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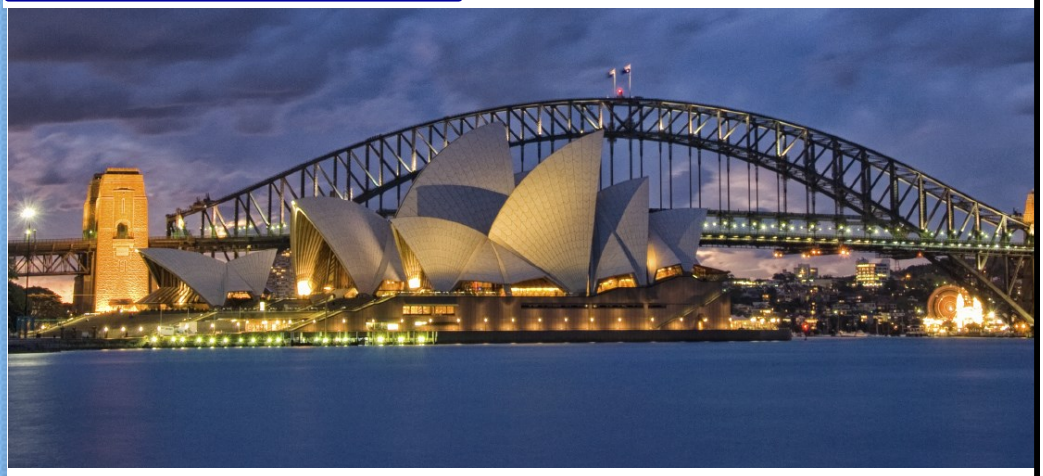

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In This Issue:

Editorial

Vicki Evans
Editor

This edition begins with an article from Thailand discussing the management of external ventricular drains, related infections, sampling advice and improved protocols for the Thai population.

Following is a paper outlining the importance of the nurses' supportive role and thorough assessment skills in order to manage the patient with leptomeningeal carcinomatosis.

The next manuscript discusses the significant benefits in relation to health economics and nursing care following the establishment of an out-patient lumbar microdiscectomy program in Victoria.

Congratulations to the new ANNA Executive team, voted in during the Sydney ANNA Conference. Handover will occur in the coming months with official duties beginning in earnest next year. On behalf of the AJoN readers, I would like to thank the previous Executive and wish them well in their new endeavours.

Having been the Editor of the AJoN for the last seven years, it is now time to hand it over to the new editor—Linda Nichols, from Tasmania. Congratulations!

Thank you all for your support and submissions over the years. The neuroscience nursing profession relies on manuscript submissions for evidence-based outcomes and best practice scenarios. Please encourage your colleagues to submit their work to be published in the AJoN. There are many excellent studies being done and they would be beneficial to publish—for the AJoN, its readers and your CV!

Cheers,
Vicki

Guest Editorial

Susan Williams
Movement Disorder Chapter Report. ANNA AGM 2016

The establishment of the Movement Disorder Chapter of ANNA was voted into the constitution at the 2015 AGM. In April 2016 the PD nurses in Australia met and the committee members were nominated and elected. The Movement Disorder Chapter of the ANNA aims to provide clinical support and professional development opportunities for Parkinson's Disease and Movement Disorder Nurse Specialists (PDMDNS). Collectively this will reduce the geographical isolation and promote a professional identity for movement disorder nurses.

There are five domains of focus:
1. Education: to equip nurses in their local settings to provide better care, and provide educational and career pathways to advanced practice nursing.
2. Clinical Practice: to develop evidence based best practice guidelines.
3. Professional Development: to develop a formal competency framework required to practise as a PDMDNS.
4. Leadership: contribution to relevant political debate and health care policy development.
5. Research: encourage clinical nursing research and provide a platform for professional communication.

Achievements

1. Mission statement was developed. This was sent out for comment to the wider Australian PD nurse population, was finalised in July, and is now ready to upload to the website.

2. The PD nurses in NSW continue to meet on a quarterly basis. The QLD nurses held their first meeting in early August. The aim of these meetings is to provide professional support, education and build relationships. The NSW nurses have come to value these meetings, as they reduce the geographic isolation we all work in, and have led to the development of clinical resources and education packages. It is hoped that this model will roll out to the other states. All that is required is a local champion to arrange a date and venue, and ask a Pharma company to pay for lunch.

3. The annual Parkinson's Disease Education Day for Nurses held in NSW on 23rd August was the first education day held under the ANNA MDC banner. This event is affectionately known as "Pump Friends" and is a Tier 1 event. PD Nurses in NSW hold this event for nurses who care for people on apomorphine pumps. These nurses are from acute wards, the community and aged care facilities. Previously this event has been solely sponsored by Hospira, now Pfizer. This year we extended the sponsorship to include Stada and Abbvie, as we also expanded the program to include Duodopa pumps by breaking in to 2 afternoon workshop groups. PAMS supported an online registration process, which enabled us to charge for the event. $36 covered the cost of lunch, morning and afternoon tea, and the PAMS registration handling fee per person. The Sponsorship covered the facility hire and lunch for the speakers. As this program has been held for 6 years, we know it is well attended and gains very positive feedback. The speakers donate their time, some traveling over 4 hours to contribute. It was encouraging to find that the new $36 registration fee did not deter numbers from attending. The lesson for next year is we will ask for more sponsorship from the pharma companies so we can also cover the cost of printing education.

It is encouraging to reflect on what we have achieved in our first year. We look forward to what the next year brings.

Sue Williams
Chair MDC ANNA

Does duration and sampling of external ventricular drainage systems influence infection rate?

Nomathemba Moyo

Abstract
External ventricular drainage systems are often necessary in neurological and neurosurgical patients. The purpose of this literature review is to review the problem of external ventricular drain related infections resulting from repeated cerebrospinal fluid sampling and manipulation of the drain systems. The aim is to provide an appropriate improved protocol for care of patients undergoing external ventricular drainage treatment. Routine analysis of cerebrospinal fluid is often performed to diagnose external drainage related bacterial meningitis at an early stage. Nurses are routinely instructed to collect cerebrospinal fluid from ventricular catheters for analysis. Does the way in which sampling occurs relate to increased infection?

