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The Role of Peripheral Nerve Blocks in the Interdisciplinary Care of Children with Chronic Pain: A Case Series and Review of the Literature

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1. Introduction

Chronic pain of childhood is an extremely complex condition which can lead to damaging effects on physical and social wellbeing. Some children with severe chronic pain embark on a downward spiral of decreased physical, psychological and social functioning. This includes loss of mobility and inability to participate in physical and sporting activities, poor sleep, difficulty concentrating on school work, school absenteeism, social isolation and family stress. As chronic pain persists the child can experience increased pain intensity, distress, anxiety and depression. When enmeshed in this disordered lifestyle the child and their family require coordinated integrated care. The interdisciplinary team management approach, based on pharmacology, physiotherapy and psychology, is now well established to be the standard of care for children with chronic pain. Treatment goals are targeted to individual children after careful consideration of the history and examination. In appropriately selected children peripheral nerve blocks can provide immediate and effective pain relief. This chapter will present a referenced review of the literature on interdisciplinary paediatric chronic pain management whilst highlighting the role of peripheral nerve blocks. The case histories of eight paediatric patients with chronic pain who gained significant relief from peripheral nerve blocks will be presented.

The International Association for the Study of Pain (IASP) defines pain as "an unpleasant sensory or emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (1986). One defining characteristic of pain is its duration. Acute pain is relatively short-term pain that typically lasts until the underlying cause has been identified and treated. On the other hand, chronic pain is understood to mean prolonged pain or "pain that extends beyond the expected period of healing" (Turk & Okifuji, 2001) and while defined time frames that determine a diagnosis of chronic pain vary, the definition adopted by most studies, including those cited here, is pain lasting longer than three months.

Chronic pain can have its roots in one or a combination of types of pain mechanism. Types of pain include nociceptive, inflammatory, neuropathic or psychogenic pain (DSM-IV "Pain Disorder"). Extreme caution is required before labelling a patient with a diagnosis of

psychogenic pain, functional pain or somatisation disorder as the true prevalence of these conditions is extremely low. Most patients with chronic pain will have psychosocial elements to their suffering, but this does not mean that the pain is "psychogenic".

Nociceptive pain is felt in response to noxious stimuli, such as the trauma associated with injury, oncological and other disease processes as well as following surgery. This pain functions as a protective and interpretable symptom: 'it hurts here' means 'here is the damage' and can be a straightforward guide to what needs to be treated or allowed to heal. *Inflammatory pain* occurs as a result of inflammatory mediators in many disease processes or associated with healing following acute trauma or surgery. If either nociceptive or inflammatory pains are left unrecognised or undertreated they can lead to ongoing and then chronic pain. *Neuropathic pain* signifies some dysfunction in the nervous system itself and is a major cause of chronic suffering, occurring in about 6-7% of the population (Vinik, 2010).

Neuropathic pain may derive from some identifiable damage to the nerves, resulting from a disease process, inflammation or accidental damage during trauma or surgery, or may result from a failure of integration and function of the peripheral and central nervous systems. Many conditions previously labelled as functional pain are now known to have peripheral and central nervous elements, which would re-class them as neuropathic pain. Complex regional pain syndrome (CRPS) is an immuno-neurological disorder (Fechir et al, 2008). It may be associated with no nerve lesion (type I) or may be related to some identifiable nerve lesion (type II). Chronic conditions like functional abdominal pain syndrome (FAPS) and CRPS have been under-recognised by physicians, but are experienced by a significant number of adolescents (Clouse et al, 2006; Kachko et al, 2008). In summary, a combination of pain mechanisms may be involved in the development of chronic pain conditions.

1.1 The epidemiology of paediatric chronic pain

The epidemiology of chronic pain in children is less well understood than it is in adults, but some useful studies have been published in the last decade that help us to understand the overall scale of the problem and to elicit some socio-demographic particulars of the affected population. A survey of over 5,000 children aged 0 – 18 years in the Netherlands reported that 25% had experienced some form of chronic or recurrent pain (Perquin et al, 2000). A Spanish study, of 561 schoolchildren aged 8 – 16 years, reported an incidence of 37%, but concluded that only 5% suffer moderate or severe chronic pain (Huguet & Miró, 2008). In a Canadian study of 495 schoolchildren aged 9 - 13, more than half reported having experienced at least one recurrent pain, typically characterised as a headache, stomach pain or 'growing pain'. Although 46% reported a 'long-lasting' pain, the researchers judged that in many cases this represented a recurrent pain condition; nonetheless, 6% of children were classified as having possible, probable or definite chronic pain (van Dijk et al, 2006).

While these studies highlight the methodological difficulties in distinguishing acute, recurrent and chronic pain from children's responses to questionnaire and interview questions, these statistics clearly also demonstrate that childhood chronic pain is a significant problem: slightly more than one child in every twenty is a chronic pain sufferer; that is, at least one child in every average-sized classroom in every school. Perquin et al (2000) conclude that childhood chronic pain is 'a common experience' and that the incidence of severe chronic pain amongst adolescents should provoke both concern and further research from the healthcare community.

Previous pain experiences, cognitive, emotional and behavioural factors, family background, environment, peer group and culture have an influence on the impact, perception and biopsychosocial outcomes of chronic pain. Children living in lower educated, lower income families have been found to be at a greater risk of suffering recurrent pain, which is consistent with adult studies (Grøholt et al, 2003). Children suffering chronic pain themselves are quite likely to be living with another chronic pain sufferer, whether parent or sibling, and further investigation suggests that pre-existing chronic pain in the family environment is a predictor of both physical and psychological effects on the child (Lynch et al, 2006). Ethnicity and area of residence also appear to affect prevalence rates. For example, in Canada, the incidence of chronic pain is higher among Aboriginal people and, for males, is higher in rural areas (Ramage-Morin & Gilmour, 2010). There may also be cultural differences in the perception and reporting of pain (Mailis-Gagnon et al, 2007).

While chronic pain is clearly not confined to the developed world, most published studies provide figures for European or North American children, which may not be generalisable to different environments. A US study found that 13% of 12-13 year-olds and 17% of 15-16 year-olds experience abdominal pain every week (Hyams et al, 1996), while Dutta et al (1999) reported a considerably higher incidence (74%) in India. However, with gastrointestinal infections more widespread than the inflammatory bowel disease seen in developing countries, these figures probably represent the outcome of different disease processes (Ganesh et al, 2010). Abu-Saad Huijer (2010) considers the effects of war and traumatic events. Despite an absence of research in this area, he argues that chronic pain has been linked with post-traumatic stress disorders and that, as a consequence, we may expect to see a different profile of chronic pain among children affected by armed conflict.

In developed countries, headache, abdominal and musculoskeletal pain form the primary foci of chronic and recurrent pain among the paediatric population. In their study of Canadian 9-13 year olds, van Dijk et al (2006) received reports of recurrent headaches (32%), growing pains (21%), stomach pains (19%) and muscle aches (2%). Perquin et al (2000) had published similar findings from their survey of Dutch schoolchildren, in which they also analysed reports of pain at multiple locations. They found that the single location pain was most often reported. The combination of headache and abdominal pain was the most commonly reported multiple pain, found in 25% of all children. This greater than one pain profile was significantly more prevalent in adolescent girls.

