Persistent pain in patients following scoliosis surgery

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Abstract Chronic or persistent pain is increasingly recognised as a consequence of surgery in a number of different disciplines. The pain often exhibit qualities that differ from the acute post-operative pain and may represent changes in the central nervous system. There is lack of information regarding the incidence of persistent pain in patients following spinal surgery for scoliosis. This study aims to estimate the incidence of persistent pain following spinal surgery for scoliosis in a group of mainly adolescent patients. Questionnaires were distributed to consecutive patients attending the outpatient clinic of a hospital with specialist services in paediatric orthopaedics and spinal surgery. One hundred and five patients out of 122 eligible patients completed the survey. Fifty-two percent had ongoing pain upon hospital discharge either in the primary surgical site and/or in the iliac bone graft site. Approximately 10 and 7% of all patients had back and pelvic pain persisting beyond 12 months, respectively. A small proportion described elements of neuropathic pain. There was a trend suggesting that those who experienced more severe post-operative pain were more likely to develop persistent pain. These data are consistent with those reports that implicate surgery as the trigger for chronic pain.

Keywords Post-operative pain · Chronic pain · Neuropathic pain · Scoliosis surgery

Introduction

Corrective spinal surgery for scoliosis can be quite a distressing experience for adolescent patients and their parents [16]. Surgery involves an extensive amount of tissue and bone trauma that can result in significant perioperative pain. Consequently, a number of acute pain management strategies have been explored, with varying successes [4, 5, 18, 27]. The focus of analgesic research has mostly been on the few days immediately post-surgery [14], as the expectation is that the severe pain will be short-lived and subside as surgical healing takes place. However, persistent or chronic pain is being increasingly recognised as a possible consequence of a number of different surgical procedures [8, 12, 15, 22]. Although the definition of chronic post-surgical pain in the literature is far from consistent, the term usually implies pain lasting beyond the expected healing time or a particular time frame. Such persistent pain is often neuropathic in nature, exhibiting qualities that may be different from the initial acute pain [6, 31]. This probably involves central sensitisation at the dorsal horn of the spinal cord [30]. There may be individual susceptibility to the development of persistent pain, and it may be related to the intensity of the initial pain experienced [12, 25]. This study was performed to provide incidence data on persistent pain in patients who underwent corrective spinal surgery with bone grafting, as this has not been well documented previously. An appraisal will also be made on the proportion of persistent pain sufferers displaying elements of neuropathic pain and whether this impacts on their daily life.

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Materials and methods

This study is a retrospective survey that was conducted in the outpatient department of a 130-bed teaching hospital conducting specialist services in paediatric orthopaedics and spinal surgery, paediatric neurology, developmental paediatrics and paediatric dental surgery. Patients presenting to this clinic need not necessarily have had any presenting complaints, but were the part of a routine long-term follow-up programme established by the hospital for spinal patients. Owing to the location of the hospital, patients are generally of Chinese ethnic origin. Inclusion criteria included all patients who had instrumented or non-instrumented spinal fusion with iliac bone grafting for scoliosis, irrespective of age, gender, or time of surgery. Exclusion criteria were patient refusal and the inability to assess pain via the administered questionnaire.

Study nurses from the clinic approached consecutive eligible patients over a 12-month period and requested their participation. After obtaining consent, the participating patients were asked to complete a questionnaire and return it to the nurse before leaving the clinic. The help of the guardian or parents was elicited by the patients if they deemed it necessary. Opportunities were available for patients to clarify the nature of the questions, should more explanation be required. The data on the returned form were then collated anonymously by a research assistant.

Basic demographic and surgical data were collected by the nurse reviewing the medical records. The questionnaire was divided into four parts and contained questions either of the yes/no type or check box to options variety. An example of the former would be ‘‘Did you still have pain after hospital discharge?’’ An example of the latter would be ‘‘How long did the pain last; 0–3 months; 3–6 months; 6–12 months or greater than 12 months’’. Part one focused on the patients’ experience of pain while in hospital and whether they felt their pain relief was adequate. The main form of analgesia administered to this patient population was parenteral opioids, either as intermittent injection or via a patient-controlled analgesia device. They were also asked to rate the severity of the pain on a descriptive numerical rating scale, where 0 is no pain and 10 is excruciating pain. Mild pain corresponded to a rating of between 1 and 3, moderate pain 4 and 6 and severe pain 7 and 10. This part of the questionnaire also ascertained whether they had experienced persistent pain after hospital discharge and was completed by all participating patients. Persistent pain for this study was defined as pain lasting longer than 3 months. Should persistent pain be present, the patients were asked to identify the site of pain, namely the back, iliac donor graft site, both the back and graft site or in a location unrelated to the surgical site. Parts 2–4 of the questionnaire required the patients to characterise the

nature of the pain at the aforementioned sites and were completed only where applicable. A list of pain descriptors and exacerbating factors were provided and patients were asked to check the adjacent box should they be present. Finally, they were asked whether they felt that the pain affected their sleep and daily life.