This literature review will discuss that prophylactic frequent cerebrospinal fluid sampling is of no benefit and increases infection risk and should be limited. It will also provide evidence that duration of the external ventricular drain (EVD) systems does not correlate with infection and therefore the EVD should stay insitu for as long as clinically needed or be removed if infected.

Key Words: *Bacterial meningitis, cerebrospinal fluid sampling, external ventricular drain systems and central nervous system.*

Background
External ventricular drainage (EVD) systems are used as temporary measures to provide reliable means of monitoring intracranial pressure (ICP) and controlling hydrocephalus (Arabi, Memish, Balkhy, Francis, Ferayan, Shimemeri & Almuneef, 2005). Hydrocephalus can be a common problem which occurs in neurosurgical patients (Arabi et al, 2005). The risk factors associated with developing external drainage related bacterial meningitis (ED-BM) are duration of drainage and drain related factors such as site leakage or frequent manipulation of the drain (Lopez-Cortes, Marquez-Arbizu, Jiminez-Mejias, Caballero-Granado, Rey-Romero, Polaina & Pachon, 2000). In order to obtain a diagnosis of ED-BM in patients with external drainage systems, routine analysis of cerebrospinal fluid (CSF) is performed. A diagnosis of bacterial meningitis can be made if there is an increased leukocyte count, high protein concentration and low glucose concentration (Shameen, Vinod-Kumar & Neelagund, 2008). It is currently unknown whether CSF analysis can be used to diagnose bacterial meningitis in patients undergoing EVD system usage or whether external factors influence the results. However, studies have found it difficult to make a comparison of the CSF of patients with EVDs, and those without EVDs due to the underlying disease (Blomstedt, 1987).

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Micro-biological tests remain the gold standard for diagnosing ED-BM, however it is time consuming compared to leukocyte count and chemical analysis. CSF samples are collected routinely from EVD systems for laboratory tests. There have been several studies conducted that discuss the correlation between sampling and infection rate (Crane & King, 2015). However, there have been few studies conducted to identify the most appropriate site for cerebrospinal fluid collection in order to reduce the disruption of the closed EVD system and reduce the risk of infection. It is also controversial whether regular changes of EVDs can reduce CSF infection (Crane & King, 2015; Wong, 2011).

Discussion: Cerebrospinal Fluid Sampling
To investigate the value of several commonly used parameters for prediction and diagnosis of ED-BM in the literature of Rogier, Schade, Janke, Freek, Roel, Ronald, Gesku, Leo, Marc, Van Dijk, Joan, Voormolen, Hans &

Kuijper, (2006), a cohort study was performed in 230 patients who had EVDs to analyse the predictive and diagnostic value of routine CSF sampling. Daily CSF samples were obtained for analysis and the results have shown that leukocyte count, glucose and protein concentrations in the CSF of EVDs with ED-BM were comparable to those of patients with external drains without ED-BM in both groups. The results of CSF have shown that they were heterogeneous during the period of external drainage (Rogier, et al, 2006). Results of patients with ED-BM during the first days of infection were compared with the results of the control group without ED-BM; there were no statistical significant differences. The results were the same with CSF obtained in patients with ED-BM for the three days preceding an active infection when compared with the control group.

Evidence points out that the CSF contents of patients who have recently undergone neurosurgery are often abnormal (Forgacs, Geyer & Freidberg, 2001). The chemical irritation resulting from the presence of blood products in the CSF leads to chemical or aseptic meningitis and disturbs the glucose and protein concentration in CSF. It also increases CSF white blood cell count (Forgacs, et al, 2001). As the blood is reabsorbed from the CSF and infection subsides, chemical disturbances normalise in patients with EVDs that do not develop bacterial meningitis. Therefore, it is expected that CSF parameters will improve during the period of external drainage in patients who do not develop meningitis (Forgacs, et al, 2001).

When analysing the results for the 200 patients with EVDs who did not have ED-BM as a reference, it was found that only a small proportion of patients who developed ED-BM had abnormal values for one of the commonly analysed CSF parameters shortly before or during the course of ED-BM infection. This led to the conclusion that combining the results for different CSF parameters did not increase the diagnosis value of CSF analysis (Rogier, et al, 2006). However this reference has not fully analysed the predictive value for ED-BM.

Daily analysis of CSF was performed on 130 patients in the literature by Pfisterer, Muhlbauer, Czech & Reinprecht, (2003). The leukocyte count for both control group and patient group was found to be heterogeneous. There was no difference in leukocyte count between the patients with ED-BM and patients without ED-BM. However the literature does not state whether glucose and protein were analysed in the report.

To assess possible causes of risk factors for infection related to external ventricular drainage, a study was carried out by Hoefnagel & Dammers, (2008). The method involved two hundred and twenty eight patients in the period from January 1993 until April 2005 (over a 12 year period). Reviews were collected covering patient information, including disease demographics, external ventricular drain data and infection occurrence. The data was compared and included in a risk analysis study. Results of this study have shown that the mean age was 56 years. Analysis of both sexes has shown equal distribution. Most indications for insertion of EVD systems were for hydrocephalus caused by intraventricular haemorrhage which accounted for 48% of patients. Infection rate was 23.3% and the authors found that duration of the EVD systems was a risk factor for infection. Frequency of CSF sampling was also a risk factor for infection. The results indicate that there was a relatively high percentage of EVD-related infection (Hoefnagel & Dammers, 2008). Limitations to the study included selection bias and some missing values.

However, further analysis supported a relationship between the drain duration and frequency of CSF sampling. The risk for infection increases with the duration of the drain, hence it has been suggested that sampling of CSF should be done less frequently (Schade, Schinkel, Visser, Van Dijk, Voormolen & Kuiper, 2005).These studies lend support for the development of protocols for EVD management to reduce infection.

Discussion: Drain Duration

The most common complication of EVD systems is CSF infection (Kim, Uttley, Bell, Marsh, Moore, 1995). Neurosurgical patients with EVDs are at high risk for developing device related nosocomial infections (Lopez, et al, 2000). The use of closed drainage systems may decrease the rate of infection (Lucey & Myburgh, 2003). Efforts must be made to distinguish clinically relevant CSF infections from contamination and catheter colonisation (Lozier, Sciacca, Romagnoli & Connolly, 2002). Infection may lead to removal and replacement of a new EVD system. Predisposing patient factors associated with high risk of infection include craniotomies, depressed skull fractures, intraventricular haemorrhages, catheter duration, catheter

irrigation, site leaks and frequent sampling of CSF (Korineck, Reina, Boch, Rivera, De Bels & Puybasset, 2005).