Recent figures from a Statistics Canada health report identify chronic pain among 2.4% of males and 5.9% of females aged 12 to 17 years (Ramage-Morin & Gilmour, 2010). It has been reported that girls are as much as three times more likely to report chronic pain than boys (Martin et al, 2007). Perquin et al (2000) also showed a significant increase in the prevalence of chronic pain in girls. These girls were aged between 12 and 14 which may well be linked with the onset of menstruation. In general, abdominal pain is significantly more likely to be reported by girls and limb pain (or growing pains/muscle aches) is significantly more likely to be reported by boys (Perquin et al, 2000; van Dijk et al, 2006). A review on gender and pain suggests potential mechanisms within social and psychological processes, such as coping processes and catastrophising, are likely to contribute to the repeatedly observed sex differences in pain (Fillingim et al, 2009).

Aetiology and predisposition to chronic pain in children is largely unknown and depends on the type of pain. Factors associated with the development of chronic pain include

surgery, trauma, emotional distress and chronic disease. In many cases, a definitive aetiology is difficult to establish. Even chronic post-surgical pain (CPSP) can be difficult to diagnose and consequently remains under-recognised. However, it represents a significant clinical problem. A 2006 review suggests that CPSP occurs after 10-50% of operations and results in severe chronic pain in 2-10% of these patients (Kehlet et al, 2006). This may, in fact, represent a significant portion of chronic pain sufferers. A UK study found that 22.5% of chronic pain patients developed their condition after surgery (Crombie et al, 1998). CPSP will often be neuropathic, resulting from nerve damage during surgery, though it could also be an ongoing inflammatory/nociceptive mechanism. The incidence of CPSP in the adult population is found to depend on a number of perioperative factors which include: genetic predisposition, degree of pre-operative anxiety, depression, pre-operative pain status, the surgical pain model, surgical technique, length of surgery and the quality of acute postoperative pain management (Kehlet et al, 2006; Macrae, 2008). The probability of an adult developing chronic pain after mastectomy or hernia surgery is decreased with increased age (Poleshuck et al, 2006; Poobalan et al, 2003). How this relationship to age translates to children and adolescents is not known as there is no published literature on CPSP in children. Six out of the eight paediatric cases presented in this chapter developed chronic pain following surgery.

Untangling factors to establish clear causality for the development of paediatric chronic pain is a challenge. Whether initiated by surgery or injury or other cause, it is a complex multi-factorial process. Understanding this mechanism requires not only a search for a cause, but also a clearer understanding of the effects of chronic pain. It is established that some paediatric chronic pain conditions have been under-diagnosed. Better recognition and early treatment of these conditions requires that healthcare providers understand the effects of chronic pain on a child and their family.

1.2 The impact of chronic pain on children and their families

Childhood chronic pain has a negative impact on physical, psychological and social function. It can prevent a child participating in sporting activities and other forms of exercise. It can cause sleep disruption and fatigue. It can contribute to depression and anxiety. It can affect school work through fatigue, poor memory and concentration and result in reduced school attendance. Friendships and family relationships are disrupted which may lead to varying degrees of social isolation. An Australian study of 207 children and adolescents attending a paediatric pain management clinic found that 95% had missed school, 90% had been unable to participate in some sporting activity and 71% had suffered some sleep disruption (Chalkiadis, 2001). Roth-Isigkeit et al (2005) found that 30-40% of children/adolescents with pain reported effects of their pain on school attendance, hobbies, social contacts, appetite, sleep, as well as increased utilization of health services because of their pain. An understanding of the range and interaction of all these different effects is crucial to the effective recognition and treatment of chronic pain in children.

These impacts on daily living can be bundled into the notion of Health-Related Quality of Life (HRQoL), which may be defined as *"an individual's subjective assessment of his or her functioning and emotional state"* (Gold et al, 2009) and can be used for comparative purposes. One such measurement instrument is the Pediatric Quality of Life Inventory (PedsQL), which contains items relating specifically to both physical and psychosocial function (the latter comprising emotional, social and school function) and can be completed by self-report or parent-proxy (Varni et al, 2001). Using this instrument, a US study of 100 patients, aged

2–21 years, attending a chronic pain clinic found that the HRQoL scores of these patients were not only considerably lower than scores obtained from normal healthy children, but were significantly lower than scores observed in children with rheumatological or cancer disease (Vetter, 2008). Another US study found that the mean PedsQL score for a cohort of 69 children and adolescents (aged 8 – 18 years) seeking outpatient pain management services, fell below the 'at-risk cut-off score' for all dimensions except social functioning, suggesting that the majority of these children were experiencing significant disruption in their day-to-day lives. The message from these studies is clear: the effects of chronic pain on a child's quality of life are wide-ranging and profound.

School functioning has received perhaps the most attention (Palermo, 2000). It demonstrates the most marked detriment of all the psychosocial dimensions of the PedsQL scale (Vetter, 2008; Gold et al, 2009) and clearly illustrates the complex effects of chronic pain on quality of life. A child with chronic pain may experience a range of problems which impact on their schooling: fatigue and/or poor sleep profile prevents early morning waking; pain inhibits physical ability to get to school, to sit in a classroom for long periods or to participate in physical activities; fear of pain by accidentally being knocked during recess times inhibits social interaction and imparts a sense of isolation, difference and not being involved with peers; poor memory and concentration affects schoolwork; as school work becomes missed or incomplete these unfinished projects become a barrier to return to school if workload is not controlled; and the school may represent an environment where their pain condition is not properly understood or tolerated.

For all these reasons school absences are common. In a survey of adolescent chronic pain sufferers aged 12-17 in Boston USA, 44% missed more than one-quarter of school days and 20% had missed more than half (Logan et al, 2008). Of course, schools typically offer only a limited degree of health-related support. In the Boston study, two-thirds of participants had received some form of accommodation from their school, such as being sent to the nurse's office, being sent home in pain, reduction in workload, extension on an assignment, and so on. Nonetheless, 44.3% of parents reported their child's grades had suffered (Logan et al, 2008) and missing school can clearly have negative consequences that extend beyond academic performance to a child's physical, emotional and social development. Six of the eight cases presented in this chapter had missed significant amounts of school.

Assessing the impact of chronic pain on a child's life is an important but problematic task. There are a number of reasons for this difficulty.

Firstly, the specific effects of chronic pain are not easily isolated from one another. For example, fatigue may be a mediating factor between pain and school functioning (Gold et al, 2009). Anxiety also plays a complex role in moderating the relationship between pain and function. Tsao et al (2007) studied anxiety sensitivity, or the fear of anxiety sensations, in 87 children aged 10-18 presenting at a US chronic pain clinic. Anxiety sensitivity was found to be linked with academic and/or social limitations, where those limitations arose from emotional rather than physical difficulties. Greater anxiety sensitivity was associated with lower self-esteem and perceived general and mental health, and with more behavioural problems and family disruption, but did not appear to affect physical functioning (Tsao et al, 2007). In a similar study of 222 adolescents aged 11 to 19 years attending two chronic pain clinics in the UK, Cohen et al (2010) found that in children with low anxiety, level of pain was a good predictor of physical and social function, but that high levels of anxiety prompted poorer function regardless of the level of pain.