Data are presented as absolute numbers and percentages of relevant response. No further statistical analyses were made. Approval for publication of the results was given by our local institutional ethics review board.

Results

Of the 122 eligible patients, there were 105 completed surveys suitable for analysis. Surveys were excluded due to incomplete entries or the failure to recall symptoms. Adolescent idiopathic scoliosis accounted for 85 of the 105 patients, 7 had Marfan’s syndrome and 3 suffered from neurofibromatosis. The remaining ten patients had variety of rare syndromes. All patients had instrumented surgery for their deformity. Four patients required the help of a parent or guardian to complete the survey. The operative dates fell between the years 1977 and 2001. The average time between the operation and survey date was 5.7 years (range 4 months to 27 years); the median duration was 4.25 years. Only 21 of the respondents were surveyed within 12 months of their operation. The average age of patients at the time of surgery and when surveyed were 13 (± 4.8) and 18.5 (± 7.5) years, respectively. There were 27 male and 78 female patients amongst those who completed surveys and 11 anterior and 94 posterior spinal fusions.

Fifty-five out of the 105 completed responses indicated the presence of prolonged post-operative pain (52%) (Table 1). Ten out of these 55 patients required medications for alleviation of their symptoms. Eleven out of the 28 patients (39.2%) who experienced mild back pain in the perioperative period developed persistent pain. In comparison, 23 out of 49 (46.9%) in the moderate perioperative back pain group and 20 out of 27 (74%) of the severe back pain group developed persistent pain. The severity and characteristics of persistent pain are shown in Tables 2 and 3, respectively. Only one respondent had a lone pelvic component to the pain and this pain was of mild intensity, although it lasted for more than 12 months.

Although persistent back pain intensity was rated as mild to moderate, it was sufficient to affect sleep or daily life in 28 and 36%, respectively, of those with persistent post-operative pain. A similar trend was seen when the pelvic component of the pain was examined in isolation. Almost half of this group reported prolonged pelvic pain of greater than 3 months in a duration that affected daily life in 25% and sleep in 14%. A small proportion of patients

Table 1 Incidence and localisation of persistent post-operative pain

Site	Patients reporting persistent pain (<i>n</i> = 55)	Percentage of all respondents (<i>n</i> = 105)	Percentage of patients with persistent pain (<i>n</i> = 55)
Isolated back pain	22	21.0%	40.0%
Isolated pelvis pain	1	1.0%	1.8%
Combined back and pelvis pain	28	26.7%	50.9%
Not localised	4	3.8%	7.3%
Total	55	52%	

responded “yes” to pain descriptors that are suggestive of neuropathic pain, such as burning (2 of 50 and 2 of 29 for back and pelvic pain, respectively), piercing (16 of 50 and 5 of 29) or pain in response to light touch (5 of 50 and 6 of 29).

Discussion

Our results show that close to half of patients surveyed suffer from prolonged post-operative pain following spinal surgery, in the primary operative and/or in the bone graft donor site. The duration of the pain exceeded 3 months in 40% of those reporting persistent back pain, and half of this group experienced it for more than a year. This latter subset of patients with pain over a year represented almost 10% of those surveyed. There seems to be a propensity to develop persistent pain in those who experience more severe peri-operative pain. It is difficult to determine whether this is a result of poor acute pain management or whether this is a group of patients that generally have a greater sensitivity to pain or perhaps even a pharmacogenetic resistance to

analgesics. It would be unethical to undertake a prospective study on such individuals, but it would seem prudent to identify them as early as possible to optimise acute pain management and follow them up carefully.

There are obvious methodological shortcomings of surveys. Of particular concern is the large range of the period between surgery and survey, especially with respect to how pain would be perceived some time later. However, the questions were not designed to score pain numerically, which indeed would be subjected to recall difficulties. Rather the questions aimed to gain an impression of whether the pain was mild, moderate or severe, an impression which would be more enduring for sentinel events such as major surgery with associated significant pain.. On the other hand, inclusion of patients surveyed at less than a year after surgery may underestimate the incidence of those with pain beyond 12 months.

