Pre-emptive local anesthesia for needlescopic video-assisted thoracic surgery: a randomized controlled trial


Division of Cardiothoracic Surgery, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, Hong Kong SAR, China

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Abstract

Objective: Studies in other surgical specialties have suggested that pre-emptive wound infiltration using a local anesthetic may reduce post-operative pain. We report the first randomized trial to assess the use of pre-emptive local anesthesia in video-assisted thoracic surgery (VATS).

Method: Thirty-one consecutive patients undergoing bilateral needlescopic VATS sympathectomy for palmar hyperhidrosis were studied prospectively. Each patient acted as their own control. For each patient, one side was randomized to receive 10 ml 0.5% bupivacaine injected to the port sites before incision, and the contralateral control site to receive 10 ml saline. Pain severity on a visual analog scale (VAS) was recorded for each chest side at 4 h, 1 day and 7 days following surgery. All patients were blinded to the results of randomization throughout the study.

Results: Follow up was complete for all patients. At 7 days after surgery, wound pain was significantly reduced by pre-emptive local anesthesia, with 10 (62.5%) of the 16 patients having residual pain reporting less pain on the pre-treated side (p = 0.039). There was a trend for reduced pain on the pre-treated side at the other time points. Pain reduction by pre-emptive local anesthesia was not correlated with any demographic or clinical variable. Chest wall paresthesia distinct from localized wound pain was noted by six patients (19.4%), but was not reduced by pre-emptive local anesthesia. Overall, the post-operative discomforts felt by the patients after needlescopic VATS were mild, and did not cause significant functional disturbances. Conclusion: Pre-emptive wound infiltration with a local anesthetic may reduce post-operative wound pain in needlescopic VATS procedures.

Keywords: Chest wall; Hyperhidrosis; Local anesthesia; Pain; Sympathectomy; Video-assisted thoracic surgery (VATS)

1. Introduction

Pain is recognized to be a major source of post-operative morbidity. In thoracic surgery, post-operative chest wall pain can lead to respiratory complications, reduced shoulder function and chronic pain syndromes [1]. This situation is compounded by the fact that the posterolateral thoracotomy—the most common surgical approach to the chest—is amongst the most painful of all surgical wounds.

Video-assisted thoracic surgery (VATS) has been developed as an alternative approach to thoracotomy for a variety of diagnostic and therapeutic operations, allowing equally effective surgery but with significantly less morbidity [2]. The advantages of VATS include reduced post-operative hospital stays, analgesics requirements, and respiratory impairment compared to open surgery [3]. Nevertheless, some degree of pain may still afflicts up to 63% of patients after VATS procedures [4–6]. We have previously reported that 52.9% of patients receiving VATS pleurodesis for spontaneous pneumothorax also experience paresthetic chest wall discomforts, which are distinct from, localized wound pain [7]. One strategy to improve on the results of VATS is needlescopic VATS (n-VATS) whereby the 10 mm ports and instruments of conventional VATS (c-VATS) are replaced by very fine 2 or 3 mm instruments [8]. Using such minimally invasive strategies, post-operative pain and discomfort may be reduced but not completely eliminated [9].

One strategy that may further reduce post-operative wound pain in minimally invasive surgery is pre-emptive analgesia. Some studies now suggest that a painful stimulus can ‘sensitize’ the central somatosensory pathways, and hence amplify the response to subsequent painful stimuli [10–12]. In theory, any treatment given before or during the operation that can prevent the original painful stimulus from activating this sensitization should therefore reduce the subsequent development and severity of post-operative pain.

Various approaches have been proposed to produce pre-emptive analgesia. Mixed results have been obtained using...
pre-emptive epidural analgesia and/or systemic analgesia for thoracotomy procedures [13—15]. However, for many simpler VATS procedures, in which the degree of pain may be less and there may be an expectation of early discharge home, such epidural strategies may be less appropriate. A simpler strategy of pre-emptive wound infiltration with local anesthesia may be more acceptable for both surgeons and patients. Pre-emptive local anesthesia has been used in minimally invasive surgery such as gynecological laparoscopy, laparoscopic cholecystectomy, and arthroscopy [12,16—18]. In thoracic surgery, there has only been one report of the use of pre-emptive local anesthesia in open thoracotomy [19], and none of its use in VATS.