Secondly, the impact of chronic pain on health and quality of life often extends beyond any immediate effects. For example, more than 50% of adolescents with chronic pain report some symptoms of insomnia (compared with less than 20% of healthy adolescents), and while these may initially be related directly to the experience of pain, behavioural patterns can transform this disruption into a primary sleep disorder (Palermo et al, 2010). Furthermore, chronic pain in childhood appears to increase the risk of developing further chronic conditions in adulthood. Adults, who have suffered recurrent headaches as children, are at an increased risk not only of headaches, but other physical and psychiatric symptoms (Fearon & Hotopf, 2001). Similarly, a longitudinal cohort study of paediatric FAPS patients, aged 6 to 18 at enrolment, found that, 15 years later, those with unresolved FAPS experienced higher levels of non-abdominal chronic pain (including migraine, tension-type headaches, and pelvic, back and limb pain) than those with resolved FAPS or normal controls (Walker et al, 2010).

Thirdly, the effects of chronic pain are felt not just by the child, but become a burden for the whole family. The child may no longer participate in shared physical activities, limiting family excursions and fun. Relationships with parents, siblings and other family members are put under strain resulting in anxiety and depression (Eccleston et al, 2004). A number of studies report associations between family functioning and the level of a child's pain-related disability, generally finding that the worse the disability, the greater the family dysfunction (Lewandowski et al, 2010). While it is difficult to interpret the causal relationship underpinning this association with confidence, it is likely that causation runs in both directions: a child's chronic pain has an adverse effect on family life; family problems make it more difficult for the child to cope and so worsen the experience of pain. The impact of chronic pain on the family matches the adverse impact experienced by families caring for children at home with severe cerebral palsy or birth defects (Vetter, 2008).

Daily care arrangements for the child/adolescent with chronic pain require additional support, which may cost money or require a parent to give up a job. The direct and indirect costs of caring for a child with chronic pain have been estimated. A UK study calculated, from a sample of 52 families, that the total annual cost, to a family living with a child in chronic pain, was as much as £14,160 or, approximately, $25,000 (Sleed et al, 2005). This figure included direct healthcare costs for the child and other family members and indirect costs such as loss of earnings, adaptations to housing, over-the-counter medications and care assistance. This is a potentially ruinous sum for low-income families.

Fourthly, physical and social effects of chronic pain carry another associated economic burden, which may be less easily identified and difficult to quantify. Diminished school function and educational achievement will have potential long-term career and economic cost for both the child and for society.

Finally, the immediate effects of chronic pain have the potential to feed back negatively on the physical and psychosocial health of children and their families. This further reduces their capacity to cope. Unremitting pain can cause sleep disruption and fatigue. Missing school leads to social isolation. The extra burden of stress and financial hardship on families makes them less able to provide the required care. The physical, psychological and social effects of chronic pain can lead the child and their family into a downward spiral, from which it is difficult to emerge without inter-disciplinary support. It is crucial that physicians not only identify the wider psychosocial effects of chronic pain, but recognise that these effects are contributory factors which play an important role in the ongoing pain and functioning of their patient (Jensen, 2011). With the goal of optimal patient care in mind, a

clinician should consider including interventions that address these factors in their treatment strategies for children with chronic pain.

1.3 Interdisciplinary team management of children with chronic pain

Management of children and adolescents with severe suffering and extensive pain-related disability as a result of chronic pain requires an interdisciplinary approach (Eccleston et al, 2003). This includes the treatment modalities of pharmacology, physiotherapy and psychology running in parallel or, more importantly, enmeshed with one another. How these elements are balanced is dependant on each individual child and takes into consideration the type and duration of pain, as well as the impact of pain on particular biopsychosocial aspects of the child's life.

1.3.1 Pharmacology

The pharmacological approach to management of a child with chronic pain requires consideration of the type of pain, the impact of the pain on the child's biopsychosocial functions and the potential side effects of the medications. Medications need to be individualised to each child and continually re-assessed for efficacy and side effects. If medications are having no impact at therapeutic dosage they need to be discontinued and the child re-evaluated for consideration of other appropriate agents. Close liaison with psychiatry is advised prior to and following up on prescription of mood stabilising medications. It is important to emphasise that pharmacological interventions are only one part of an interdisciplinary approach to improve function in children/adolescents with chronic pain. Table 1 provides a summary of the medications that may be considered in the pharmacological treatment of paediatric chronic pain.

Drug	Dose	Comments
Acetamin-ophen	**>3 months of age to adolescents:** 10-15 mg/kg/dose PO Q4H PRN (max 75 mg/kg/day)	Central analgesic action via cannabinoid or prostaglandin mechanism Hepatotoxic in acute overdose or with chronic long term use; risk factors for toxicity include fever, prolonged fasting (>48 hrs), concomitant interacting drugs, obesity, poorly controlled diabetes, liver disease, viral infections and malnutrition Doses apply to normal healthy children (i.e. no hepatic or renal compromise)
Ibuprofen	5-10 mg/kg/dose PO Q6-8H (max 40 mg/kg/day)	Non steroidal anti-inflammatory agent; should not be used concomitantly with other NSAIDs Use caution in patients with aspirin hypersensitivity, hepatic or renal insufficiency Administer with food or milk to lessen GI upset; contraindicated with active GI bleeding and ulcer disease
Naprosyn	**Children >2 years:** 5-7 mg/kg/dose PO/PR Q8-12H	Non steroidal anti-inflammatory agent; should not be used concomitantly with other NSAIDs Contraindicated with active GI bleeding and ulcer disease; administer with food or milk to avoid GI upset; common GI side effects include abdominal pain, appetite loss, stomatitis or constipation May cause photosensitive vesicular rash (pseudoporphyria)