There can be problems with sampling, as this was a convenient sample of consecutive patients attending the outpatient clinic and not consecutive patients presenting for surgery; thus, the precise percentage of patients undergoing surgery who were surveyed is not known. However, over a 100 patients were recruited over a substantial period of time and may be representative of the typical surgical patients in this population. Further, there is a lack of control for various pre- and post-operative surgical factors, and the retrospective nature of data collection can be associated with recall bias. Our patients were a fairly homogeneous group of the same ethnic origin and underwent very similar surgical procedures.

Despite the above considerations, the results do appear to suggest that the incidence of persistent pain following corrective spine surgery is clinically significant. These figures are lower than those reported after other orthopaedic surgery, such as elective trauma (61.7% across all

Table 2 Severity, duration and impact of persistent pain

	Back pain (% of total surveyed) <i>n</i> = 105	Number affected as percentage of all patients with back pain (<i>n</i> = 50) ^a	Pelvic pain (% of total surveyed) <i>n</i> = 105	Number affected as percentage of all patients with pelvic pain (<i>n</i> = 29) ^b
Intensity				
Mild	30 (28.6%)	60%	24 (22.9%)	82.8%
Moderate	20 (19.0%)	40%	4 (3.8%)	13.8%
Severe	0 (0%)	0%	1 (1.0%)	3.4%
Duration				
0–3 months	30 (28.6%)	60.0%	15 (14.3%)	51.7%
4–6 months	7 (6.7%)	14.0%	5 (4.8%)	17.2%
7–12 months	3 (2.9%)	6.0%	1 (1.0%)	3.4%
>12 months	10 (9.5%)	20.0%	7 (6.7%)	24.1%
Impact				
Affecting daily life	14 (13.3%)	28.6%	7 (6.7%)	21.4%
Affecting sleep	18 (17.1%)	36.7%	4 (3.8%)	13.8%

^a Isolated back pain (22) + concomitant back and pelvic pain (28)

^b Isolated pelvic pain (1) + concomitant back and pelvis pain (28)

Table 3 Characteristics of persistent pain

	Back (<i>n</i> = 50 ^b)	Pelvis (<i>n</i> = 29 ^c)
Characteristics		
Burning ^a	2	2
Piercing ^a	16	5
Aching	28	11
Sharp	7	1
Frequency		
Seldom	17	17
Sometimes	31	10
Often	2	0
Continuous	0	1
Exacerbating factors		
Weather	16	7
Physical activity	17	9
Sitting down	10	7
Standing	5	3
Lying on the wound	7	6
Touching lightly ^a	5	6

Values are number of positive responses. Each patient may have multiple responses

^a Descriptors suggestive of neuropathic pain (see Sect. “Discussion”)

^b Isolated back pain (22) + concomitant back and pelvic pain (28)

^c Isolated pelvic pain (1) + concomitant back and pelvis pain (28)

grades of chronic pain at 7 months post-surgery) [11], joint-replacement surgery (between 0.5 and 40% at least 1 year post-surgery) [7] or spinal surgery for degenerative disease [1]. The presence of pre-operative pain may partly explain this difference [29] as the indication for elective orthopaedic surgery is often for the relief of pain from trauma or degenerative arthritic changes. As such, it may be difficult to differentiate between pain that is of new onset post-operatively versus continuation of unrelieved pre-operative pain. In comparison, the indications for corrective spinal surgery include halting progression of the condition and preventing complications associated with scoliosis, while pain is not a common component. Chronic pre-operative pain may have already initiated changes in the central nervous system that serve as a prelude to the development of persistent pain. This may explain also the observation that successful surgery may not always result in pain reduction or resolution [26].

Persistent pain as sequelae of all surgery is increasingly being recognised as a separate entity and has been the subject of a number of comprehensive reviews [19, 24]. Close to 25% of patients referred to chronic pain clinics identified surgery as the antecedent [9]. There is a paucity of data regarding the nature and duration of post-operative pain in the area of corrective spinal surgery. In one series

examining long-term evolution of the lumbar spine below the fused segments, the authors indicated that 21.3% had back pain after 10 years [23]. Indirect reference from the rehabilitation literature suggests that the problem of pain may also be in the order of years in certain patient groups [28].