Herein, we report the first prospective, randomized, placebo-controlled trial to our knowledge to assess the effectiveness of pre-emptive local anesthesia in reducing post-operative wound pain following minimally invasive thoracic surgery. By selecting only patients receiving bilateral n-VATS sympathectomy for study, our particular study design allows for an effective control and significant results from a relatively small patient cohort.

2. Methods

2.1. Patients

For homogeneity of the patient cohort, we selectively studied only patients presenting with palmar hyperhidrosis and who underwent uncomplicated bilateral n-VATS thoracodorsal sympathectomy using 3 mm ports and instruments. The identical surgery performed on each side of the chest allowed each patient acted as his or her own control with an intervention given unilaterally.

We assessed 31 consecutive patients who received n-VATS sympathectomy for primary palmar hyperhidrosis at our institution between March 2004 and March 2005. It was pre-determined that patients would be excluded from this study if conversion to c-VATS for hemostasis or any intra-operative complication was required; if dense pleural symphysis was encountered requiring extensive adhesiolyis; if more difficulty was experienced during surgery on one side than the other; or if there was any history of allergy to local anesthetic agents, analgesic abuse, or any physical or psychological problem that may influence pain response or ability to comply with study. None of the 31 patients assessed fulfilled any of these exclusion criteria, and none refused participation in this study. All patients gave informed signed consent and were recruited for this study. The study protocol was approved by our Institutional Research Ethics Committee.

The 31 patients included 8 males and 23 females. They had a median age of 31 years and a mean age of 31.4 years (range: 15—50 years). Seven were smokers. Two patients had mild asthma for which one required use of inhaled bronchodilators. None of the other patients had any significant past medical or allergic history.

Randomization was performed by a shuffled, sealed envelope technique. The envelope was opened in the operating room after induction of general anesthesia to indicate which chest side was to receive pre-emptive local anesthesia.

2.2. Operative protocol

Our technique for n-VATS sympathectomy has been reported [9]. For all patients, we use a novel technique of selective lobar collapse [20]. We place the patient in a 20—30 degree semi-sitting position with the arms abducted to 80—90 degrees in a crucifix position. We use a three-port strategy with 3 mm ports, camera and instruments only, and emphasize minimal torquing at each port during instrumentation. We perform resection of the thoracodorsal sympathetic trunk including the T2 and T3 ganglia on each side, using a combination of gentle sharp and blunt dissection with the minimal amount of electro-cautery necessary for hemostasis. The same surgeon performed the surgery on both sides of each patient.

On the side randomized for pre-emptive local anesthesia, local infiltration with 0.5% bupivicaine is given at each port site prior to incision. A total of 10 ml of 0.5% bupivicaine is used for the three ports. The contralateral side is designated as the control side, and local infiltration with 10 ml normal saline is given at each port site on that side prior to incision. The operation performed is otherwise identical on both sides. We routinely operate on the left side first, followed by the right side, regardless of the result of randomization.

At the end of the procedure, a chest tube is not routinely placed. Our standard post-operative analgesics regime for all patients is a tablet containing a mixture of paracetamol with dextropropoxyphene given on an ‘as required’ basis. All patients are discharged on the day after surgery provided no significant complications are noted clinically or radiographically.

2.3. Data collection

All patients were kept blinded to the results of randomization throughout the study. Data collection was performed for each patient at 4 h after surgery, on the day following surgery prior to discharge, and on follow-up in our out-patients clinic at 7 days after surgery.

At each data collection time point, patients were asked to grade the severity of any pain on a 100 mm visual analog scale (VAS) for each chest side. A difference of 10 mm or greater between the two sides was taken to indicate significant difference in pain severity. Patients were asked to specify the site and nature of the pain. It was also documented whether any oral analgesia was used, and if so, whether it relieved the pain. Patients were also asked if they experienced any paresthetic discomfort in addition to localized wound pain. For the purposes of this study, ‘paresthesia’ has been defined as any numbness or disordered sensation causing chest wall discomfort, which the patient can distinguish clearly from the wound pain. The severity of any such paresthesia on a VAS was documented. At each time point, the range of unassisted active shoulder abduction on each side was also documented as an indicator of gross shoulder function.

At the out-patients follow-up at 7 days after surgery, patients were asked about any sleep disturbance or impairment in daily activities due to pain. All patients were also asked to grade their overall satisfaction with the surgery on a 10-point numeric scale. We regard a satisfaction score of below 5 to indicate that the patient was ‘dissatisfied’. Any
adverse effects following surgery (such as compensatory and gustatory hyperhidrosis, Horner’s syndrome, and pneumothorax) were recorded.