Drug	Dose	Comments
Tramadol (Ultram, Ralivia)	**Immediate-release form:** **Children:** 1-2 mg/kg Q4-6H PRN (max: 400 mg/day or 8 mg/kg/day) **Adolescents:** 50-100 mg Q4-6H PRN (max: 400 mg/day) **Extended-release form:** **Adolescents:** Initial: 100 mg PO daily; titrate by 100 mg increments every 2-3 days PRN (max: 300 mg/day).	An opioid analgesic with norepinephrine and serotonin effects Side effects include nausea and vomiting; tolerability is improved by gradual dose titration. Caution in renal and/or hepatic impairment Tramadol is metabolized to active form (i.e. a prodrug) Inter-individual pharmacogenomic variations affect efficacy Serotonin syndrome reported with concurrent use of serotonergic drugs Seizures reported with concurrent TCAs, SSRIs, and opioids or with conditions that lower seizure threshold Withdrawal symptoms may develop if abruptly discontinued; do not suddenly stop long-term treatment; wean dose by 25% per week Extended release product given ONCE daily.
Topical Lidocaine	Topical: 5% under occlusive dressing for 12 hours (once per day)	Blockade of upregulated sodium channel receptors in injured nerves. Useful for very localised pain Minimal side effects (mild skin reactions)
Amitriptyline	Initial: 0.1 mg/kg/dose PO HS; increase as needed and tolerated over 2-3 wks to 0.5-2 mg/kg/dose HS	Tricyclic antidepressant agent (TCA) used in low dose for chronic neuropathic pain; prevents the re-uptake of serotonin and norepinephrine. Pretreatment ECG required to exclude arrhythmia potential. Drug interactions via cytochrome p450 system; contraindicated if MAO inhibitors used within 14 days; tricyclics have limited efficacy for treatment of depression in children and adolescents Side effects include: sedation, confusion, weakness, fatigue, tremor, sweating, headache, anticholinergic effects, cardiovascular effects (including orthostatic hypotension, tachycardia, prolonged QTc and arrhythmias at higher plasma levels), decreased seizure threshold. Sedative side effect used to help with improved sleep profile If one TCA not helpful due to intolerable side effects try another with a different SE profile before abandoning this modality of pharmacological therapy (Nortriptyline is less sedating, doxepin less anticholinergic). Analgesic effect may not occur for 2 weeks from commencement. A withdrawal syndrome is documented for Tricyclics (flu-like symptoms, dizziness, mood changes). Assess patient carefully and limit prescribed quantities to minimum effective dose; do not suddenly stop long-term treatment; wean dose by 25% per week.
Gabapentin	**Children:** titrate to effect over a few days, starting at 2 mg/kg once or twice daily, then increase to TID dosing to a maximum of 35 mg/kg/24hr (max 3600 mg/day)	Calcium channel α 2-δ ligand; calcium channel blocker when neuron hyperexcited Analgesic, anticonvulsant, anxiolytic, and sleep-modulating activities. Side effects may include somnolence, ataxia, fatigue and behaviour change. Gradual dose increase helps to minimize sedation; increased

Drug	Dose	Comments
		oral doses are associated with decreased bioavailability; do not administer with antacids; primarily excreted unchanged in the urine, therefore need to adjust dose in renal impairment Maximum dose often not be needed for maximum effect; do not suddenly stop long-term treatment; wean dose by 25% per week.
Pregabalin	**Children > 10 years:** Initial: 25 mg PO daily Titrate upward to effect to 2.5 mg/kg PO BID or max 300 mg/day	Calcium channel α 2-δ ligand; calcium channel blocker when neuron hyperexcited. Similar in mechanism to gabapentin Side effects may include somnolence, ataxia, fatigue and behaviour change. Gradual dose increase helps to minimize sedation; increased oral doses are associated with increased bioavailability; do not administer with antacids; primarily excreted unchanged in the urine, therefore need to adjust dose in renal impairment. Maximum dose often not be needed for maximum effect; do not suddenly stop long-term treatment; wean dose by 25% per week.
Opioids	For dosing of different agents see Compendium of Pharmaceuticals and Specialties	mu-opioid agonist Additive sedative effects with other medications and/or alcohol Side effects include sedation, nausea, vomiting, constipation, pruritis, tolerance dependance opioid induced hyperalgesia, addiction Long-term use rarely indicated in children; addiction potential should be assessed prior to commencement of opioids; opioid prescription should follow national guidelines for safe practice
Venlafaxine	**Initial Dose:** 37.5 – 75 mg PO Once DAILY **Increment:** 37.5-75 mg every 4-7 days **Usual Dose Range:** 75-225 mg/day	Serotonin/norepinephrine reuptake inhibitor (SNRI) Effective in the treatment of Depression, Generalized Anxiety Disorder, Social Anxiety Disorder, Panic Disorder. Also used to treat ADHD, Post-Traumatic Stress Disorder and Obsessive-Compulsive Disorder. Side effects include: headache, nausea, increased heart rate and blood pressure (more prominent at higher doses), anorexia/weight loss, drowsiness, dizziness, dry mouth, sweating, tremor and impaired sexual function (adolescents/adults). Administer with food or milk to decrease GI upset; full beneficial effects may not be seen until 4 weeks of therapy completed. ***Warnings issued by Health Canada regarding use of antidepressants in pediatric patients.***
Clonidine	1-4 micrograms/kg/dose PO Q4-6H	An alpha adrenergic receptor antagonist; metabolism is hepatic and renal (roughly 50:50); drug interactions with beta blockers, tricyclic anti-depressants Sedative, anxiolytic and analgesic effects; a useful adjunct used to minimise other analgesic drug doses such as opioids Side effects include sedation, dry mouth, hypotension Do not suddenly stop long-term treatment; wean dose by 25% per week to prevent rebound hypertension

Table 1. Modalities of medications that may be considered in outpatient paediatric chronic pain management

1.3.2 Physiotherapy

Chronic pain sufferers often experience some level of physical incapacity and many adopt activity patterns that can make their pain worse, such as alternating episodes of over-activity and under-activity (Birkholtz et al, 2004). Physiotherapy plays an important role in the interdisciplinary treatment of chronic pain in children and adolescents. Eccleston & Eccleston (2004) divide it into the following four components:

- *Exercise* – this is used to increase aerobic endurance, flexibility, strength and overall fitness, which all have potential benefits for pain reduction;
- *Education* – this helps the patient relate their pain to their anatomy, physiology and activity levels and to address issues such as fear of movement and the potential for re-injury;
- *Behavioural management* – this may involve physical retraining and activity pacing, aiming for a gradual increase in the range and extent of movement, including a steady return to any activities abandoned since the onset of pain (see also Harding et al, 1998);
- *Performance assessment* – there is a clear link between reduced pain and improved physical function; the physiotherapist is well-placed to assess treatment progress.

Other reports of physiotherapy interventions in the treatment of chronic pain stress the importance of the interdisciplinary approach. For example, a combination of physical therapy and CBT has been shown to be effective in treating CRPS in children (Lee et al, 2002). Harding et al (1998) also highlight the need to integrate behavioural and cognitive components in activity training to minimise distress and unhelpful beliefs.

1.3.3 Psychology

There are a number of psychological factors, which are directly involved in the perception, reporting and self-management of pain. These include fear, vigilance to the feeling and threat of pain, catastrophising, avoidance of pain-inducing activity, sadness, depression, anger and self-denigration. Psychological factors are also important in coping mechanisms, taking action, and being able to predict or make sense of pain and its consequences (Eccleston, 2001). Psychologists provide continual education/reassurance on the pathophysiology of the chronic pain condition and teach mind-body techniques like breathing, muscle relaxation exercises, self-hypnosis, imagery, and cognitive strategies. These techniques help reduce the impact of pain on daily living and mood.

Cognitive behaviour therapy (CBT) is central to the notion of interdisciplinary care. CBT refers to an "*integration of treatments aimed at reducing or extinguishing the influence of the factors that maintain patients' maladaptive behaviours, beliefs and patterns of thought... and is delivered by a team of pain therapists, including anaesthetists, clinical psychologists and physiotherapists*" (Eccleston, 2001). Interdisciplinary CBT programmes aimed at adolescents with chronic musculoskeletal pain have been found to improve physical function, reduce emotional distress, increase attendance at school and reduce medicine consumption (Eccleston et al, 2003; de Blécourt et al, 2008). Furthermore, there is evidence to suggest that an interdisciplinary framework is beneficial for the family members involved. Schurman & Friesen (2010) report that an 'integrative care' approach in a paediatric Abdominal Pain Clinic (that is, service delivered by a gastroenterologist and a psychologist) was acceptable to families, produced higher satisfaction scores and, crucially, improved receptivity to treatment recommendations.