Mayhall, Archer, Lamb, Spadora, Baggett, Ward & Narayan (1984), recommend elective revision of external ventricular drainage system on day five post insertion to reduce the risk of infection. However, other larger studies have revealed that the duration of the EVD in a patient has no effect on the risk of infection (Lo, Spelman, Bailey, Cooper, Rosenfeld & Brecknell, (2007). To evaluate the roles of duration a catheter remained inserted and that of multiple catheter insertions in the literature of Lo, et al, (2007), a study was carried out at the Alfred Hospital in Victoria, Australia. Data was obtained for patients who had undergone EVD system placement between the period of October 2002 and May 2004 from the intensive care database. A record was kept for each patient, including age, conscious state, diagnosis, presence or absence of an open skull fracture, diabetes mellitus status and bacteraemia within fourteen days of EVD insertion. The outcome measure of death prior to discharge was also recorded.

Results have shown that there were two hundred patients who had EVD systems inserted during this period whilst in the intensive care unit. This group of patients had a mean age of 41 years (ranging from15-87 years). Seventy-four per cent had traumatic brain injuries; nineteen per-cent of these patients had open skull fractures. The remaining patients had presented with spontaneous subarachnoid or intraventricular haemorrhage. None of these patients had a primary diagnosis of intracranial or spinal sepsis or any recorded infection within fourteen days of admission. In these patients, twenty one had nosocomial EVD-associated CSF infections. Five patients had positive cultures for infection in their CSF but no other evidence of infection was considered for colonisation of the EVDs. Diabetes, patient's age and the presence of a skull fracture did not present any significant risk factors for infection (Lo, et al, 2007).

The literature is conflicting as to whether drain duration increases risk of EVD associated infections (Pfisterer, et al, 2003). This is reported by Sundberg, Kjellquist, Lumberg & Ponte, (1972) and has not changed since that period. They analysed 1586 patients and found that prolonged drain insertion was not a risk factor. Routine changing of EVD catheters after five days did not reduce the risk of CSF infection and did not improve outcome (Winfield, Rosenthal, Kanter & Casella, 1993).

However, the work by Mayhall, et al, (1984) presents a stark contrast to these findings. Despite these disagreements, there has been agreement that EVD- associated CSF infection is often acquired at the time of insertion when skin organisms enter the sterile intracranial compartment (Khanna, Rosenblum, Rock & Malik (1995). Retrograde colonisation may also occur as a result of continued externalisation of the cerebrospinal space during sampling (Khanna, et al, 1995).

Conclusion

Study results have shown that frequent analysis of CSF has no predictive value for ED-BM. Routine chemical analysis of CSF samples to screen patients with EVDs for ED-BM has shown no additional value. The analysis of an isolated CSF sample in a patient in whom ED-BM is suspected also has no additional value due to unclear cut-off levels. This lends support to diagnosis of ED-BM based only on the results of microbiological cultures It may be worthwhile to reduce the frequency of CSF sampling on patients with EVDs. The risk for infection increases with the duration of the drain, hence it has been suggested that sampling of CSF should be done less frequently.

It has been proven in the literature reviewed that there is a well-established relationship between the duration of EVDs and the occurrence of EVD-related infections. Studies have shown that using standard protocols helps to reduce the rate of infection. Using closed drainage systems may also decrease the rate of infection. Sample size has not been mentioned in the results and this may be a limitation of the literature. Routine CSF sampling should be avoided, unless there is suspicion of infection, in the presence of fever of unknown origin or mental status change. Multiple external drain insertion is associated with an increase in infection rate. This practice should be abandoned. There has not been much change in the technique of EVDs throughout the years, hence earlier literature still applies. From a nurse's perspective, a standard protocol for clinically managing EVD systems should be established and no routine CSF samples should be undertaken unless necessary. The EVD system should also be handled under strict aseptic practice.

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Leptomeningeal Carcinomatosis: Cerebral spinal fluid tumours.

Megan Stone

Abstract
Leptomeningeal Carcinomatosis (LC) is the dissemination of cancer, commonly breast, lung, melanoma, acute lymphoblastic leukaemia and Non-Hodgkin lymphoma occurring through either direct extension from surrounding tumours or metastasis of a preexisting, parenchymal central nervous system tumour. A rise in the diagnosis of leptomeningeal disease has been seen with increased survival rates of cancer due to improved medical treatment, with 5-8% of patients with cancer going on to develop LC.

Leptomeningeal Carcinomatosis spreads to the meninges, the outer covering of the brain and spinal cord, directly migrating into the cerebral spinal fluid (CSF), arachnoid and pia mater. This migration of tumour cells occurs throughout the arachnoid vessels or choroid plexus into the surrounding outer layers extending into the CSF. On entry into the CSF, tumour cells are infiltrated in a diffuse or multifocal manner where the leptomeninges cover the surface of the brain and spinal cord. This covering causes the meninges to become irritated causing patients to exhibit signs of photophobia, neck stiffness, neurological decline and cranial nerve defects. LC has a significant morbidity and mortality rate with a median survival of 4-6 weeks if untreated and 2-3 months if treated. Diagnosis is based on analysis of the cerebral spinal fluid, through detection of positive cytology of LC tumour cells, elevated protein and CSF pressures. Magnetic resonance imaging findings identify areas of meningeal enhancement indicative of meningeal irritation.

The neuroscience nurse role in the patient care includes providing a supportive environment and thorough assessment of vital and neurological signs. Treatment aims to improve or maintain a patient's neurological status while prolonging survival and palliation. The literature review will highlight the diagnosis, progression and treatment for LC to further increase awareness and inform neuroscience nurses of increasing trends in management.

