Uniportal vs standard three-port VATS technique for spontaneous pneumothorax: comparison of post-operative pain and residual paraesthesia

Rajwinder Singh Jutley, Mohammed Wesam Khalil, Gaetano Rocco*,1

Price Thomas Unit, Department of Thoracic Surgery, Northern General Hospital, Sheffield Teaching Hospitals NHS Trust, Herries Road, S5 7AU Sheffield, UK

Received 18 December 2004; received in revised form 24 February 2005; accepted 28 February 2005; Available online 31 May 2005

Abstract

Objective: VATS using the conventional three ports is currently the technique of choice for blebectomy/bulleectomy for spontaneous pneumothorax. However, the procedure has recently been shown to have neurological complications related to the port sites. Uniportal VATS has recently been proposed as an alternative to conventional three-port VATS. It is anticipated that the single incision will predispose to a lower incidence of neurological complications. Methods: We report our initial single surgeon experience of uniportal VATS (n = 16) and provide a comparison of post-operative pain and residual paraesthesia to conventional three-port procedures (n = 19) for the same pathology. Results: In both groups, the pneumothorax pathology was principally primary. There was no difference between the groups in terms of age, spirometry, tissue resected, drainage time and inpatient stay. A difference was, however, noted in inpatient pain scores. The uniportal group had a lower median score of 0.4 (visual analogue range 0–4) while the three-port technique reported 0.8 (P = 0.06, Mann–Whitney test). The maximum score trend was similar (1.4 vs. 2.6, respectively, P < 0.001, Mann–Whitney test). Follow-up for uniportal and three-port VATS averaged 9.4 ± 6.6 and 32.1 ± 9.9 months, respectively. One patient in the three-port group had a pneumothorax recurrence. Three-port VATS also had a higher residual pain score (0.5) compared to uniportal VATS (0.3). Of clinical significance was the incidence of neurological complications. Eighty-six percent of uniportal patients reported no symptoms. The remaining experienced only mild ‘numbness’ or ‘swelling’. However, in the three-port group, only 42% reported no symptoms. A similar number experienced ‘numbness’. Two females described sexual dysfunction due to altered breast sensitivity. Seventeen percent (2/12) reported ‘pins and needles’. Conclusions: Uniportal VATS appears to be tolerable, safe and efficient in treating spontaneous pneumothorax in our series. Moreover, post-operative pain and paraesthesia incidence was lower than three-port VATS. Prospective randomised trials are important to evaluate this technique.

Keywords: Uniportal; VATS; Pain; Paraesthesia; Spontaneous pneumothorax

1. Introduction

Conventional two- or three-port video-assisted thoracic surgery (VATS) has been clearly shown to offer greater advantages in relation to patient pain and respiratory function when compared to traditional open incisions [1,2]. However, even this approach is not without its long-term neurological complications as demonstrated recently by Sihoe et al. [3]. The group found that over 50% patients who had VATS for primary spontaneous pneumothorax (SP) complained of paraesthesia distinct from their wound pain. The incidence of chronic pain following VATS for spontaneous pneumothorax has also been documented. In a study comprising 78 patients and after a follow-up period of 59 months, Passlick et al. [4] showed that about a third of all patients who underwent minimally invasive surgery experienced chronic pain.

We have developed a single-port approach (uniportal) as an alternative to the conventional multi-port VATS. This technique has shown to be safe and effective for pulmonary resections and biopsies [5,6]. When used for primary or secondary SP, the bullectomy/bulleectomy and pleural abrasion/plurectomy is performed through the single incision through which the chest drain is then inserted. We report our single surgeon (GR) experience of post-operative pain and residual paraesthesia using the uniportal approach and compare it to conventional three-port VATS for the same pathology.

2. Patients

Between December 2002 and August 2004, 16 patients underwent uniportal VATS for primary or secondary SP. These were compared to 19 patients who underwent the three-port approach between February 2002 and January 2003. Since January 2003, the uniportal technique was offered as a routine option whenever surgical intervention
was indicated. For each patient, a retrospective case note review was undertaken to include the following variables—age at operation, sex, primary or secondary pneumothorax, %FEV\textsubscript{1.0} of predicted, %FVC of predicted, location of pathology, intra-operative pleural abrasion, intra-operative pleurectomy, length of chest drainage (days), length of hospital stay (days), inpatient pain score (visual analogue score 0–4) and specimen volume as measured by pathologist. A telephone interview was then conducted to evaluate for any residual pain or paraesthesia.

Both median and maximum pain scores were evaluated using visual analogue scales (VAS) from 0 to 4. A description of each score is provided in Table 1. The same pain protocol was applied to both study groups. All patients were prescribed regular paracetamol (1 g six-hourly), dihydrocodeine (60 mg six-hourly) and Nefopam (60 mg eight-hourly). No epidural or NSAID were used. The scores were obtained every time the patient's observations were documented in the post-operative period. For the first 12 h, this was every hour followed by every 4 h until discharge. The attending nurse responsible for the patient obtained all scores. During the follow-up of telephone interview, all patients were re-educated about the VAS. The paraesthesia was assessed using descriptions employed by Sihoe et al. [3]. In their study, they demonstrated that the most commonly characteristics for paraesthesia were 'pins and needles', a sensation of 'abnormal swelling', and 'numbness'.

