as shown in Table 2. Of the 92 patients 39 (42.4%, 33 males aged 45-65 years, 6 females aged 57-62 years) had Parkinson's disease, 23 (25%, 15 males aged 48-57 years, 8 females aged 63-69 years) had stroke syndromes, 15 (16.3%, 5 males aged 64-71 years, 10 females aged 62-72 years) had dementias, and the remaining 15 (16.3%, 6 males aged 46-62 years, 9 females aged 49-65 years) had various neurological diagnoses.

Estimated service impact on the hospital system: The average length of hospital stay for the cohort was 9 days and there were 12 patients readmitted during the pilot period, approximately 2 readmissions every 3 months. The average length of hospital stay had decreased significantly from 28 days in 2011 to 9 days currently (a 65.4% decrease) with a low rate of re-admission (approximately 11.5%). These results were of clinical importance in terms of efficient hospital bed use and patient flow impact.

Estimated service impact on the Neurocare program: The 104 referrals represented more than 17 times the number of referrals in 2011. The CNLN attended to all referrals within 7 days of their referral dates, this demonstrated a 77.4% decrease compared to 2011 where patients were attended to up to 31 days. These results showed a promising upward change in service throughput for the Neurocare program.

Quality of patient care: Quality of patient care referred to the deliberate engagement of patients and their family carers with education and advice relevant to actual and possible effects of their conditions including those self-management skills for living with the particular neurological condition by the CNLN, and the early linkage with the CNLN who would be their primary neurological nurse in the community. Of the 104 referrals 99 were first seen in the hospital and only 5 were first seen one to two days after discharge home by the CNLN. The impact of this deliberate approach to care included high patient satisfaction ratings and low readmissions. Patient satisfaction ratings were obtained from the survey forms completed by 63 patients. As shown in table 3, the satisfaction ratings were extremely high. The low readmissions rate could be inferred as less morbidity and relatively good health for the cohort under the support of the Neurocare program.

Conclusion and Discussion

Traditionally referrals to a community service agency occur by chance or are stimulated by crisis and the emergence of a particular problem (Freeman & Thompson, 2000; Boter et al., 2004). Indeed, the NICP with the inward-outward model is superior to that of the traditional referral system for it serves as a continuity thread for smooth transitioning of care between hospital and home. The interprofessional exchange between hospital and community services is in itself an invaluable resource of relationship development and service integration (Aspinal, Bernard, Spiers & Parker, 2014). This may include the transfer of understanding, knowledge, insights and skills in self-management, symptoms and lifestyle influencing factors that help in care decisions and problem solving. More importantly the patient journey home was fully supported and positively influenced through this service integration. The NICP with the inward-outward model has been proven to be a practical method of resource utilisation in health service provision, and that it can be easily reproducible and sustainable. This new model of service delivery may also offer a cost-saving opportunity in terms of reduced length of hospital stay, readmissions and hospital bed use as well as improved patient flow.

Whilst acknowledging that the project has ended in June 2013 the new practice continues to be used in its original frame. The continuing flow of referrals to the Neurocare program clearly demonstrates true consolidation of the practice change. In this case service integration has achieved the best value from existing resources and can be regarded as a viable model of service delivery for long term neurological conditions.

Strength and limitations

The strengths of this observational study in-

cluded a large sample size in a major regional hospital, the inclusion of service impact of both hospital system and community support service and quality of patient care as outcomes. Future work needs to focus on maintaining long-term sustainability of this new model of practice. The limitations include the lack of a control group, and data collection by a person who was not blinded to the study.

Conflicts of interest
None exist.

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Timely Anticoagulant Thromboprophylaxis is Safe and Effective in the Care of Patients Suffering Traumatic Brain Injury.