Key Words: *Leptomeningeal carcinomatosis, meninges, cerebral spinal fluid, tumour.*

Introduction

Leptomeningial carcimomatosis (LC) was first identified in the 1870 by Ebert in a patient with lung cancer, and was named in 1902 by Sieffert as meningitis carcinomatosa (Schiff, Kesari & Wen, 2008). Sixteen thousand patients globally will be diagnosed with LC each year (Abrey, 2002). There has been a significant rise in the incidence of LC since 1970, thought to be due to improvements in the diagnostic techniques and neuro imaging available in today's healthcare system (Schiff, Kesari & Wen, 2008). The rise in diagnosis is the direct result of patients surviving their primary cancer. Hence there is a need for health professionals to be aware of LC and the clinical presentation, in order to provide appropriate care and interventions along with the potential for future research and cure.

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Currently epidemiological studies suggest that 3-8% of patient with solid tumours will develop leptomeningeal metastasis (LM) throughout their illness (Abrey, 2002). Twenty per cent of patients are diagnosed on autopsy. These are patients undiagnosed and asymptomatic (Le Rhun, Taillibert & Chamberlain, 2013). It was determined that the rise in diagnosis is due to increased survival rates of cancer as a result of improved medical treatment. All cancers have the potential to metastasise into the meninges causing LM. The leading primary cancers associated with LM include lung cancer (10-26%), melanoma (5-25%), gastrointestinal (4-14%), cancer of unknown primary (1-7%) and breast cancer (12-35%) (Le Rhun et al 2013).

The brain and spinal cord are surrounded by three membranes referred to as the meninges, composed of the dura mater being the pachymeninges, arachnoid mater and pia mater referred to as the leptomeninges. The space between is referred to as the subarachnoid space, containing the CSF and the Circle of Willis providing arterial blood supply. Approximately 140ml of cerebral spinal fluid surround the brain and spinal cord at any one time, replenishing approximately five times a day (Hickey, 2014). CSF is produced in the choroid plexus of the third, fourth and lateral ventricles. Tumours cells gain entry into the CSF and subarachnoid space by metastatic seeding. Entry is gained by hematogenous spread to the choroid plexus onto the leptomeninges, primary hematogenous metastasis through leptomeningeal vessels, metastasis from the Batson venous plexus, retrograde dissemination, centripetal extension or direct extension from contiguous tumour deposits (Gleissner & Chamberlain, 2006; Le Rhun et al 2013). Once tumour cells have invaded the leptomeninges, the flow of CSF causes the seeding and infiltration of tumour cells in a diffuse and multifocal manner (Le Rhun et al 2013). Greatest infiltration occurs in the basal cisterns and dorsal surface of the spinal cord and cauda equina.

Case Study

Patient X presented to hospital with increased confusion, ataxia and lower limb mild weakness. Histology included breast cancer where a left mastectomy and lymph node clearance was completed in the 14 months prior to diagnosis. Symptoms of leptomeningeal metastases are caused by pressure from the metastases placed on the nerves that run across the meninges in both the head and the spine. This includes those running from the spinal cord out to the body, and is dependent on the location of the metastases. Symptoms that occur simultaneously in both the head and the spine suggest a diagnosis of leptomeningeal metastases (LM). Leptomeningeal metastases can also cause hydrocephalus, a condition that occurs when the metastatic cancer interferes with the flow of cerebrospinal fluid around the brain. As the spinal fluid continues to be produced, an increase in the intracranial pressure is then seen as the arachnoid villi are no longer able to effectively reabsorb the CSF.

Clinical presentation occurs in a pleomorphic and multifocal manner with neurological signs and symptoms emerging over days to weeks. Symptoms correlate to the region of malignant cell infiltration in the central nervous system (CNS). The clinical manifestation of LM can be caused by several different pathophysiological mechanisms and can be characterised into the following main categories:

- cerebral hemisphere dysfunction causing a mass effect due to the invasion of the leptomeninges and associated inflammation thus a raised intracranial pressure (ICP) and occlusion of CSF flow occurs.
- cranial nerve and spinal cord symptoms: Through direct involvement of the tumour.
- exiting nerve roots (Demopoulos & Brown, 2014; Drappatz & Batchelor, 2007; Hickey, 2014).

A recent study described the signs and symptoms of 150 patients with solid tumour LM (Clarke, Perez, Jacks, Panageas & DeAngelis, 2010; Clarke 2012; Demopoulos & Brown, 2014). Between 30-50% of patients describe headache as their initial symptoms (see Table 1). Headaches can be associated with raised ICP or meningeal irritation resulting in neck stiffness and pain, along with signs of nuchal rigidity. Headaches occurring due to a raised ICP are known to be associated with nausea, vomiting and dizziness.

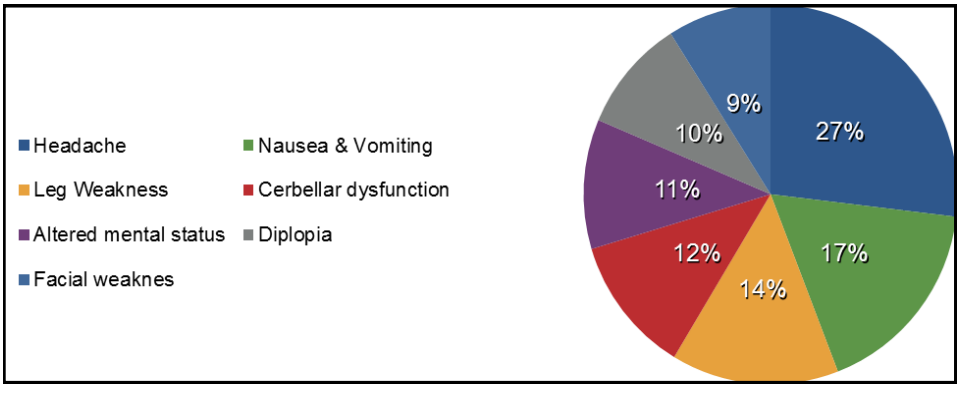

Table 1 *(Above): Initial symptoms of LM as reported by patients.*

These symptoms commonly occur in wave patterns caused by changes in position due to arachnoid villi failing to reabsorb CSF thus resulting in hydrocephalus. Altered mental status accounts for 11% of presenting symptoms with confusion, forgetfulness, disorientation, lethargy or personality changes the most common. These changes in mental state are referred to as an encephalopathy, the result of hydrocephalus, seizure activity, cerebral dysfunction or a combination of those. When cranial nerves are directly invaded by malignant cells within the subarachnoid space, cranial neuropathy occurs.