The uniportal technique involves a 2–2.5 cm incision placed in the 5th intercostal space in the posterior axillary line. A 5-mm 0\degree video thoracoscope along with two roticulating instruments (Endo-GIA Universal and Roticulator Endograsp, USCC-Tyco Healthcare) are then easily placed through the incision. Unlike the conventional three-port technique, the uniportal technique approaches the target lesion in a sagittal plane or cranio-caudal perspective (Fig. 1). Interference of the instruments was avoided by use of the roticulating instruments. In all cases, the bullectomy/blebectomy was performed with staplers. Pleural abrasion was easily done under direct vision using a diathermy scratch pad mounted on a long Roberts clamp or on the roticulating endograsper. In all cases, the abrasion was performed until the pleura was seen to peel off. In 11/16 (69%) uniportal patients and 17/19 (89%) of three-port cases, the result was a complete pleurectomy.

The three-port VATS technique employed in our unit involves standard 'inverted triangle' positioning through incisions of 1–1.5 cm. The 5- or 10-mm working ports were placed in the 5th intercostal space between the scapula tip and anterior axillary line aiming to get as wide as possible. The 5- or 10-mm 0\degree video thoracoscope was introduced through the 7th intercostal space approximately midway between the working ports. In all cases, the bullectomy/blebectomy was performed with staplers (Endo-GIA, USCC-Tyco Healthcare).

### Results

Sixteen patients in the uniportal group (all males) and 19 patients in the three-port technique (14 male and 5 female) were identified. The mean age for each group was $28.9 \pm 15.4$ and $32.1 \pm 10$ SD years, respectively. In 12 of 16 (75%) uniportal patients, the pathology was primary while in the three-port group it was $17/19$ or 90%. Pre-operative FEV\textsubscript{1.0} and FVC findings for the uniportal and three-port group were $85.7 \pm 16.1$, $82 \pm 14.4$ SD\% and $81.2 \pm 21.4$, $85.7 \pm 17.9$ SD\%. There was no statistical difference noted between the groups ($P=\text{n.s.};$ t-test). These findings and those detailed below may be seen in Table 2.

Intra-operatively, all lesions were identified in apex of the affected lung except for a case in the three-port technique where blebs were only found in the apex of the right lower lobe. The volume of the resected specimens between the two groups was similar with no difference demonstrated statistically ($21,785 \pm 14,592$ mm\textsuperscript{3} SD vs.}
In our study, we have demonstrated lower complication rates using a single-port technique without compromising efficacy. The limitation remains the small study numbers in each group and the relatively short follow-up period for the technique at 9.4±6.6 SD months. This makes any conclusions on recurrence rates difficult to justify. However, no recurrence of pneumothorax was noted compared to a single recurrence for the three-port technique. This suggests that the technique allows for good exposure and adequate resection of the affected areas of the lung with both primary and secondary pathology. In addition it permits adequate pleurectomy/pleural abrasion with the diathermy scratch pad, which we believe offers superior results than stapling alone [4]. It is possible that the higher post-operative pain score observed in the three-port group may be due to a higher rate of pleurectomy compared to the uniporal group (89 vs. 69%). However, in all cases of pleural abrasion, the procedure was performed until the parietal pleura was seen to peel rather than simply abrade. It is therefore anticipated that the procedure would be equally painful.

The efficacy of the uniportal approach is further lent credence by evaluation of drainage time and hospital stay. Even though with the initial uniportal cases, we adopted a cautionary approach to home discharge, drainage time and hospital stay were similar suggesting that the uniportal approach does not pose an additional burden on hospital resources. This suggests a resource implication, which need to be evaluated formally.

We have clearly demonstrated a definite occurrence of neurological symptoms following VATS with a higher incidence in the three-port technique than the uniportal approach. While 86% uniportal patients reported no residual pain or paraesthesia, this was only 42% in the three-port technique, with the remaining complaints ranging from mild to lifestyle-limiting sexual dysfunction. While we recognise that there were no female patients in the uniportal group to be able to make a direct comparison, these findings may be explained by the additional two incisions used in the three-port technique (of which at least one in the submammary fold), which theoretically exposes the patient to a three-fold risk of intercostal nerve damage compared to a single

Only one patient in the three-port group had a recurrence of the pneumothorax on the operated side approximately 2 years after the procedure.

4. Conclusions

With advances in thoracoscopic instruments and techniques, VATS blebectomy/bullectomy remains the procedure of choice for many centres for the treatment of spontaneous pneumothorax. It has a low acceptable recurrence rate of around 4-5% [7,8] and has been shown clearly to deliver better patient satisfaction and tolerability as well as cost implications [9–11]. However, VATS is not without its attendant complications and recent observations have quantified associated residual and neurological sequelae [3,4]. In an attempt to reduce these complications, conventional VATS has developed to include either smaller working ports and instrumentation or fewer incisions [5,12,13].

