Management of Spontaneous Pneumothorax in a Developing Caribbean Nation: A Clinical Practice Audit

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Citation

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Abstract

A five year clinical audit was conducted between January 1, 2000 and January 1, 2005 to evaluate the management of patients with spontaneous pneumothoraces at three tertiary referral centres across Kingston, the capital city of Jamaica. Secondary pneumothoraces (SSP) were considered present if there was underlying lung pathology, otherwise patients were considered to have primary pneumothoraces (PSP). Data retrospectively extracted from hospital records, including patient demographics, clinical details and therapeutic outcomes, were analyzed using SPSS Version 12.0.

Of the 81 cases identified, 58 patients with a mean age of 41.3 +/-18.2 years (SD) had PSP. The remaining 23 patients at a mean age of 51.8 +/-17.7 years were diagnosed with SSP from COPD (11), tuberculosis (6), asthma (3), PCP (1), endometriosis (1) and sarcoidosis (1). Recurrent SSP was present in 13/81 (16.1%) cases. One patient had a clinically diagnosed tension pneumothorax while the remaining cases were diagnosed on chest radiographs. Most cases were unilateral: 52 right sided (64.2%); 28 left sided (34.6%); 1 bilateral (1.2%). Of this, 80 patients had tube thoracostomy and 1 had aspiration as the definitive therapeutic maneouvre. Prophylactic second procedures (chemical pleurodesis in 3; open gauze pleurodeses in 5) were offered to 8/81 (9.9%) patients, all with recurrent SSP. The remaining patients had ongoing surveillance. There were no recurrences recorded during the study period.

Needle aspiration and prophylactic procedures were under-utilized in this setting in contravention of evidence-based guidelines. Educational programmes and early referral to thoracic surgeons may increase the compliance with the standardized guidelines.

INTRODUCTION

A spontaneous pneumothorax is an abnormal collection of air within the pleural space that occurs in an individual without a clinically apparent predisposition. ([1]) They are distinguished from pneumothoraces that occur after thoracic injuries (traumatic) and medical interventions (iatrogenic). There are two types: Primary spontaneous pneumothorax (PSP) occurs in individuals without underlying lung disease whereas secondary spontaneous pneumothorax (SSP) occurs as a complication of pre-existing lung pathology. ([1])

The overall incidence of spontaneous pneumothorax in Jamaica was reported to be 1.96 per 100,000 persons in the general population per year. ([2]) This is lower than the overall incidence (combined SSP/PSP) reported from developed nations that range from 7.8 to 16.9 per 100,000 persons per year. ([3]) In Kingston, the capital of Jamaica, these patients are treated at one of three tertiary institutions. With an estimated 826,880 persons residing in and around Kingston, ([4]) each of these hospitals will manage an estimated 5.4 patients per year. Hospitals that manage small case volumes may not always adhere to therapeutic guidelines. This study examines the therapeutic practices at these referral hospitals serving the Kingston area to determine their compliance to standardized evidence based guidelines. ([1],[5])

METHODS

The Kingston Public Hospital and the University Hospital of the West Indies are tertiary level hospitals in Kingston that provide multidisciplinary care to unselected patients. ([6]) The National Chest Hospital is a specialist hospital that provides sub-specialty care to the select adult population with respiratory diseases. ([6])

The admission records from these three institutions were reviewed over five years from January 1, 2000 and January 1, 2005. All patients who were treated for pneumothoraces during the study period were identified and their hospital records retrieved for analysis.

Patients who had pneumothoraces without a clinically apparent reason were considered to have spontaneous pneumothoraces. We excluded patients with traumatic and

iatrogenic pneumothoraces. The episodes were classified as PSP if there was no evidence of underlying lung disease and SSP if the condition occurred as a complication of underlying lung disease. Each separate hospital admission for spontaneous pneumothorax was considered an individual occurrence. Patients who had a confirmed prior admission for spontaneous pneumothorax were considered to have recurrent disease.

At these institutions, the patients were resuscitated and investigated with plain radiographs, if the clinical scenario allowed. The patients treated by aspiration were discharged when there was no evidence of continued air leaks after 24 hours. Those with tube thoracostomies were discharged once follow up chest radiographs confirmed the absence of continued pleural leaks and the lung remained expanded. The treatment listed for each occurrence was the definitive treatment used to resolve the pneumothorax.

The following data were retrospectively extracted from the hospital records: patient demographics, presence of associated lung pathology, location and estimated size of the collection, details of definitive treatment and therapeutic outcomes. The extracted data were entered into a Microsoft Excel worksheet and analyzed using SPSS version 12.0.