The first intervention in diagnosis is a lumbar puncture to obtain a CSF specimen. Malignant cells are detected in 70-89% of CSF specimens (Le Rhun et al, 2013). Repeated samples are often necessary as only 50% of patients with LM on initial lumbar puncture exhibit positive cytology. Patients are 25% more likely to have positive cytology on second lumbar puncture. Multiple lumbar punctures are often required due to the meningeal dissemination, where tumour cells are localised in the brain rather than the spinal cord hence movement of CSF must occur in order to obtain a positive sample. Therefore negative CSF cytology is directly related to the flow of malignant cells within the spinal cord CSF when lumbar punctures are taken.

Clinical finding on CSF analysis includes, an elevated opening pressure of > 200mm Hg in 57% of patients, decreased glucose concentration, high protein concentration, lymphocytic pleocytosis and a positive cytology for malignant cells (Chamberlain, 2008; Drappatz & Batchelor, 2007; Palma, Fernandez-Torron, Esteve-Belloch, Fontes-Villalba, Hernandez, Fernandez-Hidalgo, Gallego Perez-Larraya & Martinez-Vila, 2013).

A positive MRI assessment of an undiagnosed patient includes a whole CNS scan where a complete neuraxis and A T1 C+ gadolinium enhancement is completed in order to obtain the primary diagnosis (Drappatz & Batchelor, 2007).

Typical findings include a thin diffused enhancement along the contours of the gyri and sulci with multiple nodular deposits in the subarachnoid space in 30-50% of cases (Le Rhun et al, 2013). LM enhancement can be found in cerebellar folia, cortical surface, basal cisterns and ventral surface along the brainstem, indicating abnormal thickening and enhancement. However these are not the most common sites of LM. Between 15-25% of patients present with spinal enhancement, showing linear or nodular enhancement along the spinal cord or cauda equina where clumping of nerve roots can be seen (Le Rhun et al, 2013). CT is an uncommon practice due to poor diagnostic value, with significantly reduced sensitivities of 23-38% when compared with the MRI.

Prognosis

The overall prognosis for a patient with LM is poor; patients have an expected survival rate of 4-6 weeks if untreated and 4-6 months if treated. Research indicated that 14% of LM cases occur as a result of an advanced primary breast cancer with no well-established prognostic makers for patients with LM other than the presence of malignant cells within the CSF and low performance in Karnofsky performance status scale (Palma, et al 2013).

Treatment

Due to current poor prognostic outcomes, treatment aims to reduce mortality through improving and stabilising the patient's neurological status, while maintaining neurological quality of life (Gleissner & Chamberlain, 2006). Current treatment plans are comprised of intrathecal or systemic chemotherapy and focal radiation therapy with the goal to reduce size of tumours and growth. Statistically 20% of patients who receive treatment will respond (Demopoulos & Brown, 2014; Palma et al, 2013). Suitable patients will undergo insertion of a ventriculo-peritoneal shunt to alleviate hydrocephalus symptoms.

Chemotherapy is the only treatment which allows for simultaneous treatment of the brain and spinal cord. Intrathecal administration is defined as injecting chemotherapy into a cerebral- access device inserted surgically or via repeated lumbar punctures (Demopoulos & Brown, 2014). Intrathecal administration allows for an even distribution throughout the subarachnoid space and is not required to cross the blood brain barrier (Drappatz & Batchelor, 2007). Access devices avoid the risk of epidural or subdural hematomas. Methotrexate and thiotepa are the most effective chemotherapies in the treatment of LM patients with metastasis from primary breast cancer (Demopoulos & Brown, 2014; Drappatz & Batchelor, 2007). Chemotherapy is administered initially twice weekly for three weeks then weekly for four week followed by monthly (Demopoulos & Brown 2014).

Radiation therapy involves field radiotherapy

to symptomatic sites of the disease, bulky disease and sites where CSF flow is obstructed. The aim is to shrink tumour cells, stabilise neurological symptoms, establish CSF flow and relieve pain caused by radiculopathies (Demopoulos, 2014).

Nurses must consider the adverse effects of chemotherapy and radiation therapy. Administration of chemotherapy may result in raised ICP and impaired CSF flow. Nurses must observe for acute signs of fever, headache, nuchal rigidity, seizures, dizziness or blurred vision. Subacute signs include transverse myelitis, cranial nerve palsies, seizures or coma (Demopoulos, 2014). When administering radiation therapy the nurse should be aware of increased patient fatigue, changes in skin colour and flushing of skin along with skin tension and Lhermitte's sign - an electrical signal running from the back of the cervical spine to the tips of the feet, when the neck is bent forwards (Demopoulos, 2014).

When selecting patient treatment options, chemotherapy or radiation therapy is considered and each play a significant role in the treatment of LM. Research indicates that intra CSF chemotherapy is better on smaller LC tumours due to the thickness of cells and diffusion capacity (Demopoulos, 2014). Radiation therapy is better at treating large bulky tumours and assisting in the restoration of CSF flow (Demopoulos, 2014). Combination therapy is currently the choice of treatment.

Nurse's Role

When nursing a patient with LM the holistic approach is essential due to the array of symptoms a patient can display. Leg weakness and difficulty walking are common symptoms, thus ongoing assessment of mobility status including the need for walking aids, wheelchairs or hoisting devices. Referral to an occupational therapist before discharge is also important. Regular speech and swallowing assessments should be performed, as LM can increase the risk of aspiration as cranial nerve deficits impair the ability to chew and swallow. Constipation is a significant issue for LM patients as decreased mobility, pain medications and chemotheraphy contribute to constipation (Drappatz & Batchelor, 2007). Nursing staff should commence a bowel regime including a high fibre diet, adequate oral intake and aperients.

Conclusion

As health professionals, it is important to note that in 3-8 % of patients with solid tumours, the chance of developing LM is a real consideration. In Patient X's case, due to a delayed diagnosis and intervention, prognosis and outcome was poor.

MRI and lumbar puncture allows for earlier diagnosis and intervention, while chemotherapy and radiation therapy improve longevity and quality of life. Nurses are critical to the care of the LM patient. An understanding of the disease process and care required will ensure quality of life during the progression of the disease. With cancers increasing in today's society and certain treatments readily available, health professionals will have an increased awareness of LM, therefore with the ability to identify and treat earlier.