We estimated that a 10 mm difference in VAS scores may be demonstrated by a patient cohort size of 30 patients on power analysis where \( \alpha = 0.05 \) with a power of 80%. Statistical analyses of the collected data were performed using the Student’s t-test for normally distributed data and the Mann–Whitney U-test for skewed data. McNemar tests were performed to test the hypothesis that pre-emptive local anesthesia improved pain, paresthesia or shoulder function compared with the control side at each of the time points after surgery. All computer analyses were performed using the SPSS for Windows software, version 13.0 (SPSS Inc., Chicago, IL, USA). We regard a \( p \) value of less than 0.05 as being significant.

3. Results

Follow-up and data collection was complete for all 31 patients. There were no conversions to a c-VATS or open procedure in any patient. There were no deaths or major complications in any patient. Two patients had a small unilateral pneumothorax on CXR following surgery, but neither required insertion of a chest drain and the pneumothorax resolved by the time of out-patients follow-up in both patients. One patient had a small unilateral pleural effusion on CXR following surgery, but this again did not require insertion of a chest drain and resolved on conservative management. There were no wound complications or adverse event related to injection of the local anesthetic in any patient. All patients had resumed full work or full pre-operative levels of activity on out-patients follow-up 1 week after surgery.

None of the patients had residual palmar hyperhidrosis after surgery. Eight patients (25.8%) noted some degree of compensatory hyperhidrosis, defined as increase in sweating in parts of the body other than the hands compared to pre-operative levels. None of the patients developed Horner’s syndrome, gustatory hyperhidrosis or other specific complications from the sympathectomy.

3.1. Pain

The results relating to pain are summarized in Table 1. During the course of the first 7 days after surgery, the number of patients reporting pain and the mean VAS scores in those who reported pain fell as expected. Statistical analysis confirmed that the pre-emptive wound infiltration with local anesthetic significantly reduced the severity of wound pain at 1 week after surgery \( (p = 0.039) \). There was a trend for reduced pain on the pre-treated side at the other time points, but this did not reach significance. Of patients with reduced wound pain from pre-emptive local anesthesia, the VAS score on the pre-treated side was less than half that of the control side in four (40.0%), three (23.1%) and two (20.0%) patients at 4 h, 1 day, and 7 days after surgery, respectively.

Further subgroup analyses failed to detect any correlation between pain reduction with pre-emptive local anesthesia and any demographical or clinical factor in any patient, or the side of the chest given local anesthesia. Only four patients reported occasional use of the prescribed oral analgesia described above at post-operative day (POD) 7, and hence there were insufficient numbers to correlate analgesic use with the use of pre-emptive local anesthesia.

The two patients who described pain being worse on the pre-treated side at 1 week after surgery also reported pain being worse on the pre-treated side at the earlier two time points. Review of the operation and case records in these two patients could not identify any intra- or peri-operative factors that could account for the worse pain on the pre-treated side in these two patients.

3.2. Paresthesia

The results relating to chest wall paresthesia are summarized in Table 2. On POD 7, six patients (19.4%) reported having chest wall paresthesia, with a mean VAS score of 1.7 (range 0—3). In these six patients, the discomfort described was poorly localized and unrelated to the wound sites. Numbness of the chest wall was described in four patients, chest wall ‘bloating’ sensations by four, ‘pins and needles’ by one, and burning and ‘constricting’ sensations by one each.

At none of the three time points could pre-emptive local anesthesia be correlated with a reduction in severity of chest wall paresthesia.

3.3. Functional disturbances

At 4 h and at 1 day after surgery, four patients (12.9%) were noted to have a mild degree of limitation of their active range of unassisted shoulder abduction. However, the
limitation was equal on both sides in all four patients, and no correlation with the use of pre-emptive local anesthesia could be demonstrated. At 1 week after surgery, all 31 patients had complete active range of unassisted shoulder abduction.

At 1 week after surgery, seven patients (22.6%) noted sleep disturbance due to wound discomfort following surgery. In five of the seven patients, sleep was only disturbed on one out of the seven nights following surgery. No statistical correlation was found between sleep disturbance and the use of pre-emptive local anesthesia.

