Ward-based, nurse-led, outpatient chest tube management: analysis of impact, cost-effectiveness and patient safety†

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Abstract

OBJECTIVES: Prolonged drainage and air leaks are recognized complications of elective and acute thoracic surgery and carry significant burden on inpatient stay and outpatient resources. Since 2007, we have run a ward-based, nurse-led clinic for patients discharged with a chest drain in situ. The aim of this study is to assess its cost-effectiveness and safety.

METHODS: We present a retrospective review of the activity of the clinic for a period of 12 months (November 2009–10). An analysis of the gathered data is performed, focusing specifically on the duration of chest tube indwelling, the indications, complications and cost efficiency.

RESULTS: The nurse-led clinic was housed in the thoracic ward with no additional fixed costs. Seventy-four patients were reviewed (53 males, 21 females, mean age of 59) and subsequently discharged from the clinic in this time period, accounting for 149 care episodes. Thirty-three (45%) of the patients underwent a video-assisted thoracoscopic surgery procedure, 35 (47%) of them a thoracotomy and 7 (9%) had a bedside chest tube insertion. Following hospital discharge, the chest tubes were removed after a median of 14 days (range 1–82 days). Fifty-eight percent of the patients were reviewed because of a prolonged air leak, 26% for persistent drainage and 16% due to prolonged drainage following evacuation of empyemas. For the care episodes analysed, we estimate that the clinic has generated an income of €24 899 for the department. Hourly staffing costs for the service are significantly lower compared with those of the traditional outpatient clinic: €15 vs. €114.

CONCLUSIONS: Our results show that a dedicated chest tube monitoring clinic is a safe and efficient alternative to formal outpatient clinic review. It can lead to shorter hospital stays and is cost effective.

Keywords: Chest tube • Outpatient • Nurse-led

INTRODUCTION

Prolonged drainage and air leaks are recognized complications of elective and acute thoracic surgery. They carry a significant burden on inpatient stay and outpatient resources [1, 2]. With healthcare expenditure coming under constant scrutiny, an increased emphasis falls on fast-tracking thoracic patients in an attempt to decrease the cost of hospital stay and increase revenue, while at the same time maintain high standards of care and patient satisfaction [3]. While it has been shown that patients can be discharged home safely with portable drainage devices, even if they have ongoing drainage and/or air leak after thoracic surgery, there is no consensus on how they should be followed up optimally [4, 5]. The predominant practice is for them to be reviewed within a standard outpatient service [5].

Nurse-led clinics have been endorsed by the UK government since the early 1990’s. Trained nurses have been responsible for reviewing and monitoring patients without direct medical supervision in a number of specialities. Such services have demonstrated that they are safe and cost efficient [6]. Since 2007, we have run a dedicated ward-based, nurse-led clinic for patients, who are discharged with a chest tube in situ. They are reviewed and managed by an experienced staff nurse, strictly implementing the standardized care protocols of the department with no direct medical supervision. This has led to a decrease in the load of the regular thoracic outpatient follow-up service, while facilitating patient fast-tracking by shortening both waiting times and hospital stay. We have reviewed the activity of this clinic in an attempt to demonstrate its safety and cost-effectiveness.

MATERIALS AND METHODS

In our practice, patients with persistent air leak and/or excessive drainage are discharged home, when medically appropriate, with a chest tube in situ. The introduction of digital drainage devices in the department allowed us to quantify the air leaks
prior to discharge. During the period of this study, any patient with an air leak, whose lung had achieved full expansion on the chest film without applied suction, was deemed suitable for discharge. The cut-off point for 24 h drainage was 200 ml for non-infected and 100 ml for infected fluid. We utilize a device containing a one-way valve and a soft fluid reservoir. Patient compliance and understanding of the functioning of the system are taken into consideration, as are distance to medical support and adequate community service. The thoracic nurse-led outpatient chest tube clinic in our department runs once a week in a specifically designated treatment room within the ward. It takes place over the course of the whole working day and is divided into 30 min appointments for individual patient review. During that slot, the chest tube is assessed and removed if appropriate, an X-ray is performed and additional tests can be carried out if deemed necessary (e.g. inflammatory markers).