Kandace Micallef

Abstract
Despite the high prevalence and associated morbidity of Venous Thromboembolism (VTE) development, thromboprophylaxis in the neurosurgical setting remains a source of contention due to concerns of iatrogenic haemorrhage progression associated with anticoagulant thromboprophylaxis. Opinions of ideal time to initiate chemical prophylaxis for VTE within the neurosurgical community vary between clinicians. It is nevertheless rarely disputed that timely and appropriate prophylaxis of VTE reduces morbidity. This review aims to determine the safety and efficacy of chemical VTE prophylaxis within the neurosurgical setting. The consequences of VTE can be devastating and patients with neurotrauma are amongst those at greatest risk. With this in mind, the neuroscience nurse must be meticulously conscientious for the prevention of VTE in the neurosurgical setting. The neurosurgical nurse has a close affiliation to the patient, is often the first to observe the clinical signs and symptoms associated with VTE, is responsible for implementing prevention strategies and assisting with treatment for those who unfortunately develop a Deep Vein Thrombosis or Pulmonary Embolism (PE).

Key Words: *Venous thromboembolism, thromboprophylaxis, neurosurgical, head trauma, enoxaparin, intracranial bleeding.*

Introduction

Venous Thromboembolism (VTE) encompasses both Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE) (Welch, 2010). Accounting for the death of 5-10% of hospital inpatients, PE is the most common avertible cause of inpatient death (Cohen, Tapson, Bergmann, Goldhaber, Kakkar, Deslandes, Huang, Zayaruzny, Emery & Anderson, 2008).

Virchow's triad as explained in Delaune, Nanda & Barker (2008) defines the three contributing factors associated with VTE formation. These factors are venous stasis which is reduced or stagnant blood flow in deep veins, venous injury which causes the release of procoagulant factors within the bloodstream as part of the normal clotting mechanism and hypercoagulability which refers to a more intrinsically active clotting state, often as a result of traumatic injury (Maclean, 2014).

The quoted incidence of DVT in the neurosurgical setting varies from 9-50% (Delaune et al., 2008), with patients suffering from multisystem traumatic injuries in addition to their neurotrauma, being at the greatest risk (Reiff, Haricharan, Bullington, Griffin, McGwin & Rue, 2009). Despite the high prevalence and associated morbidity of VTE development, thromboprophylaxis in the neurosurgical setting remains a source of contention due to concerns of iatrogenic haemorrhage progression associated with anticoagulant thromboprophylaxis. There is further reticence to use early chemical VTE prophylaxis due to the absence of a national care standard and the nature of previous studies which are by majority, limited to retrospective and observational studies (Phelan, 2012).

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Method

A literature search was conducted utilising the electronic databases CINAHL, PubMed and MEDLINE in August 2014 using the keywords venous thromboembolism, thromboprophylaxis, neurosurgical, head trauma, enoxaparin and intracranial bleeding. Articles were limited to English papers, which were published from 2008 to present. The reference lists of articles were searched for additional publications. A total of 30 papers were reviewed and 15 included in the review combining both contemporary literature and seminal work pieces.

Review of the literature

VTE is a common complication for hospitalised patients irrespective of their pathology, and no group of patients has a higher risk than those who have suffered traumatic injury (Urden, Stacy & Lough, 2015). Taniguchi, Fukuda, Daitoku, Minakawa, Odagiri, Suzuki, Fukui, Asano & Ohkuma (2009), conducted a prospective study of 37 patients stratified into risk categories which analysed the prevalence of venous thromboembolism in the neurosurgical setting. Their study group received thromboprophylaxis with graded compression stockings, with or without the use of intermittent pneumatic compression (IPC), but did not receive chemical prophylaxis. Their results suggested that mechanical prophylaxis alone was inadequate with the prevalence of DVT within their cohort at 13.5% which is within the expected baseline of risk in the untreated. Also of note, within their study group, of those found to have DVTs, there was a 60% prevalence of PEs requiring long term treatment. Similarly, Phelan (2012), conducted a critical literature review of 56 papers to determine the safety and efficacy of chemical VTE prophylaxis in the setting of neurosurgical patients. They reported rates of DVTs in patients who had suffered traumatic brain injury (TBI) in the intensive care unit (ICU) setting as being as high as 51%, with a subsequent post thrombotic-syndrome rate of 30%; a syndrome, it should be noted, associated with a poorer expected long term outcome than chronic fibrotic lung disease and diabetes. They advised that initiation of low molecular weight heparin (LMWH) prophylaxis was critical once haemorrhage progression was deemed stable, suggesting 48 hours postop to be the optimal time, due to the increasing requirement of invasive prophylaxis via use of devices such as inferior vena cava (IVC) filters beyond this period. Scudday, Brasel, Webb, Codner, Somberg, Weigelt, Herrmann & Peppard (2011), also hypothesised that the use of anticoagulant prophylaxis would decrease the incidence of VTE without increasing intracranial haemorrhage in their retrospective case control study of 812 patients. Anticoagulant prophylaxis in the form of unfractionated heparin (UFH) or LMWH was initiated in 402 (49.5%) patients. 169 commenced anticoagulant prophylaxis within 48 hours of presentation, whilst 242 patients had treatment initiated within 72 hours. Findings of the study indicated that patients receiving anticoagulant prophylaxis in contrast to mechanical prophylaxis had a reduced VTE incidence of 1% and 3% respectively.