In addition to the above, at POD 7, one patient found it difficult to dress herself and another patient claimed that use of the arm for heavy lifting was mildly impaired because of wound pain on the control side. Again, statistical significance was not reached to demonstrate any benefit of pre-emptive local anesthesia.

3.4. Patient satisfaction

Table 3 shows the overall satisfaction with surgery of the 31 patients following bilateral n-VATS sympathectomy as expressed by the patients on a 10-point numeric scale. Defining a score of ‘5’ as a pass mark, 30 patients (96.8%) were satisfied with the results of their surgery.

Only one patient (3.2%) gave a satisfaction score of less than ‘5’. This patient’s dissatisfaction was mainly because of wound pain, and she claimed that were it not for the pain, she would have given a score of ‘8’ as she was pleased with the cure of her palmar hyperhidrosis. In this patient, the pain severity was equal on pre-treated and control sides at all time points. Review of her clinical records could not identify any specific cause for her particularly severe pain.

Overall, patient satisfaction was found not to correlate statistically with any patient demographic factor, the severity of pain or paresthesia, or any benefit from pre-emptive local anesthesia. Satisfaction was also not correlated with any complications from surgery in this series, including compensatory hyperhidrosis.

4. Discussion

Physiological studies have confirmed that a painful stimulus does not merely transmit a nociceptive signal to the central nervous system. It may trigger a complex cascade of physiological alterations in the somatosensory system, which lowers the dorsal horn neurone thresholds, ‘sensitizing’ the peripheral and central pain pathways [10–12]. The response to subsequent or persisting painful stimuli may thereby be amplified, resulting in hyperalgesia, spontaneous pain and allodynia. Pre-emptive analgesic intervention given before surgery may therefore prevent this sensitizing cascade, reducing the development and severity of post-operative pain.

The efficacy of pre-emptive analgesia has been documented in many animal studies over the years [21]. However, similar benefits in a clinical setting in humans have thus far not been consistently reproduced [12, 22]. Many explanations have been proposed, including that animals in a laboratory provide a more controlled study model than a clinical setting, and that the laboratory-inflicted injuries in animals provide more specific noxious stimuli than the more complex pain patterns seen in surgical patients [14, 18].

Studies of pain management in human populations are confounded by the large potential inter-patient variations in reporting pain severity. Sex, age, socioeconomic background, psychosocial factors and so on can greatly influence the level of pain reported subjectively by a patient. Studying patients undergoing bilaterally symmetrical surgery allows each patient to act as his or her own control, effectively eliminating the influence of such variables. The use of the bilaterally symmetrical surgery model to test the efficacy of pre-emptive analgesia using local anesthesia has been described in patients undergoing dental surgery [23]. In thoracic surgery, bilateral n-VATS sympathectomy for palmar hyperhidrosis provides a similar model of bilaterally symmetrical surgery. We have duly studied a cohort of 31 patients, which is equivalent to a study involving 62 patients (31 intervention group and 31 control group) had the bilateral model not been used.

Various approaches have been proposed to produce pre-emptive analgesia in patients undergoing surgery. In thoracic surgery, the main focus in this field has been the provision of pre-operative epidural, systemic and/or regional analgesia for patients undergoing thoracotomy. Results thus far have been mixed. Aguilar and colleagues reported a randomized trial of 45 patients undergoing posterolateral thoracotomy who received pre-operative extradural bupivicaine, post-operative extradural bupivicaine or placebo [13]. They found no significant difference in VAS pain scores at up to 48 h after surgery. Doyle and Bowler randomized 30 patients undergoing posterolateral thoracotomy to receive either pre-operative or post-operative analgesia using a combination of systemic opiates and NSAIDs plus intercostal nerve blockade [14]. They reported a modest reduction in pain scores during the first 48 h in the pre-treated group, but no benefit thereafter. More recently, Yegin and co-workers reconfirmed that pre-operative initiation of epidural analgesia could reduce post-operative pain for up to 48 h after thoracotomy [15]. Nevertheless, such epidural and systemic strategies may prove less appropriate for minimally invasive thoracic surgery, where the severity of pain may not be as great as after thoracotomy. Patients undergoing VATS may also have expectations of early discharge home. Many centers now offer n-VATS sympathectomy as day case surgery. Epidural analgesia may therefore not be the most appropriate choice for such situations.