We performed a retrospective review of the activity of the clinic over a period of 1 year (November 2009–10). The data were collected on a specifically designed form and entered prospectively into a database. Numerous demographic and clinical parameters were recorded, such as age, gender, type of surgery, length of hospital stay, number of chest tubes on discharge and their further management.

Based on the gathered information, an analysis was performed, looking at the indications for prolonged chest tube drainage, its actual duration and the associated complications.

A cost analysis was performed after taking into consideration several factors. Whereas regular outpatient facilities take place in a dedicated outpatient setting, the nurse-led service (due to fewer members of staff involved) takes place in a ward space, thereby incurring much lower logistical costs. There were no extra fixed costs (such as consumables and waste disposal), as the fully stocked treatment room on the ward is available 24/7; hence, cost estimations were concentrated on personnel alone. Similarly, consumable costs (X-rays, sutures, chest drains) were not factored into calculations—this was due to the assumption that the same materials were likely to be used regardless of the outpatient setting within the same hospital.

English National Health Service pay scales were utilized in order to calculate the hourly rates of the involved staff members. A comparison was made in the actual cost of running this service as a nurse-led clinic within the department to a regular outpatient service.

RESULTS

Over the study period (November 2009–10), 74 patients, who were undergoing chest tube care were reviewed in the nurse-led clinic, accounting for 149 care episodes. Fifty-three (72%) and 21 (28%) of patients were males and females, respectively (ratio 2.5:1). The age of the patients ranged from 19 to 84 years (mean 59.7 years). The mean number of appointments for each patient was 2 (1–7). The mean length of chest tube indwelling was 19.56 days from ward discharge (range 1–82 days).

There were three main reasons for prolonged chest tube drainage. Forty-three (58%) of the patients had a prolonged air leak, 19 (26%) had persistent fluid drainage (non-infected; >200 ml/24 h) and 12 (16%) had chronic empyema drainage (>100 ml/24 h). The reviewed patients had received a variety of surgical procedures (Table 1).

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of cases</th>
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<tbody>
<tr>
<td>Thoracotomy and lobectomy VATS drainage of effusion (with or without pleural biopsy)</td>
<td>17 (22.9%)</td>
</tr>
<tr>
<td>Empyema drainage VATS bullectomy and pleurodesis</td>
<td>9 (12.2%)</td>
</tr>
<tr>
<td>VATS lobectomy</td>
<td>9 (12.2%)</td>
</tr>
<tr>
<td>Thoracotomy and decortications VATS lung biopsy</td>
<td>8 (10.8%)</td>
</tr>
<tr>
<td>Bedside chest drain insertion</td>
<td>7 (9.5%)</td>
</tr>
<tr>
<td>VATS drainage of effusion (with or without pleural biopsy)</td>
<td>7 (9.5%)</td>
</tr>
<tr>
<td>VATS bullectomy and pleurodesis</td>
<td>7 (9.5%)</td>
</tr>
<tr>
<td>VATS lung biopsy</td>
<td>4 (5.4%)</td>
</tr>
<tr>
<td>Other</td>
<td>6 (8%)</td>
</tr>
</tbody>
</table>

Complications related to prolonged chest tube drainage were recorded in 13 of the patients (18%). Six had superficial infection of the chest tube site (managed with oral antibiotics and observed), four had a residual air space after chest tube removal (one required additional fine bore chest drain placement) and three patients developed an empyema. Four (5%) of the patients had to be readmitted for further management, namely the patient requiring a chest tube and the empyema cases. The former was discharged 48 h latter with the tube removed, while two of the latter cases required a video-assisted thoracoscopic surgery (VATS) washout. The remaining empyema patient was managed conservatively and made a full recovery. All patients, who developed an empyema, had an air leak at the time of discharge.

No complications were identified as unique to the nurse-led service or attributed to any procedural difference. None of the chest tubes fell out during the monitored period or required re-siting.