Relaxation strategies and plans to improve sleep hygiene are a vital part of the psychologist's role. When schooling has been impacted by pain, the psychologist helps

teachers become more aware of the condition and its impact on schoolwork. The psychologist helps to negotiate or advocate for any accommodations needed in order to help the child succeed at school. Psychologists help the child and their family identify and resolve stresses such as anxiety or depression that could be preventing return to function.

A Cochrane Review determined that there is strong evidence for psychological therapies being effective in the treatment of headaches in children and some evidence for their efficacy in the treatment of musculoskeletal and recurrent abdominal pain (Eccleston et al, 2009). Psychological interventions are often, and ideally, delivered as part of an interdisciplinary approach and consequently there are few randomized-controlled-trial (RCT) studies providing definite evidence for individual therapies (McGrath & Holahan, 2003). Nonetheless, psychological techniques are a vital component of the interdisciplinary approach and experienced therapists will select particular techniques according to the needs of the individual patient.

1.3.4 Interventional therapies

Interventional procedures offered at Canadian paediatric *multidisciplinary pain treatment facilities* (MPTFs) include continuous epidural infusions, single epidural injections, facet injections, stellate ganglion nerve blocks, peripheral nerve blocks, trigger point injections, sympathetic blocks with local anaesthetic, Botox injections, intravenous regional anaesthesia, paravertebral nerve blocks and radiofrequency lesioning (Peng et al, 2007). Nerve blocks are used widely among Canadian anaesthesiologists who specifically practice chronic pain management: of those, 84% perform nerve blocks, compared with 60% who use pharmacotherapy, and a majority of them estimated that more than 40% of their patients require some form of nerve block as part of their treatment programme (Peng & Castano, 2005).

However, there is very little evidence to demonstrate that interventions benefit a patient more than would be seen from a placebo response. The literature is comprised of case reports and small case series, along with a few randomized, placebo-controlled trials (RCTs). For example, therapeutic lumbar facet joint nerve blocks can provide effective pain relief and functional improvement (Manchikanti et al, 2010). However, epidural corticosteroid injections for sciatica appear to offer only transient benefit (Arden et al, 2005). Results of RCTs are not always consistent, however. For example, one RCT has shown that radiofrequency lesioning of the dorsal root ganglion for treatment of chronic lumbosacral radicular pain appears not to be more effective than control treatment with local anaesthetic (Geurts et al, 2003); on the the other hand, another RCT has shown that it is both safe and effective (Simopoulos et al, 2008). For some techniques, such as myofascial trigger point injections, it has not even been possible to establish a consensus on methods for diagnosis or treatment (Tough et al, 2007). Furthermore, any RCTs that have been done mainly comprise adult studies. The evidence of efficacy in children/adolescents is even more limited and more research is required. There are also rare but significant iatrogenic risks associated with some of these interventions. Injection therapies for lower back pain carry the risk of paraspinal, spinal end epidural abscesses or meningitis (Gaul et al, 2005).

Despite this negative portrayal of interventional medicine for chronic pain "absence of evidence is not evidence of absence" (Altman & Bland, 1995) and there are many pain physicians and patients, including those in this case series, who have derived enormous benefit from interventional treatments.

2. Case reports

The cases are described below and summarised in table 2.

No	Gender	Age	Weight	Site of pain	Duration (months)	Diagnosis	Block(s) performed
1	Male	16	60kg	Chest	5	Intercostal neuralgia related to Nuss bar	Intercostal nerve blocks (1 diagnostic and 3 therapeutic)
2	Male	14	56kg	Abdomen	9	Abdominal wall pain	Bilateral rectus abdominis sheath blocks (diagnostic and therapeutic)
3	Male	18	60kg	Groin	12	Ilioinguinal neuralgia following hydrocele repair	Ilioinguinal nerve blocks (1 diagnostic and 3 therapeutic)
4	Male	15	66kg	Abdomen	3	Neuropathic pain, *not* incisional hernia	Intercostal nerve block; rectus sheath block.
5	Male	9	25kg	Groin	4	Genitofemoral or ilioinguinal neuralgia following orchidopexy	Rectus abdominis sheath block
6	Female	15	45kg	Rib	8	Intercostal neuralgia, post-surgery	intercostal nerve blocks (diagnostic and therapeutic)
7	Female	9	33kg	Abdomen	2	Abdominal wall pain following laparascopic appendectomy	Bilateral rectus abdominis sheath blocks (diagnostic and therapeutic)
8	Female	17	66kg	Rib	7	Intercostal neuralgia	Intercostal nerve blocks (diagnostic and therapeutic)

Table 2. Summary of cases

2.1 Case 1: A 16-year-old adolescent with chest pain related to a Nuss bar

A 60kg 16-year-old male presented with a 5 month history of right sided chest wall pain. He had undergone a Nuss procedure for cosmetic repair of pectus excavatum one year prior to presentation and had received satisfactory acute pain management with epidural analgesia. He was referred to the Pain Service by his surgeon. His pain was precipitated by a sudden lateral movement, but aggravated by activity, laughter and bending down. The pain was described as "shooting". The pain was not relieved by ibuprofen and/or acetaminophen.

This young man, an active kick-boxer, was extremely fit and well. However, his pain was so unremitting that he had to stop all sporting activities and was completely sedentary. His sleep was not disrupted, nor was his school attendance or academic performance. However, he was very frustrated that his pain prevented him pursuing his kick-boxing and his ability to perform simple physical tasks. He was able to maintain friendships, but could not engage in some of the more physical social activities.

On examination, his pain was found to radiate laterally from the site of his Nuss bar on the right side, in one dermatomal level at the level of the 7th rib from midaxillary line to sternum. There was no pain on palpation or deep inspiration/expiration. There was no numbness, allodynia or skin changes. Palpation of the thoracic spines, costochondral

junctions, and left side of chest were unremarkable and pain free. His chest X-ray (CXR) revealed that his Nuss bar had not moved, with no bony reaction or wire migration. The CXR was otherwise normal. The presumed diagnosis was intercostal neuralgia.

A diagnostic intercostal nerve block was performed, which provided effective short-term symptomatic relief so a follow-up therapeutic block was done 10 days later. For the therapeutic block, 5mls of 0.25% bupivicaine with 1/200,000 epinephrine and 10mg triamcinolone was injected at four sites: at the affected rib, one above, one below and at the right sided Nuss bar insertion scar site. This provided complete pain relief to allow the patient to return to his previous physical activities.

He required repeat therapeutic blocks at 3 months and 1 year from the initial block for resurgence of pain, but had no further pain up to and after the removal of the Nuss bar.