Such lack of data may result from the difficulty in defining persistence or chronic in post-surgical pain. A working definition has been proposed by the Task Force on Epidemiology of the International Association for the Study of Pain to facilitate collation of data from a large pool of studies. Four criteria should be met in order for the pain to be classified as chronic post-surgical pain [20]:

1. the pain developed after a surgical procedure
2. the pain is of at least 2 months duration
3. other causes for the pain should have been excluded
4. the possibility that the pain is continuing from a pre-existing problem must be explored and exclusion attempted.

Determining when the expected acute pain from surgery ceases and when chronic pain begins are also difficult. It is complicated by the protean manifestation of chronic pain, in terms of onset, quality, severity and duration. Both pain states can possibly coexist in the post-operative period, with the chronic pain component concealed by the “normal” inflammatory pain from tissue injury. Inflammatory mediators can themselves modulate both peripheral and central afferent processing mechanisms. Qualities such as burning, hyperalgesia (exaggerated response to a normally nociceptive stimulus) or allodynia (a painful response to a non-painful stimulus) may indicate the onset of neuropathic changes that are prominent components of chronic pain.

Presence of persistent pain does not and need not imply a surgical mishap, incompetence or even failure of healing. The cause of this condition is certainly complex, and it would be naïve to implicate surgical trauma as the sole cause. Indeed, complex regional pain syndrome, a manifestation of severe neuropathic pain, can occur following trivial injuries. Some pain experts are of the opinion that individuals may differ in their susceptibility to the development of this condition [19], with a multifarious interplay also involving familial and psychological factors [2, 21]. Persistent pain has actually been described as a disease state of the nervous system and is not merely a symptom of some other disease conditions [3]. Some indirect evidence suggests that it may be related to the intensity or duration of the acute pain experience [12, 25]. Results from our survey seem to support this notion, as a higher percentage of those who experienced more severe post-operative pain developed persistent pain.

Much pain research has now been directed towards preventive or pre-emptive analgesia, focusing on antino-

ciceptive treatment that may prevent the establishment of altered central processing of afferent input from sites of injury [10]. For this to be successful, it appears that effective analgesia should be instigated as early as possible and then continued well into the post-operative period in order to prevent central sensitisation during the acute inflammatory period. Multimodal therapy may be more efficacious in this regard [13]. This emphasis on effective acute pain management underscores the need for appropriately trained staff with well-formulated pain-management plans.

The acknowledgement of persistent pain by both patients and medical personnel during the pre-operative consultative process may help patients in a variety of ways. Anticipating this possibility ahead of time may revise the patient's expectation and open up discussion of various coping strategies of both medicinal and non-pharmacological varieties. Such information and discussion may improve the patient's ability to manage the situation, should it occur [17]. It may even allay patient's fear and anxiety that something has either "gone wrong" with the surgery or that they have done something to account for the pain. Unnecessary investigations and/or interventions may be avoided after a reasonable search to exclude an "organic" cause has been conducted.

Conclusions

In conclusion, findings from this survey offer some insight into this under-documented area of persistent post-surgical pain in major corrective spinal surgery. Post-surgical pain may last well beyond the period expected for normal healing and represent neurobiological changes in the peripheral and central nervous systems. This condition should encourage more research into effective preventive strategies.