Cost analysis was performed based on the difference between staff required to run the nurse-led clinic and the regular outpatient service. On a typical day, the latter is staffed by one consultant, two junior doctors, one senior nurse and two health-care assistants. Additionally, it takes ~2 h for an administrative member of staff to prepare the clinic. In contrast, the nurse-led service required only a single experienced nurse and an administrative member of staff (who also spent 2 h preparing the clinic). Of note, the regular outpatient service ran for only half-a-day but allowed for three consultations to take place at a time. This meant that 24 half-an-hour appointments could take place in one clinic, whereas only 16 could take place in a whole day of the nurse-led clinic. However, in our practice, those were more than sufficient. The hourly staffing costs are summarized in Table 2.

Based on our calculations, the hourly staffing cost of the nurse-led clinic is €15.40 compared with €114.72 for the regular outpatient service.

The nurse-led clinic takes place in a dedicated treatment area in the thoracic ward. There are no additional fixed costs. No space modifications, disposal areas or consumable stock are required as storage, consumables and instruments are there for the post-operative care of surgical inpatients.

The implementation of the nurse-led clinic has increased the number of patients who can be reviewed every month, effectively providing an additional weekly session. The most challenging
patients, who usually require more time-consuming follow-up appointments and often instrumentation, are reviewed by this service. And as the healthcare system in the UK reimburses surgical departments for each patient followed in an outpatient setting, the nurse-led clinic has generated an income of €24,899 for the department for the period in question.

**DISCUSSION**

As the economic aspects of medical services fall under increasing scrutiny, fast-tracking patients and shortening post-operative hospital stays have become important components of clinical practice. Such ever-growing pressure has prompted us to seek ways to streamline patient follow-up, while at the same time optimize the role of the involved staff.

Chest tube management is arguably one of the most significant factors that affect the length of hospital stay in thoracic patients, adding a significant strain to the healthcare expenditure [3]. Prolonged air leaks and fluid drainage are the most common causes for prolonged chest tube indwelling and significantly contribute to increased hospital stays. Most patient discharges are dependent on the removal of the chest tubes, although more and more surgeons are sending patients home with chest tubes in situ, fitted with an outpatient device. Discharge criteria have been identified several risk factors that can predict a prolonged air leak [8]. This allows surgeons to predict the natural history of air leaks and prepare patients and their families for early discharge with a chest tube in situ, fitted with an outpatient device. Discharge criteria include the presence of the chest tube with no air leak for at least 3 days, while the patient is free of chest pain, fever, and tachycardia.

However, the practical aspects and actual cost of further follow-up and management of such patients have not been extensively discussed.

In recent years in the UK, there has been a marked growth in nurse-led clinics in various areas. The clinics vary greatly in the way they are set up, both within and between specialties, but there are common characteristics. In most cases, nurses have their own caseload and patients consult them in specialized time slots. Care decisions are made according to established protocols [10]. Their implementation in clinical practice requires careful planning and structuring with clearly identified aims. Their activity must be regularly evaluated to ensure high standard of care.

We believe that an organized service, dedicated to outpatient chest tube management, can facilitate early discharge, without any additional complications. Furthermore, it can function without constant medical supervision if strict protocols are adequately implemented following adequate staff training.

Such a clinic has run in our department since 2007 and has received a very high patient satisfaction as evidenced by an in-house audit. It has met the expectations of all involved parties, while generating an extra income with existing resources.

Our results show that it has not led to any additional complications, while at the same time being extremely cost-effective. It has decompressed the regular outpatient follow-up clinic from the complex cases and those needing additional care, instrumentation, consumables and interventions and has allowed for better utilization of the services of available surgical staff.

The nurse-led outpatient chest tube clinic can be perceived as having minor disadvantages. There is no designated surgeon attending the service, therefore patients are unable to ask specific questions concerning their condition and future management. Cancer patients still need to be seen in the regular outpatient services. The nurse running the clinic can be dependent on a surgeon if she encounters a particularly difficult or unorthodox scenario, which requires complex decision-making.

Although no disadvantages on their own accord, patient compliance and availability of community support have to be carefully considered before implementing such a service.