2.2 Case 2: A 14-year-old male with abdominal pain

A 56kg 14-year-old male presented with a 9 month history of abdominal pain. There was no apparent precipitating event. He was referred to the Pain Service after multiple referrals and investigations had excluded a remedial cause for his pain but drawn a blank on a diagnosis. The pain was described as a dull, aching pain, present all the time, but worse with exercise and on palpation. There was no pattern to his pain or any relation to his diet. There were no other symptoms related to the abdominal system. The pain was not relieved by ibuprofen, acetaminophen or homeopathic remedies.

This young man had been extremely fit and well. However his pain was such that he had to stop all his sporting activities, experienced difficulty getting to sleep, was depressed and grumpy with his family and had been absent from school for the preceding 6 months.

On examination, his abdomen was slim and soft, with normal bowel sounds, no masses and no organomegaly. There was tenderness in the midline above the umbilicus, which was worse on abdominal wall tensing (Carnett's test positive). The presumed diagnosis was chronic abdominal wall pain.

A diagnostic bilateral rectus sheath block was performed above the umbilicus under ultrasound control which provided effective short-term symptomatic relief so a follow-up therapeutic block was done two weeks later. For the therapeutic block 10mls of 0.25% bupivicaine with 1/200,000 epinephrine and 20mg triamcinolone was injected at each site. He did not require repeat therapeutic blocks.

Two weeks after his therapeutic block, he slowly returned to his normal activity levels, sleeping and eating patterns and resumed his previous happy demeanour. The following term, he returned to school and reported no subsequent absences.

2.3 Case 3: An 18-year-old with groin pain after hydrocele repair

A 60kg 18-year-old male presented with a 1 year history of a shooting pain in his groin, which was present all the time and radiated down the medial aspect of his thigh to his knee. There was no apparent precipitating event; however, he was a competitive fencer and had undergone a left hydrocele repair 6 months prior to the onset of pain. The pain was worse in morning, walking up stairs and mobilizing from lying down. He had episodes of severe pain 2-3 times per day, which lasted several hours.

He was referred to the Pain Service after multiple referrals and investigations had excluded a remedial cause for his pain, but drawn a blank on a diagnosis. The pain was not relieved by acetaminophen.

This young man had been extremely fit and well. However his pain was such that his appetite was reduced, he was losing weight and he had to stop all his physical activities to the point that his future competitive aspirations were severely compromised. He continued to attend school, but was under pressure to compete in the fencing team. His mood during this period was described as 'testy'.

On examination, he had pain on palpation of the hydrocele repair scar, but no pain on palpation underneath inguinal ligament. He had a full range of non-painful movements of his lumbar spine, hips and knees with normal bulk, tone & power in his lower limbs, and brisk but equal knee and ankle jerk reflexes. He exhibited a downgoing plantar reflex and bilateral abdominal reflexes. His abdomen was slim and soft, with normal bowel sounds, no masses and no organomegaly. There was no apparent numbness to light touch of his scar or thigh and no allodynia, skin or hair changes. There was no pain to palpation in his scrotum or penis. The presumed diagnosis was ilioinguinal neuralgia.

A diagnostic ilioinguinal nerve block was performing under ultrasound control which provided effective short-term symptomatic relief so a follow-up therapeutic block was done one week later. For the therapeutic block 20mls of 0.25% bupivacaine with 1/200,000 epinephrine and 20mg triamcinolone was injected between the internal oblique and transverse abdominis muscles; some was also injected under the scar site from his hydrocele repair. This provided complete pain relief.

His mood and eating pattern improved within the first month, but he did require repeat therapeutic blocks at 5 months and 11 months following the initial block. These provided good pain relief to allow the patient to make a graded return to competitive fencing.

2.4 Case 4: A 15-year-old male with a suspected incisional hernia

A 66kg 15-year-old male presented with a 3 month history of left upper quadrant pain associated with a bulge just lateral & inferior to the incision from a congenital diaphragmatic hernia repair when he was 14 months old. The pain was described as a burning, stabbing sensation. He exhibited no symptoms related to the respiratory, cardiovascular or abdominal systems.

He had been extremely fit and well. However his pain was such that he could not stand up straight, suffered pain with all activity and was unable to sleep soundly because he could not get comfortable. He had completely lost his appetite and had lost 10kg in weight. He became depressed and ceased to interact with friends. His suffering affected his family deeply: his parents' relationship suffered, his sister became depressed. He could not sit or concentrate and consequently missed 5 months of school.

An upper gastrointestinal endoscopy was normal. Surgical repair of the suspected incisional hernia revealed no hernia of the abdominal wall. Pain occurred in the immediate postoperative period. This pain did not respond to simple analgesics or hydromorphone. He was referred to the Pain Service and a diagnosis of neuropathic pain was made.

Intercostal nerve blocks were administered to the left sided 9th, 10th, and 11th ribs. This provided effective short-term symptomatic relief, so a follow-up therapeutic block was done a week later. For the therapeutic block, 5ml of 0.25% bupivacaine with 1/200,000 epinephrine & 10mg triamcinolone was injected at the same 3 intercostal spaces; in addition, the same amount was administered as a left rectus sheath block under ultrasound control, adjacent to the site of surgery. On awakening, the patient reported that his pain had gone.

This treatment provided immediate pain relief, which allowed the patient to return to his normal self. His appetite returned the next day. Within a few days, he was laughing again

and was sleeping normally. Within 2 months he had started gym. He quickly caught up with most of his schoolwork and was now motivated to do additional study during the summer vacation. He resumed contact with friends and his family were able to return to normal. He did not require repeat therapeutic blocks.

2.5 Case 5: A 9-year-old with post-orchidopexy pain

A 25kg 9-year-old male presented with a 4 month history of left sided groin pain. He had been experiencing this pain for three years on and off, but it had been worse since his orchidopexy surgery 4 months prior to the consultation. He was referred to the Pain Service by his surgeon.

He continued to attend school, but had to visit the nurse twice a day and lie down to recover his strength. Often the school requested that he be collected and taken home early. He found it difficult to engage in physical or social activities and had to give up Tae Kwon Do. He was often woken with pain and cramps and cried as a result of his pain.

The pain was described as "stabbing". It was not relieved by ibuprofen and/or acetaminophen. On examination, there was no numbness, allodynia or skin changes and Carnett's test was positive. The presumed diagnosis was genitofemoral or ilioinguinal neuralgia.

A diagnostic rectus abdominis sheath block was performed, under ultrasound control: 15ml 0.25% bupivicaine, 1/200,000 epinephrine was injected into the rectus sheath and between the transverse abdominis and internal oblique; 10ml was injected at his flank at the anterior superior iliac spine; and some was injected at his orchidopexy scar site. On awakening, the patient reported the pain was gone.

A therapeutic block was not done in this case. He was able to resume a normal sleeping pattern within 2 weeks, was much happier and once again able to spend time with friends. He made a gradual return to Tae Kwon Do and normal schooling with no absences.

2.6 Case 6: A 15-year-old female with chest pain following removal of exostosis

A 45 kg 15-year-old female presented at the Complex Pain Clinic with post-surgical chest pain. Successful removal of an exostosis from her right rib cage was followed by the gradual emergence of a new, sharp pain, which was present every day. It worsened during the day and with sitting or physical activity.