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Clinical and health economic benefits of out-patient lumbar microdiscectomies in Australia.

Alison Magee, Ivan P Bhaskar, Paul Ilett, Michael A Murphy, Yi-Yuen Wang

Abstract

Introduction: This study reports on the clinical, nursing and health outcomes on the out-patient lumbar microdiscectomy program at a single institution. A multi-disciplinary team approach to the pre- and post-operative planning and education is key to the success of this program.

Methods: A retrospective review of prospectively collected data for two patient groups (out-patient microdiscectomy and in-patient microdiscectomy) over a two-year period in a single institution was performed. Clinical, demographical, surgical and economic measures were collected including a 10-point visual analogue pain scale (VAS), patient satisfaction, direct and indirect costs of treatment. Patients included had a single level lumbar disc prolapse with persistent disabling sciatica of more than 8 weeks consistent with failure of conservative measures.

Results: Twenty-one out-patient and forty-one in-patient microdiscectomy patients were treated over this period. Post operatively pain levels showed a significant improvement in VAS levels from 5.2 ±2.9 to 1.6 ±0.8 and 0.7 ± 0.8 at day 1 and 7 post-operatively respectively. This was not different across both groups. Patient satisfaction was high in both surgical groups. There was a significant cost savings in out-patient lumbar micro-discectomy with the majority of savings coming from costs associated with staff (nursing, allied health and medical) funding. There was successful discharge 100% of out-patient microdiscectomy patients without readmission.

Conclusion: Outpatient lumbar microdiscectomy is a viable option in Australia. It demonstrates no difference in patient outcomes as compared to in-patient lumbar microdiscectomies and has high patient satisfaction outcomes. There are significant benefits in terms of health economics and nursing care in establishing an out-patient lumbar microdiscetomy program.

Keywords: *Microdiscectomy, outpatient, economic*

Introduction

Lumbar microdiscectomies are the gold standard in the surgical treatment of patients with prolonged sciatica secondary to a compressive lumbar disc prolapse. Surgery is indicated following failure of conservative management inclusive of rest, physical therapies and percutaneous therapeutic interventions such as epidural or foraminal cortisone injections (Kreiner, Hwang, Ease, Resnick, Baisden, Bess, Cho, DePalma, Dougherty, Fernand. Ghiselli, Hanna, Lamer, Lisi, Mazanec, Meagher, Nucci, Sembrano, Sharma, Summers, Taleghani, Tontz & Toton, 2014). Successful relief of sciatica occurs in over 90% of surgical candidates and recovery classically entails an overnight stay (1-2 nights) admission to hospital and gentle mobilization in the ensuing 4-6 weeks (Aichmair, DU, Shue, Evange, Sama, Hughes, Isbl, Burket, Cammisa & Giradi, 2014; Koebbe, Maroon, Abla, El-Kadi & Bost 2002. Soliman, Harvey, Howes, Seibly, Dossey & Nardone, 2014).

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The advent of the operative microscope has allowed micro-surgical techniques to be performed for surgical lumbar disc disease with studies showing early mobilization, no sitting restriction and activity as beneficial in the recovery phase post-lumbar discectomy (Danielsen, Johsen, Kibsgaard & Hellevik 2000; Dolan, Greenfield, Nelson & Nelson, 2000). This has led to the concept of out-patient lumbar microdiscectomies which have now been performed internationally with excellent clinical outcomes (Gonzalez-Castro, Shetty, Nagender & Greenough, 2002; Abou-

Zeid, Palmer & Gnanalingham, 2014; Singhal & Bernstein, 2002). Within Australia, lumbar microdiscectomy surgery is invariably performed in an in-patient model, despite the potential health economic benefits of out-patient lumbar microdiscectomies. This paper reports on the clinical and health economic outcomes following the establishment of an out-patient lumbar microdiscectomy program at a single institution.

Methods

A retrospective review of prospective collected data including clinical, radiological and surgical details, was undertaken on consecutive patients undergoing out-patient lumbar microdiscectomies between July 2011 and December 2013. All surgeries were performed by the senior spinal trainee or spinal neurosurgeon in a single institution with indication for surgery being persistent disabling sciatica (duration more than eight weeks) secondary to a radiologically confirmed lumbar disc prolapse. Inclusion criteria for this study included all adult patients aged above 18 years (no upper age limit) with single level lower lumbar disc prolapse (L3/4 L4/5 or L5/S1). Exclusion criteria included non-elective surgery, a history of chronic pain (prolonged opioid use >12 months), substance abuse, previous spinal infection, or geographically distant patients living more than 200kms from the institution. Data was similarly collected for a control group of consecutive patients undergoing in-patient lumbar microdiscectomies at the same institution over the same time period.

Clinical outcomes

Visual analogue pain scores were obtained pre-operatively and post-operatively at six weeks with patient satisfaction scores obtained at the same post-operative review. Patient satisfaction was based on a four-point grading system with 1 being very satisfied, and 4 being very unsatisfied. All patients were contacted at a minimum of twelve months post-surgery for assessment of recurrent sciatica with recurrent disc prolapses identified following repeat magnetic resonance imaging (MRI) where clinically indicated.

Economic outcomes

Direct and indirect hospital costs were obtained using the PowerPerformance Manager system (Power Health Solutions, SA Australia) for each individual case inclusive of breakdown of costs for in-hospital services (ie theatre costs, nursing/allied health time, imaging etc) and out-patient services (ie pre- and post-operative assessments). Indirect hospital costs were measured for those departments that do not result in direct patient contact, but are a necessity for the hospital to function (ie payroll, finance, decision support units etc). Costs were calculated using the accounting methodology of 'Simultaneous Equation' based on using statistics within the costing system to allocate indirect costs to direct patient care areas.

Out-patient lumbar microdiscectomy protocol

A surgical treatment protocol was established as depicted in Figure 1. In short, all patients consented for out-patient lumbar microdiscectomies were subject to a pre-operative physiotherapy session encompassing education, physical assessment and implementation of pre-operative treatments. Patients were then scheduled for surgery with the proviso they reach the recovery room post-operatively by midday. A second physiotherapy contact was established following that with discharge from hospital completed within six hours post-operatively. For the first ten patients subjected to out-patient lumbar microdiscectomies, a follow-up phone assessment was made by the physiotherapist, however this was ceased due to the lack of any identifiable benefit from this process.