In conclusion, we believe that an outpatient nurse-led clinic for patients discharged with chest tubes in situ provides a cheaper alternative to regular follow-up. It allows optimization of the time of the medical staff and outpatient services without the risk of additional complications. It improves patient flow, offers nurses a different role and generates revenue for the department without compromising standards of care.

**Conflict of interest:** none declared.

**REFERENCES**

APPENDIX. CONFERENCE DISCUSSION

**Dr A. Chapelier (Suresnes, France):** No question about the cost-effectiveness of this method, which is interesting.

**Dr Tcherveniakov:** I guess everybody is convinced.

**Dr S. Mattioli (Bologna, Italy):** We are struggling in Italy with this problem, because we are proposing the Nurse Assistant of surgery and we have the council of the doctors against it, because they say this means less room for the young surgeons or the young doctors. My question is, in the UK, are the young doctors and surgeons happy with this innovation?

Second question: Part of the money spent by the institution can possibly be stretched to the surgeon’s stipend. This could be a good motivation for the new organization. What do you think?

**Dr Tcherveniakov:** I will take the liberty of answering your questions in reverse order. Mr Papagiannopoulos, what do you think about the second question? I think it is a very good idea.

To answer your first question, we had a very similar problem when this clinic was established. There were a lot of questions: who is going to carry the responsibility, how is it going to function? But in practice, it works very well and the junior doctors are very happy. Once the clinic starts running, once the staff is appropriately trained, there are very few problems.

The real issue comes from patient compliance. The nurses must have support for complicated problems which they can’t manage on their own, but they can easily deal with the basics. They can determine if there is still an air leak, what the drainage is, and if you establish your parameters accordingly, the entire clinic becomes very straightforward.

And to be honest, the junior doctors have been very happy, because we don’t have to follow-up these patients ourselves and it frees time to do other things.

**Dr K. Papagiannopoulos (Leeds, UK):** Many of the juniors don’t consider that as experience. I think they hate it. They don’t want to be called for this, and they don’t consider it a scientific experience to go and see someone about whether their wound is okay, or whether a drain needs to be removed, or at the time when the drain has to come out.

That clinic, clearly, was established from our side, one aim being to decompress our outpatient clinic, because we were extremely busy, and the second thing is that then we built it into the budget. We classed it as an outpatient clinic for the Primary Care Trust, so we get extra money from them, we charge them, but for us, it is within the ward. So we didn’t need any more facilities. We had them there already.

**Dr A. Chapelier:** Just a comment. So you mean this system, a very interesting system, spares more time for surgeons, but in many centres in France or Europe, we have chest physicians in our department looking after the tubes and sparing the surgeon’s time. Do you still have a chest physician in your department?

**Dr Papagiannopoulos:** We don’t have chest physicians. The middle tier, as we call it, our registrars, our juniors, are the ones who are looking after the ward and anything else in the department. And obviously because of the European working time directives, they are really very tired and they have to go home and get some sleep, and we have problems in filling up the slots on the shifts. So the only way for us was to legally offload some of this work safely onto another person.

And I have to say to Sandro Mattioli that nurses, if they have worked for 10–15 years in the service, oftentimes do much better than junior doctors in looking after this kind of patient. They have a massive experience. They actually educate the juniors when they walk in.

**Dr Chapelier:** I do agree. And you put emphasis on this excellent relationship needed for that between the surgeons and nurses. Just a question: do these nurses volunteer for this?

**Dr Tcherveniakov:** No is the honest answer. There is a pool of nurses who are considered more experienced, that have previous experience with thoracic surgery. They are offered the position as a choice. Their commitment to the nurse-led clinic relieves them from certain duties. There is a certain amount of compromise for the time schedule. They have to do less weekend and fewer night shifts. So, in fact, we are never short of nurses for the clinic. At this moment in time, everybody is happy and it has been going on for 3 years now.

**Dr Chapelier:** So you are moving forward with this system?

**Dr Tcherveniakov:** Yes. The data is being recorded prospectively, so hopefully in a future meeting we will give you an update on how it is going.