Opinions of ideal time to initiate chemical prophylaxis for VTE within the neurosurgical community vary between clinicians. It is nevertheless rarely disputed that timely and appropriate prophylaxis of VTE reduces morbidity. A study of Canadian practice conducted by Scales, Riva-Cambrin, Le, Pinto, Cook & Granton (2009), surveyed 160 neurosurgeons and intensivists, confirming that the majority of clinicians utilised anticoagulant prophylaxis in the neurosurgical setting despite the perceived risks of haemorrhagic progression. 88% of surveyed intensivists and 75% of surveyed neurosurgeons described the use of UFH, LMWH or other anticoagulant thromboprophylaxis for patients with diffuse axonal injury after severe traumatic brain injury. The majority (58%) who favoured anticoagulant thromboprophylaxis reported that they would initiate anticoagulant thromboprophylaxis within two days of injury. In the instance of patients suffering intracranial haemorrhage after severe traumatic brain injury, 60% of those surveyed reported that they would initiate anticoagulant thromboprophylaxis during the inpatient course. In this case however, the initiation time was more varied with 34% of those surveyed stating that they would commence anticoagulant prophylaxis within two days of surgery, 57% would commence within four days and 80% within one week. The use of anticoagulant thromboprophylaxis in patients who are considered high risk for the development of VTE undergoing intracranial neurosurgery is also supported by Barillari & Pasca (2009) who state that the use of IPC in addition to low dose UFH or LMWH postoperatively is more efficient than the use of IPC alone. This statement is based on their review of guidelines presented from the American College of Chest Physicians (2008), consensus conference on antithrombotic therapy. In spite of the observed efficacy of anticoagulant thromboprophylaxis, a clinical decision analysis study conducted by Scales, Riva-Cambrin, Wells, Athaide, Granton & Detsky (2010), revealed that the probability of no intracranial haemorrhage progression in the context of mechanical or anticoagulant thromboprophylaxis was associated with expected values of 0.90 (90%) and 0.89 (89%) respectively, meaning that the decision to anticoagulate patients was approximately equivocal in terms of its absolute risk. It went on however to conclude that given the implications of intracranial haemorrhage when measured against the implications of VTE, that the risks while equivalent numerically, were not necessarily contextually equal.

In favour of early anticoagulation, it has been shown that delayed time to treatment with appropriate anticoagulation therapy has been shown to have a significantly increased burden of disease. Reiff et al (2009) conducted a retrospective, multicentre study which included 15,269 eligible patients of which 2000 had sustained traumatic brain injury (TBI) investigating DVT risk dependent on admission time to commencement of prophylaxis. They found that patients suffering from TBI are associated with a high risk of DVT which became significantly greater when the presentation time to anticoagulant prophylaxis was longer. In their observed cohort when the time to commence prophylaxis was beyond 48 hours, DVT risk in TBI surged to 15.4%, compared with a significantly less risk of 3.6% in TBI patients who had prophylaxis initiated at 0-24 hours. In contradiction to their findings, the retrospective study by Salottolo, Offner, Levy, Mains, Slone & Bar-Or (2010), was not able to establish an association between the development of VTE and the timing of anticoagulant prophylaxis commencement.