Each patient was then seen in the post-operative clinic at six to eight weeks by the physiotherapist running an out-patient clinic in parallel to the senior spinal trainee with any concerning clinical issues immediately referred on to the medical staff.

Statistics

Data was processed using commercially available statistical software (SPSS, Inc., Chicago, IL) with normally distributed parametric data compared using Student's t-test or ANOVA and post-hoc Bonferroni tests.

Results

Demographics and Pathology

Twenty-one patients underwent outpatient lumbar microdiscectomy during the study period. Mean ± SD age of the patients was 33.3 ± 9.4 years (Range: 26 – 66) with a slight male predominance (M:F = 12:9). Mean ± SD BMI of patients was 29.9 ± 6.5. All cases were single level with the majority being at L5/S1 (n=11) followed by L4/5 (n=9) and L3/4 (n=1). Two cases were redo-surgeries and there was no difference in the

side of disc prolapse (Right:Left = 12:9).

Forty-one patients underwent in-patient lumbar microdiscectomy during the study period. Mean ± SD age of the patients was 40.4 ± 13.5 years (Range: 18 – 65) with a slight female predominance (F:M = 23:18). Mean ± SD BMI was 28.5 ± 6.3. Similar to the day-case cohort, the majority of surgeries were at L5/S1 (n=25) followed by L4/5 (n=15) and L3/4 (n=1) without any side preponderance. Only one case was a redo-surgery. Average hospital length of stay was 1.7 ± 1.3 days (Range: 1 – 6) with the majority staying one night (n=23). Prolonged length of stay more than one day was due to increased post-operative back pain.

Surgical Data

A higher proportion of out-patient lumbar microdiscectomy patients underwent fragmentectomies as opposed to discectomies compared to overnight-stay lumbar microdiscectomies (52% vs 32%). Operative time was significantly longer for in-patient lumbar microdiscectomies (77.6 ± 22.3 mins) compared to day-stay lumbar microdiscectomies (56.4 ± 14.4 mins; $p<0.05$). There was one CSF leak in the entire study (in-patient cohort) and no intra-operative nerve injury or wound infection.

Clinical Outcomes

No patients failed discharge following out-patient lumbar microdiscectomy. All patients were discharged from clinics following the post-operative review. There was no early (within three months) recurrence of disc prolapse in either cohort. Patient satisfaction was high in both cohorts with only three patients (one out-patient, and two in-patient) being very unsatisfied with their outcome (Table 1).

Patient Satisfaction Scale	Day-stay	Overnight
1	15	28
2	5	11
3	0	0
4	1	2

Table 1 (Above): *Patient satisfaction scores for each cohort (1: Highly satisfied; 2: Satisfied; 3: Unsatisfied; 4: Highly unsatisfied).*

Of these, the out-patient presented with increased L5 radiculopathy following an L5/S1 day-stay lumbar microdiscetcomy at two years post-operatively and underwent a lumbar fusion procedure. One in-patient suffered from persistent pain despite adequate neural decompression, whilst the last patient had persistent numbness in the L5 distribution with mild weakness in the same distribution (MRC 4+/5). There was no difference in outcomes when stratifying for level and position of disc prolapse, duration or type of surgery.

Post-operative pain levels demonstrated a significant progressive improvement in back VAS levels from 5.2 ± 2.9 to 1.6 ± 0.8 and 0.7 ± 0.8 at day 1 and 7 post-op respectively.

Economic Outcomes

There was a significant cost saving in undergoing out-patient lumbar microdiscectomy in our institution. Mean ± SD total cost for out-patients ($3545.69 ± $633.82) and in-patients ($6370.82 ± $1397.71) revealed a total saving per patient of $2825.14 ($p<0.0001$). The majority of savings came from costs associated with staff funding. In-patients were also more likely to undergo further investigations and treatment as shown by a significantly increased pathology and pharmaceutical cost (Table 2).

Discussion

Out-patient lumbar spinal surgery for radicular disc disease has been reported in North America as early as 1994 with successful discharge achieved in ninety percent (Bookwalter, Busch & Nicely, 1994). More recently, Abou-Zeid et al., (2014) reported on the initial United Kingdom experience of fifty patients with successful discharge occurring in thirty six patients. Our program was achieved successful discharge in one hundred percent of patients. Whilst the careful selection criteria is believed to have helped, we believe the intensive pre-operative multi-disciplinary team approach and education of patients was vital to achieving this.

Previous reports have suggested provision of adequate patient information and proper preparation of all clinical staff involved are key issues in successful application of out-patient lumbar microdiscectomies (Gonzalez-Castro, et al., 2002). In our study protocol, each patient was consented for surgery by the operating surgeon, and was individually assessed and educated by the neurosurgical physiotherapist in a separate 45 minute consultation. Key-points emphasized to the patients were the goal of same-day discharge, as well as goal of post-operative pain control rather than complete cessation of pain. Similarly

	Out-patient (AUD)	**In-patient (AUD)**		**p-value**
Total Cost	3545.69 ± 633.82	6370.82 ± 1397.71		
- direct	2970.53 ± 556.98	5216.10 ± 1157.00		
- indirect	575.16 ± 91.59	1154.72 ± 258.80		<0.0001
Theatre Cost				
- direct	2413.28 ± 452.19	3089.84 ± 786.31		
- indirect	322.80 ± 44.55	369.12 ± 98.83		0.003
Medical Cost (Surgical)				
- direct	546.76 ± 236.10	854.35 ± 379.08		
- indirect	129.34 ± 55.70	203.93 ± 88.55		0.005
Medical Cost (Non-surgical)				
- direct	72.48 ± 24.73	485.26 ± 265.20		
- indirect	39.80 ± 20.28	300.65 ± 165.38		<0.0001
Allied Health				
- direct	97.37 ± 38.50	131.270 ± 100.47		
- indirect	22.54 ± 9.06	29.60 ± 20.56		0.222
Nursing				
- direct	190.39 ± 68.60	1277.39 ± 512.85		
- indirect	40.14 ± 12.41	195.45 ±70.43		<0.0001
Radiology				
- direct	93.15 ± 2.37	207.70 ± 277.86		
- indirect	12.15 ± 0.17	26.42 ± 37.00		0.121
Pathology				
- direct	227.37 ± 38.50	90.79 ± 76.38		
- indirect	32.54 ± 9.06	14.72 ± 14.24		<0.0001
Pharmacy				
- direct	114.19 ± 34.38	212.18 ± 78.03		
- indirect	5.26 ± 5.88	7.95 ± 7.32		<0.0001

Table 2 (Above): *Costings (direct and indirect) of out-patient versus in-patient lumbar microdisectomies.*

education of the anaesthetics team and theatre nursing staff allowed for positive reinforcement to the patients at the immediate post-operative setting (Figure 1).