It was 8 months since her surgery. She had missed some school, had stopped gymnastics classes and soccer training completely and had to limit her social activities. She was grumpy with friends and family. Physiotherapy had not helped, but ketorolac (10mg twice a day as needed), psychology, TENS and laser therapy were judged to have provided some benefit.

She was examined by the interdisciplinary team. Physical examination revealed that her pain was localised to the right anterolateral aspect of her 10th rib, close to the exostosis excision; there was no associated numbness, no allodynia and no skin colour change. The physiotherapist noted that her right waist crease and elevated iliac crest suggested a protective response, but that she had a full range of motion in spine and extremities. The psychologist determined that she was not overly anxious or depressed, despite some ongoing family conflicts. A preliminary diagnosis of intercostal neuralgia was made.

A diagnostic intercostal nerve block was performed. This provided effective short-term symptomatic relief so a follow-up therapeutic block was done 3 weeks later. The therapeutic block comprised: 5ml 0.25% bupivicaine with 1/200,000 epinephrine & 2mg/ml triamcinolone injected at 3 sites above & below the affected rib; and 4ml 0.25% bupivicaine with 1/200,000 epinephrine & 1mg/ml triamcinolone injected under the scar site.

Though she did not return to gymnastics, her tiredness was resolved and she was able to begin soccer refereeing a week later. She was more energetic, happier and able to spend time with friends again. Her concentration and focus improved which enabled her to achieve better grades at school.

2.7 Case 7: A 9-year-old female with persistent pain following appendectomy

A 33kg 9-year-old female presented with right-sided abdominal pain, which had begun 3 days after a laparoscopic appendectomy two months previously. The pain, present all the time, but varying in intensity, was described as 'stabbing'. It was worse with activity and at the end of the day.

She had experienced disturbed sleep and was often woken by pain. She had only attended school for only three or four days since her surgery and was completely unable to attend her rhythmic gymnastics classes. Her appetite was reduced and her pain was worse after eating. She became anxious and this period of uncertainty was a tremendously stressful time for her whole family. Tramadol, ibuprofen and acetaminophen had not helped her pain.

A physical examination revealed a positive Carnett's test and normal bowel sounds. Her femoral pulses were present and equal. There was no lymphadenopathy in the inguinal region or neck and no organomegaly. There was no allodynia, no numbness and no skin colour change at the site of her pain. Pain was increased by squatting, walking, use of upper extremities and right leg raises. Right hip flexor function and ability to do sit-ups were limited by pain. She was diagnosed with abdominal wall pain secondary to surgery for laparoscopic appendectomy.

A diagnostic abdominal wall block was performed, which provided effective short-term symptomatic relief so a follow-up therapeutic block was performed two weeks later. The therapeutic block was administered on the right side using ultrasound control, with a 22-gauge IV cannula. A total of 10ml 0.25% bupivicaine with 2mg/ml triamcinolone was injected: 4ml into rectus sheath and 6ml between the transverse abdominus and internal oblique muscles.

On awakening she reported her right side was numb. She experienced an achy bruising pain for 36 hours, which settled down. She was soon able to return to normal sleeping, eating and activity levels. She returned to gymnastics within 3 weeks and was back to her previous level of activity within 2 months. She was significantly happier and quickly re-established her relationships with friends. She returned to school within 2 weeks and was back to a full timetable within a month.

2.8 Case 8: A 17-year-old female with rib pain

A 66kg 17-year-old female presented with a 6 month history of right-sided lower rib pain. It may have been caused by an injury incurred playing volleyball. She described it as a 'stabbing', burning pain that sometimes radiated to the back or the epigastrum. She had no pain-free days. The pain was worse at night, with deep-breathing and with sitting for long periods of time.

She experienced considerable difficulty maintaining a normal sleep balance: she had trouble getting to sleep and was woken at least once a night in pain, often for long periods. As a consequence, she was often very fatigued, which she felt made her pain worse. She had a reduced appetite in the morning and had stopped all sporting activities. She showed some signs of depression and isolated herself from friends and family. She struggled to concentrate and missed approximately 40% of school.

A variety of therapies had been tried, including psychology, physiotherapy, acupuncture, TENS and two sessions with a chiropractor, but these had afforded only partial pain relief. Acetaminophen and non-steroidal anti-inflammatory agents were not effective. She obtained some relief from morphine, consuming up to 50mg each day. The presumed diagnosis was intercostal neuralgia.

A diagnostic intercostal nerve block was performed, which provided effective short term symptomatic relief so a follow-up therapeutic block was done three weeks later. For the therapeutic block, a total of 12ml 0.25% bupivicaine with 1/200,000 epinephrine was injected at 3 sites; one above & below and at the site of the affected rib on the right side.

This treatment allowed her to make a gradual return to normal. She began exercising again after 2 weeks, started sleeping deeper and longer and was generally in much better mood. She was able to sit and concentrate once again and resumed social activities with friends.

3. Discussion

3.1 Diagnosis and selection criteria for the use of peripheral nerve blocks

The cases described in this chapter demonstrate that, in properly selected children and adolescents, a peripheral nerve block can be an extremely beneficial component of interdisciplinary care. The case histories demonstrate the effective use of targeted nerve blocks for specific pain conditions such as ilioinguinal block for ilioinguinal neuralgia. The children and adolescents affected are often extremely physically active prior to the first reports of pain. They are usually previously fit and well with no previous pain or medical problems. There is typically an inciting event. The pain is characteristically neuropathic in description with sharp shooting elements and allodynia. The pain distribution is often dermatomal but not necessarily associated with numbness. The pain is not responsive or resolved with simple medications. The impact of the pain is considerable in its effects on physical function, schooling, mood and family dynamics.

3.2 Effective techniques in the use of peripheral nerve blocks

Peripheral nerve blockade in paediatric chronic pain has previously been described specifically for chronic abdominal wall pain (Skinner & Lauder, 2007). Due to the lack of evidence to guide therapy, the following recommendations are the opinion of the author (GL). Peripheral nerve blocks are done under sedation or general anesthesia to minimise further stress and pain to children and adolescents. Strict sterile procedure is followed. Plain local anaesthetic is used for the initial block to ensure that the diagnosis is correct prior to installation of steroids. Peripheral nerve blocks are done whenever possible under ultrasound control to maximise the chance of an effective block by ensuring the local anaesthetic is deposited in the correct plane or near the correct nerve. A diagnostic peripheral nerve block is considered to have worked if the local anaesthetic provided numbness in the dermatomal region to be blocked and also resulted in a clinically significant reduction in pain (>50% reduction). A therapeutic block is only performed after a positive diagnostic block. To achieve a therapeutic peripheral nerve block the same block is performed under ultrasound control with local anaesthetic and steroid (1-2mg/ml of trimcinolone to a maximum dose of 40mg). Peripheral nerve blocks are only offered if children and adolescents are willing to participate in the whole team approach with adherence to paced activity and integration with psychology. The duration of effect of a therapeutic block is extremely varied and may be related to time from diagnosis as well as

to the degree in which paced return to activity is adhered to following successful block. Subsequent therapeutic blocks tend to last longer than the previous.