Reticence to initiate anticoagulation is based on the perceived risk of haemorrhagic progression. However, some evidence suggests that intracranial haemorrhage rates within those treated with anticoagulant prophylaxis are significantly less than is intuitively assumed. In a retrospective study undertaken at an academic tertiary care facility including 4293 patients undergoing surgery for intracranial brain tumour, Chaichana, Pendleton, Jackson, Martinez-Gutierrez, Diaz-Stransky, Aguayo, Olivi, Weingart, Gallia, Lim, Brem & Quinones-Hinojosa (2013), reviewed 126 patients who acquired DVT and/or PE; 67% suffered solely DVT, 25% PE and 8% both. All were diagnosed within 30 days of surgery through a variety of means including ultrasound, CT pulmonary angiogram and ventilation perfusion scan. The majority of patients diagnosed with VTE (81 patients, 64%) were treated with UFH, and in follow up imaging only 5 (4%) had an intracranial haemorrhage. While the cohort studied was not focused purely on patients suffering TBI, given the degree of parenchymal injury associated with tumour and other surgery, a degree of extrapolation is not unreasonable. Similarly, Dudley, Aziz, Bonnici, Saluja, Lamourex, Kalmovitch, Gurasahaney, Razez, Maleki & Marcoux (2010), undertook a retrospective study that reviewed 694 cases of moderate to severe traumatic brain injury over a period of 5 years and analysed the use of LMWH for VTE prophylaxis. Eligible patients, 287 in total, were fitted with mechanical prophylaxis; both graded compression stockings and IPC, and were also commenced on LMWH at 48-72 hours post traumatic injury. It is important to note that in this instance, patients were commenced on LMWH only when two or more CT scans displayed intracranial haemorrhage. 186 patients underwent a CT scan within three weeks of commencing LMWH and only one (0.4%) developed progression of a known intracranial haemorrhage. The authors concluded that early LMWH commencement post traumatic brain injury showed a decreased incidence of VTE (7.3%) and should be considered safe given that only 0.4% suffered a progression of intracranial haemorrhage. Farooqui, Hiser, Barnes & Litofsky (2013), concluded that the use of anticoagulant prophylaxis in head injured patients appears to be effective in preventing DVT and PE without increase in haemorrhage rates in their retrospective study of 236 patients. They reviewed an anticoagulant VTE prophylaxis protocol after TBI mandating the use of anticoagulant prophylaxis (UFH or LMWH) at 24 hours post injury for all patients. The analysis compared two groups of patients; one cohort of 107 patients treated without this protocol and the other cohort of 129 patients were in the described manner. The incidence of PE in the former was 3.74%, and 0.78% in the latter. Curiously, without the protocol, the observed number of haemorrhagic progressions, (3 incidences) was higher than those treated with the protocol (1 incident). Similarly, Minshall, Eriksson, Leon, Doben, McKinzie & Fakhry (2011), retrospectively reviewed the charts of 386 patients admitted to an ICU with a hospital stay of greater than 48 hours with significant TBI over a 42 month period. Their aim was to compare the use of LMWH and UFH to better gauge haemorrhage progression risk in patients suffering severe traumatic brain injury and to explore the related rates of VTE. Of their study group; 158 patients were treated with LMWH, 171 were treated with UFH and 57 patients had sequential compression devices, the latter considered the control group. The observed incidence of VTE within the treated groups of patients was 0.9% and 1.9% respectively. Patients in the untreated group had a 47% mortality rate in stark contrast to the observed 5% in the LMWH group and 16% in the UFH group. In patients treated with UFH the incidence of DVT was 1% and 3.7% for PE, only marginally higher than those patients treated with LMWH. After the commencement of treatment, only 8 (5%) patients in the LMWH group and 20 patients (12%) in the UFH group had a progression of their in-