Post-operative pain control is the other factor that may adversely affect success of an out-patient lumbar microdiscectomy program. Pre-operative education of the goals of operative site pain control as opposed to complete pain relief is important in this setting. We routinely infiltrate 20-30mls of 0.25% Bupivacaine into the wound and paraspinal muscles upon wound closure. In addition, patients are pre-medicated with paracetamol upon induction and discharged with regular paracetamol (1g qid strict) and endone (5-10mg qid/prn) for one weeks duration. Using this analgesic regime, recovery room pain control was optimized resulting in decreased recovery room nursing requirements and earlier discharge. Similarly, no patients were readmitted following out-patient lumbar microdiscectomy and a five-fold decrease in back VAS was achieved by day 7 post-op.

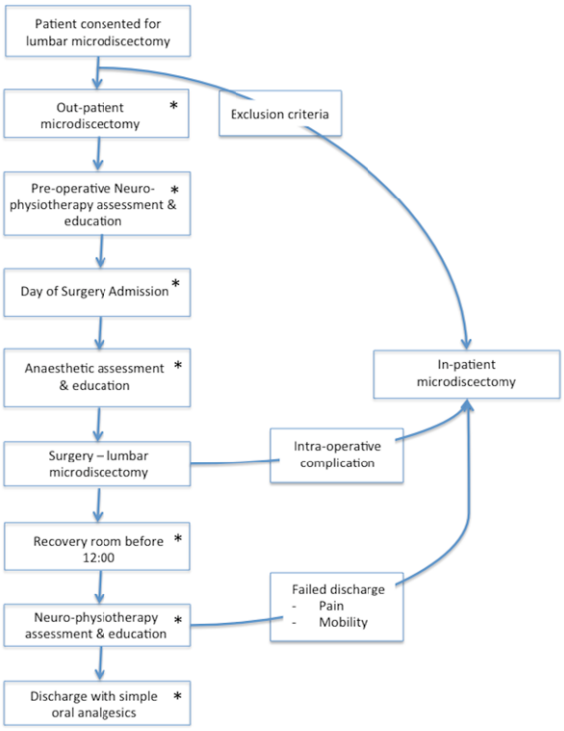

Figure 1 (Above): *Outpatient lumbar microdiscectomy protocol. * denotes patient contact where outpatient education and assessment occur via medical, nursing or allied health staff.*

During the post operatively period no sitting restrictions were prescribed for the patients and early mobilization was encouraged. There is no consensus in current literature with regards to post-operative mobilization and all patients in this study were encouraged to sit for as long as comfortable and gradually build up the walking over the four week period. The patients were each given exercises and education from the physiotherapist and nursing staff prior to discharge. It is believed that this reinforced education contributed significantly to the successful implementation of this out-patient program.

Detractors of an out-patient lumbar microdiscectomy program suggest poorer outcomes, increased complication rates or increased recurrence rates for disc prolapse. Pugely, Martin, Gao & Mendoza-Lattes (2013), reviewed 4310 lumbar discectomy cases (both day-stay and overnight) selected from the American College of Surgeons National Surgical Quality Improvement Program database. This review found a significantly higher complication rate for in-patient versus out-patient cases (6.5% vs 3.5%; odds ratio 1.521) (Pugel, et al., (2013). Abou-Zeid et al., (2014) reported excellent improvement of resolution of pre-operative symptoms in ninety-four percent. Whilst we acknowledge the relatively small number of patients in this study, we did not find any difference in complication rates in our cohort of patients. Clinical outcomes were also excellent with patient satisfaction high in both groups.

The advantages of implementing an out-patient lumbar microdiscectomy program are clear with regards to health economics. A demonstrable average saving of $2825.13 per patient is seen in our cohort of out-patients as opposed to in-patient lumbar microdiscectomies. The increased cost of in-patient treatment is mainly borne by increased medical and nursing care requirements with a lesser increase in pathology and pharmaceutical costs. The implementation of specialized pre- and post-operative neuro-physiotherapy clinics is cost neutral when offset against the in-patient physiotherapy requirements post-operatively (Table 2). Coupled with the improved hospital bed access by freeing up an in-patient bed, there are positive flow-on effects to health access in general.

Conclusion

Out-patient lumbar microdiscectomies are a viable option in Australia following appropriate multi-disciplinary protocols. It demonstrates no difference in patient outcomes as compared to in-patient lumbar microdiscectomies and has high patient satisfaction outcomes. Health economic and access improvements are also seen in this setting.

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- **WFNN Hawaii Conference**
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  Sydney.
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This prize is in honour of our colleague Louie Blundell and will be awarded for the best neuroscience nursing paper by a student submitted to the Australasian Neuroscience Nurses Association (ANNA) for inclusion in the Australasian Journal of Neuroscience by the designated date each year. The monetary value of the prize is AUD$500.

Louie Blundell, was born in England, and although she wanted to be a nurse she had to wait until after World War II to start her training as a mature student in her late twenties. Later she and her family moved to Western Australia in 1959. She worked for a General Practice surgery in Perth until a move to the Eastern Goldfields in 1963. Subsequently, she worked at Southern Cross Hospital and then Meriden Hospital. During this time she undertook post basic education to maintain her currency of knowledge and practice, especially in coronary care.

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.

She felt strongly that education was important for women and was a strong supporter and advocate of the move of nursing education to the tertiary sector, of post graduate study in nursing and the development of nursing scholarship and research, strongly defending this view to others over the years.

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