References

- Andersen T, Christensen FB, Hansen ES, Bunger C (2003) Pain 5 years after instrumented and non-instrumented posterolateral lumbar spinal fusion. *Eur Spine J* 12:393–399
- Bachiocco V, Scesi M, Morselli AM, Carli G (1993) Individual pain history and familial pain tolerance models: relationships to post-surgical pain. *Clin J Pain* 9:266–271
- Basbaum AI (1999) Spinal mechanisms of acute and persistent pain. *Reg Anesth Pain Med* 24:59–67
- Beaulieu P, Cyrenne L, Mathews S, Villeneuve E, Vischoff D (1996) Patient-controlled analgesia after spinal fusion for idiopathic scoliosis. *Int Orthop* 20:295–299
- Blumenthal S, Min K, Nadig M, Borgeat A (2005) Double epidural catheter with ropivacaine versus intravenous morphine: a comparison for postoperative analgesia after scoliosis correction surgery. *Anesthesiology* 102:175–180
- Breivik H (2002) How to implement an acute pain service. *Best Pract Res Clin Anaesthesiol* 16:527–547
- Brown TE, Larson B, Shen F, Moskal JT (2002) Thigh pain after cementless Tital hip arthroplasty: evaluation and management. *J Am Acad Orthop Surg* 10:385–392
- Callesen T, Bech K, Kehlet H (1999) Prospective study of chronic pain after groin hernia repair. *Br J Surg* 86:1528–1531
- Crombie IK, Davies HT, Macrae WA (1998) Cut and thrust: antecedent surgery and trauma among patients attending a chronic pain clinic. *Pain* 76:167–171
- Dahl JB, Mathiesen O, Moiniche S (2004) 'Protective premedication': an option with gabapentin and related drugs? A review of gabapentin and pregabalin in the treatment of post-operative pain. *Acta Anaesthesiol Scand* 48:1130–1136
- Gehling M, Scheidt C-E, Niebergall H, Kocaoglu E, Tryba M, Geiger K (1999) Persistent pain after elective trauma surgery. *Acute Pain* 2:110–114
- Katz J, Jackson M, Kavanagh BP, Sandler AN (1996) Acute pain after thoracic surgery predicts long-term post-thoracotomy pain. *Clin J Pain* 12:50–55
- Kelly DJ, Ahmad M, Brull SJ (2001) Preemptive analgesia II: recent advances and current trends. *Can J Anesth* 48:1091–1101
- Kotzer AM (2000) Factors predicting postoperative pain in children and adolescents following spine fusion. *Issues Compr Pediatr Nurs* 23:83–102
- Kroner K, Krebs B, Skov J, Jorgensen HS (1989) Immediate and long-term phantom breast syndrome after mastectomy: incidence, clinical characteristics and relationship to pre-mastectomy breast pain. *Pain* 36:327–334
- Lamontagne LL, Hepworth JT, Salisbury MH (2001) Anxiety and postoperative pain in children who undergo major orthopedic surgery. *Appl Nurs Res* 14:119–124
- LaMontagne L, Hepworth JT, Salisbury MH, Cohen F (2003) Effects of coping instruction in reducing young adolescents' pain after major spinal surgery. *Orthop Nurs* 22:398–403
- Machida M, Imamura Y, Usui T, Asai T (2004) Effects of pre-emptive analgesia using continuous subcutaneous morphine for postoperative pain in scoliosis surgery: a randomized study. *J Pediatr Orthop* 24:576–80
- Macrae WA (2001) Chronic pain after surgery. *Br J Anaesth* 87:88–98
- Macrae WA, Davies HTO (1999) Chronic postsurgical pain. In: Crombie IK, Croft PR, Linton SJ, LeResche L, Von Korff M (eds) *Epidemiology of pain*. IASP Press, Seattle, pp 125–142
- McLean SA, Clauw DJ (2004) Predicting chronic symptoms after an acute "stressor"—lessons learned from 3 medical conditions. *Med Hypotheses* 63:653–658
- Meyerson J, Thelin S, Gordh T, Karlsten R (2001) The incidence of chronic post-sternotomy pain after cardiac surgery—a prospective study. *Acta Anaesthesiol Scand* 45:940–944
- Michel CR, Lalain JJ (1985) Late results of Harrington's operation. Long-term evolution of the lumbar spine below the fused segments. *Spine* 10:414–420
- Perkins FM, Kehlet H (2000) Chronic pain as an outcome of surgery. A review of predictive factors. *Anesthesiology* 93:1123–1133
- Perttunen K, Tasmuth T, Kalso E (1999) Chronic pain after thoracic surgery: a follow-up study. *Acta Anaesthesiol Scand* 43:563–567
- Slosar PJ (2002) Indications and outcomes of reconstructive surgery in chronic pain of spinal origin. *Spine* 27:2555–2562
- Vitale MG, Choe JC, Hwang MW, Bauer RM, Hyman JE, Lee FY, Roye DP Jr (2003) Use of ketorolac tromethamine in children undergoing scoliosis surgery. An analysis of complications. *Spine J* 3:55–62

28. Weiss HR (2002) Rehabilitation of scoliosis patients with pain after surgery. *Stud Health Technol Inform* 88:250–253
29. Wilder-Smith OH, Tassonyi E, Arendt-Nielsen L (2002) Preoperative back pain is associated with diverse manifestations of central neuroplasticity. *Pain* 97:189–194
30. Woolf CJ, Salter MW (2000) Neuronal plasticity: increasing the gain in pain. *Science* 288:1765–1769
31. Woolf CJ, Thompson SW (1991) The induction and maintenance of central sensitization is dependent on *N*-methyl-D-aspartic acid receptor activation; implications for the treatment of post-injury pain hypersensitivity states. *Pain* 44:293–299