In our study, we have demonstrated lower complication rates using a single-port technique without compromising efficacy. The limitation remains the small study numbers in each group and the relatively short follow-up period for the technique at 9.4±6.6 SD months. This makes any conclusions on recurrence rates difficult to justify. However, no recurrence of pneumothorax was noted compared to a single recurrence for the three-port technique. This suggests that the technique allows for good exposure and adequate resection of the affected areas of the lung with both primary and secondary pathology. In addition it permits adequate pleurectomy/pleural abrasion with the diathermy scratch pad, which we believe offers superior results than stapling alone [14]. It is possible that the higher post-operative pain score observed in the three-port group may be due to a higher rate of pleurectomy compared to the uniporal group (89 vs. 69%). However, in all cases of pleural abrasion, the procedure was performed until the parietal pleura was seen to peel rather than simply abrade. It is therefore anticipated that the procedure would be equally painful.

The efficacy of the uniportal approach is further lent credence by evaluation of drainage time and hospital stay. Even though with the initial uniportal cases, we adopted a cautionary approach to home discharge, drainage time and hospital stay were similar suggesting that the uniportal approach does not pose an additional burden on hospital resources. This suggests a resource implication, which need to be evaluated formally.

We have clearly demonstrated a definite occurrence of neurological symptoms following VATS with a higher incidence in the three-port technique than the uniportal approach. While 86% uniportal patients reported no residual pain or paraesthesia, this was only 42% in the three-port technique, with the remaining complaints ranging from mild to lifestyle-limiting sexual dysfunction. While we recognise that there were no female patients in the uniportal group to be able to make a direct comparison, these findings may be explained by the additional two incisions used in the three-port technique (of which at least one in the submammary fold), which theoretically exposes the patient to a three-fold risk of intercostal nerve damage compared to a single

28,543±20,051 mm³ for uniportal and three-port technique, respectively; P=n.s.; t-test).

In 3/16 patients in the uniportal group, the length of drainage exceeded the length of hospital stay by a mean of 3 days. In these cases, the patient was allowed home with a flutter bag in situ until the air leak resolved. In the three-port technique, 1 of the 19 patients was discharged with a flutter bag for 7 days. Despite this, the length of chest drainage in each group was similar at 4.6±2 vs. 3.9±1.2 SD days, respectively, for the uniportal and three-port technique, as was the length of hospital stay at 4.6±2.1 vs. 4.1±1.0 SD days. Both these findings were not statistically significant (P=0.35; t-test).

However, there was a difference noted in the inpatient median and maximum pain score between the two groups. The three-port technique patients had a higher median score compared to the uniportal approach (0.4±0.5 vs. 0.8±0.7 SD; P=0.06; Mann-Whitney test). The maximum pain score reported was also significantly higher between the two groups at 1.4±0.9 vs. 2.6±0.9 SD; P<0.001; Mann-Whitney test).

telephone interview was conducted to assess residual symptoms. As the uniportal approach is a relatively recent development, the mean follow-up time from surgery for the group was 9.4±6.6 SD months while for the three-port technique 32.1±9.9 SD months. The follow-up was complete in 14/16 uniportal subjects (88%) and 12/19 (63%) three-port patients. Four out of 14 (28%) uniportal patients complained of mild residual pain (Grade 1) compared to 5/12 (42%) patients in the three-port group. In the latter group, the pain was Grade 1 except for one patient who had Grade 2 symptoms occasionally for which explanation was not, however, statistically significant (P=0.6; Mann-Whitney test).

In the uniportal group, 12/14 (86%) patients had no residual neurological symptoms. The remaining complained only of occasional ‘numbness’ or ‘swelling’ sensation. The incidence of neurological complaints was higher in the three-port group. Seven out of 12 (58%) had symptoms ranging from mild ‘pins and needles’ (two patients) to ‘numbness’ of varying severity (five patients). The numbness was ‘mild’ in two patients, ‘moderate’ in two patients and ‘severe’ in one patient. In two female patients, the symptoms of numbness were lifestyle-limiting in that they altered breast sensitivity with sexual dysfunction.
incision. This risk is similar regardless of the size of the incisions used. Recent work comparing needlescopy to three-port VATS has showed no difference in post-operative pain between the two techniques [15]. Pain following thoracic procedures can be unrelenting and difficult to treat such that serious consideration must be given before making any additional incisions.

Our study has demonstrated that the uniportal technique is a safe and effective approach for primary and secondary spontaneous pneumothorax despite a demonstrable learning curve for surgical efficacy as with any VATS procedures [16]. While we appreciate the potential bias in our study by virtue of its retrospective design and different study periods, we believe that it heralds important findings. The lower incidence of post-operative pain and paraesthesia of uniportal VATS when compared to the conventional approach certainly deserves further work in the form of a randomised controlled trial to evaluate this novel technique which, along with current strategies like early patient mobilisation and the use of flutter bags, may be an important step to realise day case surgery for spontaneous pneumothorax.

Acknowledgements

The authors acknowledge the assistance of Dr Sarah Lewis (sarah.lewis@nottingham.ac.uk), University of Nottingham for statistics advice.

References