An alternative approach is the pre-emptive use of peripheral local anesthetic agents. The strategy of pre-emptive analgesia by wound infiltration with local anesthesia
has been reported in minimally invasive surgery in other surgical specialties with mixed results. Effective analgesia by pre-emptive local anesthe

sia has been reported in gynecological laparoscopy, laparoscopic cholecystectomy, and arthroscopy [12,16—18], but in one meta-analysis a significant benefit with this approach could not be confirmed [22]. In thoracic surgery, only one previous study has been performed randomizing 119 patients undergoing thoracotomy to receive either pre-emptive local anesthesia to the skin or a placebo [19]. Significant benefit was not shown with pre-emptive local anesthesia, probably because the pain from a major thoracotomy involves neuropathic and visceral components not controllable by local anesthesia at the skin only. Nonetheless, no adverse effects have been found in all these studies using pre-emptive local anesthesia, and the technique is undeniably quick and simple to perform. It therefore remains an attractive option for the surgeon, especially when performing minimally invasive surgery. To our knowledge, our current study is the first to assess the use of pre-emptive analgesia in minimally invasive thoracic surgery.

Our results show a significant reduction in pain with pre-emptive local anesthesia. The most significant benefit from pre-emptive local anesthesia is seen not immediately after surgery, but at 1 week after surgery. This was consistent with a blocking of the central sensitization that would have given rise to amplified pain responses at some time after surgery. Another possibility is that a significant component of the pain during the first few days after surgery may be from the use of electro-cautery for hemostasis. This electro-cautery-related pain at the pleura may partly mask the effect of the local anesthesia on the pain at the wounds. A closer look at Table 1 suggests this may be the case as it is only when the number of patients with similar pain on both sides is reduced by POD 7 that the statistical significance is reached.

We note that the mean VAS scores for pain at all three time points in this study were less than 4.0, and that the pain following n-VATS caused only minimal functional disturbances if at all in the patients studied. The pain we are addressing in this study is therefore relatively mild. Nevertheless, in such simple, non-life saving surgery as n-VATS sympathectomy, a patient’s overall impression of the outcome may be greatly swayed by comparatively simple details such as perceived discomforts, side effects and cosmesis. In this context, the benefits potentially achievable by the use of pre-emptive local anesthesia may play an important role in post-operative satisfaction this group of patients. The fact that the only patient dissatisfied with surgery in this study was only dissatisfied because of pain corroborates this view.

One limitation of our study may be the simplistic measure of pain using a VAS score. Although the VAS score is the most frequently used measure of pain in most surgical studies, it is a subjective score that can be influenced by many variables, such as any side effects of treatment, psychosocial factors, satisfaction with resolution of the hyperhidrosis, and discomforts other than pain (such as chest wall paresthesia). The use of more sophisticated means of quantifying pain, like the McGill pain questionnaire, may also be susceptible to the influence of these confounding variables as well as being cumbersome to use [19]. We believe our bilaterally symmetrical surgery model effectively minimizes such variables to a large degree, however, because each intervention is compared with an identical control (namely, the same patient).

Another limitation is the inability to ensure that the degrees of analgesia achieved were similar or adequate in all patients after induction of general anesthesia. We used a standardized dose of 10 ml 0.5% bupivacaine distributed amongst the three ports in all patients. We acknowledge that this does not fully account for variations in patient size, in the depth and area of infiltration by bupivacaine, or in the different rates of diffusion of bupivacaine through the tissues in each patient. Ideally, could achieve similar degrees of analgesia in all patients by titrating the administration of bupivacaine in an awake patient. However, this is not practical in the setting of most thoracic operations, and would also negate the blinding of the patient in this randomized trial.

It has also been argued that effective pre-emptive analgesia should not stop at the end of surgery [21]. Although bupivacaine can provide analgesia immediately following surgery, nociceptive stimuli continue to be produced by the wounds until they are fully healed. Therefore, the process of central sensitization to pain may continue long after the effect of pre-incisional bupivacaine has subsided. Technically, full pre-emption of the sensitization of central pain pathways can only be provided by continuously giving bupivacaine from prior to incision to the time of complete wound healing and cessation of noxious stimuli. In the case of patients undergoing sympathectomy who are typically discharged within 24 h of surgery, this is obviously not practicable. For future studies, the use of post-operative bupivacaine infiltration as an alternative control to pre-incisional saline or in both study arms can be investigated.