tracranial haemorrhage which, as with the study by Farooqui et al., (2013), is considerably lower than their control group with a progression rate of 25%. Again, early initiation of anticoagulant prophylaxis in patients with severe TBI was shown to significantly reduce the risk of VTE without significant risk of intracranial haemorrhage progression. Depew, Hu, Nguyen & Driessen (2008), suggested early prophylaxis had merit following conducting a retrospective study including 124 patients who suffered blunt head trauma reviewed rates of ICH progression with early prophylaxis. 62 patients were commenced on LMWH, 20 patients on UFH and 42 patients had pneumatic compression devices alone. Of those with chemical VTE prophylaxis, 10 developed VTE and 3 developed ICH progression of which only one was significant. In contrast, a decision analysis study conducted by Niemi & Armstrong (2010) proposed that if bleeding risk was high intraoperatively, the administration of anticoagulant prophylaxis should be postponed until as late as possible, but consequences should be considered case dependent. They concluded that patients considered very high risk from thrombus development should have anticoagulant prophylaxis implemented provided risk of inadequate prevention outweighed the risk of bleeding.

Nursing Considerations

The essential role of the neuroscience nurse is continually evolving. Neuroscience nurses are conscientiously accountable for the coordination of patient care throughout recovery and are instrumental in the prevention of VTE in the neurosurgical setting. Prevention of VTE and risk reduction should be considered fundamental nursing goals (Andrews & Habashi, 2010). Rapid patient assessment in order to review effectiveness of care, quick identification of issues and prompt management of complications is essential in high risk patients. Due to their close affiliation to the patient, the nurse is often the first to observe the clinical signs associated with VTE and is responsible for implementing prevention strategies and treatment for those who develop DVT or PE. DVT, as described in Scruth & Haynes (2014), typically presents with pain in the calf, often with redness, swelling and distended superficial veins. The affected calf is often warmer to touch and Homan's sign, pain in the calf on dorsiflexion of the foot, may also be present. Although a late sign of DVT, cyanotic discolouration due to deoxygenated haemoglobin present within the stagnant veins, may also be present (Söhne, Vink & Büller, 2009). As explained in Hix & Tamburri (2009), the signs and symptoms of PE include dyspnoea, tachypnoea, inspirational chest pain, chest wall tenderness, decreased spO2, cough, cyanosis, tachycardia, fever and haemoptysis. PE may present with varied signs and this can often make the diagnosis challenging (Mathers, 2015). A possible PE should be considered in any patient who displays or reports new onset of cardiorespiratory signs and symptoms or any risk factors for VTE (Hix & Tamburri, 2009).

The neuroscience nurse is also responsible for providing sufficient patient education for patients considered high risk or who have developed DVT or PE. In the context of ICU patients, Andrews & Habashi (2010), recommend the use of minimal sedation where possible to promote activity including ventilator management and weaning as early as possible and the implementation and continuation of prophylaxis for the prevention of VTE.

It is extremely important that the neuroscience nurse be attuned to the potential for patients to precipitously deteriorate in the setting of anticoagulant prophylaxis, particularly given the inability to immediately reverse the effects of anticoagulants such as, LMWH, given that an exclusive antidote is not available (Niemi & Armstrong, 2010).

Conclusion

VTE thromboprophylaxis in the neurosurgical setting remains controversial and can be challenging and complex. As highlighted in the review, the consequences of VTE can be devastating and patients with neurotrauma are amongst those at greatest risk. Complicating that which would otherwise be a simple matter, the risk of haemorrhagic progression and the consequences of postoperative bleeding lend credence to a more conservative approach, with delays to onset of chemical prophylaxis being the most commonly described intervention. As a nurse within the neurosurgical field, the key challenges remain early detection of VTE complications within the untreated cohort of patients, and the early detection of haemorrhage within the treated population.

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Louie was also active in the community. She joined the Country Women's Association and over the years held branch, division and state executive positions until shortly before her death in 2007. She was especially involved in supporting the welfare of students at secondary school, serving on a high school hostel board for some time.

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