3.2.1 Pharmacology

The steroid element of the therapeutic peripheral nerve block is considered to either reduce inflammation or result in thinning of the connective tissue around painful nerves (Suleiman & Johnston, 2001). There is no consensus on the correct dose of steroid that should be used for peripheral nerve blocks in children. Steroids have local and systemic side effects. The local effect of fascial thinning may have detrimental effects with repeat injections (Suleiman & Johnston, 2001). Side effects of ongoing or chronic systemic steroids include carbohydrate intolerance, hypothalamic-pituitary-adrenal suppression, growth failure (Hochberg, 2002) and others such as immunosuppression, cataracts, pseudomotor cerebri, pancreatitis steroid psychosis, and steroid myopathy (Rimsza, 1978). The incidence of major systemic side effects to infrequent intermittent steroid injections is not known.

3.3 The mechanism and effects of the treatment

The specific effects of peripheral nerve blocks rely on the action of pharmacological agents such as local anaesthetics and triamcinolone. However, broader elements of care are also significant. In the context of an ongoing treatment regime, it is particularly important to consider the psychosocial dynamics of the diagnosis and treatment processes, including development of trust in the healthcare team and springboard effects from the realization of interim treatment goals. It is presumed that the combination of these effects creates/initiates a break or change in the pain cycle and reverses the changes that occurred within the peripheral and central nervous system to cause chronic pain.

3.3.1 Nonspecific treatment effects

We may like to think that when a patient gets better, it is the direct and intentional result of medical intervention, but it may not be quite so straightforward. Jamison (2011) identifies three mechanisms, which may contribute to any improvement in a patient's pain or functioning – (i) the specific or intended effects of any treatment, (ii) natural history and (iii) nonspecific effects of treatment – and there may be some interaction between these elements. Nonspecific treatment effects are the outcomes of patient encounters with healthcare providers. These include attention, stimulation of the desire to get better, reduced anxiety, increased understanding, trust, hope, optimism and improved ability to cope (Jamison, 2011). One important nonspecific treatment effect with children and adolescents is for others, including healthcare providers, to believe that they have pain. These non-specific treatment effects represent a complex array of psychosocial variables that, when utilized correctly, can bestow huge benefit to the patient's sense of wellbeing and outcomes.

The team's attention to the broader effects of pain on daily functioning and quality of life is crucial. What does the child's pain mean to them? What does it mean to their family? What are the patient goals of therapy and are they achievable? As discussed, psychosocial effects of pain such as sadness, frustration, anxiety or depression can become contributory factors to the continuation or worsening of pain in a vicious circle that is hard to escape without effective support. If they remain unrecognized and untreated, these factors may hinder the progress of any management plan.

It has been established that the style of communication adopted by a physician can have a dramatic effect on patient patient's health outcomes (Di Blasi et al, 2001; Griffin et al, 2004;

Verheul et al, 2010). Meaningful two-way communication between healthcare provider and patient is crucial. However, a patient-centred dialogue may depend on circumstances, as physicians appear to adopt a more patient-centred style of communication with patients who participate actively in the discussion (Cegala & Post, 2009). In paediatric care, the communication is, typically, three-way between provider, patient and parent or caregiver which makes adopting a patient-centred approach will often be more challenging. Effective communication, in this context, means using appropriate terminology and actively listening to both patient and parent as well as giving attention to their body language. Factors which have to be considered include: identifying patient and parental expectations, i.e. goal directed therapy; devoting enough time to acquire the whole pain-related history; interpreting non-responsiveness; identifying hidden messages conveyed in what's being said and not said; understanding family beliefs, hopes and fears; asking potentially embarrassing questions separately and in confidence; conveying empathy; introducing appropriate humour into the dialogue; conveying expertise and credibility in pain management; establishing trust; not causing more pain on examination; providing an agreed workable goal-directed and achievable management plan.

3.3.2 Placebo response to peripheral nerve block intervention

Without the evidence of a randomized double blind placebo controlled trial, it is not easy to stipulate that the interventional blocks are the overriding therapeutic modality in this case series. Many would argue that this represents a placebo response. A placebo response refers to the psychobiological response seen after administration of a placebo (a non therapeutic modality) in an individual or groups of patients. Placebo treatments have known effects on the endogenous pharmacology, cognitive and conditioning systems in humans (Fields & Levine, 1981; de la Fuente-Fernandez et al, 2001; Meissner et al, 2007; Wager et al, 2007; Benedetti, 2008; Scott et al, 2008; Eippert et al, 2009; Finniss et al, 2009).

Expectations have the strongest evidence for contributing to the placebo response, especially placebo analgesia. Within the neuro-pharmacological aspect of an analgesic placebo response, there is evidence for the role of endogenous endorphins as some placebo analgesic responses are reversed with naloxone. The respiratory centres, serotonin secretion, hormone secretion, immune responses and heart function are also involved in the biological response to placebo analgesic treatments (Finniss et al, 2009).

Whatever the mechanism of therapeutic benefit, placebo responses are potentially embedded in every intervention for pain relief (Robinson, 2009). The key message from our case series is that plain local anaesthetic nerve block provided only temporary relief for 7 out of 8 cases. Only when local anaesthetic and steroid was used, in conjunction with their ongoing interdisciplinary care, did these children and adolescents turn their lives around to their pre-pain level of functioning. If only a placebo response, it would be expected to last 1-3 months only. Only 2 of the cases required repeat therapeutic blocks which were performed greater than three months after the initial therapeutic block. This all points to a mainly therapeutic effect, but would have to be supported by a properly conducted study.

4. Conclusion

Chronic pain of childhood is an extremely complex condition which can have devastating effects on physical, psychological and social functioning. The interdisciplinary team management approach, based on pharmacology, physiotherapy and psychology, is the

standard of care for children with severe or ongoing chronic pain. However, in a small proportion of appropriately selected children peripheral nerve blocks can provide immediate, effective and long-term pain relief. The case histories outlined in this chapter demonstrate the enormous impact that pain can have on a child, their functioning and their families. The significant relief received from peripheral nerve blockade indicates that this is a modality that must be considered when the history and examination findings match those presented. However, formal studies are required to definitively evaluate the effectiveness of the peripheral nerve block intervention.

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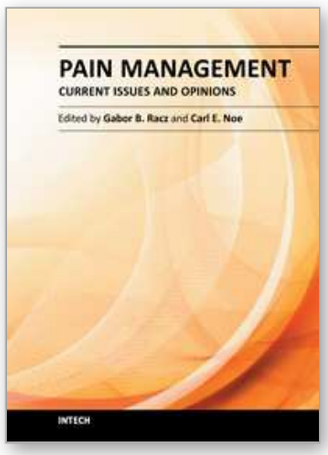
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Pain Management - Current Issues and Opinions is written by international experts who cover a number of topics about current pain management problems, and gives the reader a glimpse into the future of pain treatment. Several chapters report original research, while others summarize clinical information with specific treatment options. The international mix of authors reflects the "casting of a broad net" to recruit authors on the cutting edge of their area of interest. Pain Management - Current Issues and Opinions is a must read for the up-to-date pain clinician.

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