We recognize that the painful stimuli originate not only from the wounds, but also from the entire surgical procedure. Discomfort from thoracic surgery may result from inflammation, rib spreading, costochondral and costovertebral trauma, pleural injury and other sources. In this study, our use of wound infiltration by local anesthetic targets the painful stimuli from the wounds only. We have tried to reduce the influence of other surgical sources of pain by studying only patients undergoing bilateral n-VATS sympathectomy, which is a quick, simple procedure that involves minimal intra-thoracic manipulation and trauma. Again, the bilaterally symmetrical nature of the surgery should help minimize the influence of these other pain sources. However, as pointed out above, one weakness of this model is that electro-cautery injury may still be present at the pleura which can obscure wound site pain. One option for future study would be the infiltration of local anesthetic to the pleura at the site of resection.

It is increasingly recognized that one of the sources of discomfort after thoracic surgery may be neuropathic pain resulting from intercostal neural injury [24]. We have previously reported that chest wall paresthesia is a discrete element of discomfort following VATS which may be caused by such neurogenic mechanisms [7,9]. In this study, our results indicate that wound pain appears to be improved by the use of pre-emptive local anesthesia, whereas chest wall paresthesia is not. This is most likely due to the small numbers of patients reporting paresthesia. However, this
finding is also consistent with previous studies in animals suggesting that pre-emptive analgesia can reduce nociceptive pain, but has no significant effect on animal models of neuropathic pain [25]. It may be hypothesized that perhaps the local anesthesia was effective in blocking the sensitization to pain by sharp wound incision, but less effective in pre-empting paresthesia which results from blunt trauma and compression to the intercostal nerves. Specific treatment for neurogenic discomforts with drugs such as gabapentin may yet prove to have a role if used pre-emptively [24].

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References

Appendix A. Conference discussion

Dr D. Kim (Seoul, South Korea): In my opinion, VATS sympathectomy pain originates from three factors. One is the skin incision, the next is the pleural damage during sympathectomy using electrocautery, and the last is the mediastinal shift from the one-lung ventilation, lung collapse and expansion sequentially, right and left. The patients complained of chest discomfort. In my institute, I used not only skin anesthesia, like you, but also I used pleural cavity anesthesia using the instillation with 10 cc amount of 2% lidocaine into the pleural cavity. What is your opinion?

Dr Sihoe: That’s an excellent question, and I totally agree. I think in any thoracic operation, the pain comes from definitely more than one source. We chose to look at sympathectomy simply because the sources of pain are relatively few, but I agree totally that the pleural site is important. I think if you look at our results, the reason we had significance at 7 days rather than at 4 h or 1 day was because a lot of the patients actually had pain on both sides in the first two time points. If you take away those patients, I think the results are pretty significant all the way through in showing benefit of the side given preemptively with a local anesthetic, and that is our next step of study.

Dr K. Athanassiadis (Hannover, Germany): Normally our anesthesiologists advise us when we do such kinds of local anesthesia in thoracotomy that we go at least two intercostal spaces up and two intercostal spaces down of our incision. Do you do it in that way, or how do you do it?

Dr Sihoe: That’s another excellent point. Certainly in all of our major operations, lung resections, thoracotomy, or VATS, we use that approach, injecting above and below. In this particular case with just needlescopic operations, lung resections, thoracotomy, or VATS, we use that approach, sequentially, right and left. The patients complained of chest discomfort. In my institute, I used not only skin anesthesia, like you, but also I used pleural cavity anesthesia using the instillation with 10 cc amount of 2% lidocaine into the pleural cavity. What is your opinion?

Dr Sihoe: That’s another excellent point. Certainly in all of our major operations, lung resections, thoracotomy, or VATS, we use that approach, injecting above and below. In this particular case with just needlescopic surgery, though, I think the level of trauma to the adjacent intercostal spaces is relatively low. In this particular study we injected at the skin and deep into the intercostal space with our injections, but not to the adjacent intercostal spaces.

Dr Athanassiadis: If I saw your slides correctly, in some of them, on the intervention side there was less paresthesia. Am I correct?

Dr Sihoe: Yes, that’s true.

Dr Athanassiadis: Can you comment on that, please?

Dr Sihoe: In a previous study, which we published in the EJCTS, we found a higher rate of paresthesia after needlescopic surgery. We were a little bit surprised that the rate of paresthesia in this particular study was relatively low. But because the numbers were really so few in the study, we didn’t wish to speculate too much on the significance of this or attempt any statistical analysis.