RESULTS

There were 81 patients treated for spontaneous pneumothoraces over the study period. There was a preponderance of males with a 3:1 overall male to female ratio.

Twenty three patients were diagnosed with SSP (28.4%) from underlying lung pathology as outlined in Table 1. There were 8 females with an average age of 51.4 +/-21.9 years and 15 males with an average age of 60.4 +/-15.9 years (mean +/-SD).

Figure 1

Table 1: Underlying Disorders in patients with SSP

Disease	Number (n = 23)	Percentage
COPD	11	47.8%
Tuberculosis	6	26.1%
Asthma	3	13.0%
PCP in HIV+ patients	1	4.4%
Endometriosis	1	4.4%
Sarcoidosis	1	4.4%

The remaining 58 patients were diagnosed with PSP. In this group there were 48 males with an average age of 46.7 +/-14.8 years and 10 females with an average age of 40.8 +/-11.6 years (mean +/-SD).

There were no recurrent episodes in patients diagnosed with PSP but 13 cases (16%) of recurrent SSP were encountered, all with their first diagnosis occurring before the current study period. These patients were all males between the ages of 45 and 55 years with COPD (9), Tuberculosis (2) and asthma (2). Nine were ipsilateral, all on the right, and 4 were contra lateral recurrences.

A 35 year old man was clinically diagnosed with a tension pneumothorax within minutes of presentation. All remaining patients presented with subtle complaints of dyspnoea and chest pain. Their diagnoses were confirmed on plain chest radiographs.

Diagnostic radiographs revealed that most pneumothoraces were unilateral (52 right sided; 28 left sided). There was a single case of bilateral pneumothoraces in a 92 year old woman with COPD. Both pneumothoraces were estimated to occupy <15% of the respective hemi-thorax. She had an uneventful recovery after needle aspiration and in-hospital observation.

The sole patient with a tension pneumothorax had emergent needle decompression at the second interspace followed by definitive drainage with a basal thoracostomy tube. The remaining 79 patients had basal thoracostomy tubes inserted as the first therapeutic manouevre. None of the patients treated in this series had suction applied to their thoracostomy tubes. Supplemental oxygen was routinely administered, with appropriate caution in patients with COPD.

Eight (9.9%) patients had a second procedure to prevent a further recurrence. Three patients had talc pleurodesis across a thoracostomy tube and 5 had open thoracotomy and pleurodesis by gauze abrasion. All prophylactic procedures were performed in patients with recurrent pneumothoraces. Table 2 tabulates the clinical diagnoses of the patients who had prophylactic procedures and compares them to the recommended indications for prophylaxis from standardized therapeutic guidelines. ([1])

Figure 2

Table 2: Prophylactic procedures performed in patients meeting recommended indications in standardized therapeutic guidelines [1]

Indication*	(n)	Prophylactic Procedures Performed			
		Thoracostomy + talc pleurodesis	Thoracotomy + gauze pleurodesis	Thoracotomy + pleurectomy	None
Second ipsilateral pneumothorax	9	2	5	0	2
First contralateral pneumothorax	4	1	0	0	3
Bilateral pneumothorax	1	0	0	0	1
Tension pneumothorax	1	0	0	0	1
Incomplete lung expansion	0	-	-	-	-
Persistent air leak >3-5 days	0	-	-	-	-
Associated haemothorax	0	-	-	-	-
Bullae / blebs present on CT	0	-	-	-	-
High risk occupations	N/A				
Remote locations where medical care unavaialable	N/A				

DISCUSSION

Despite the fact that patients with spontaneous pneumothoraces are channeled to tertiary referral centres in Jamaica, only 5.4 cases are seen per year in these hospitals. It is recognized that hospitals managing low case volumes may not always adhere to current practice guidelines. The British Thoracic Society (BTS) published updated evidence based guidelines for the treatment of spontaneous pneumothoraces in 2003. ([1],[5]) This study examines the therapeutic practices at the referral hospitals serving the Kingston area to determine compliance to these guidelines.

The subtle clinical presentation seen in this series was typical of other reports. ([1],[3],[7],[8]) Most patients presented without a clear precipitating event ([1]) and complained of mild ipsilateral chest pain and/or dyspnoea. ([7],[9]) These patients compensated for their pneumothoraces well, most having diagnoses made on radiographs. A tension pneumothorax was the clinical presentation in 1 (2.4%) case and this is in keeping with international reports where it occurs in 3% ([8]) to 5% ([9]) of cases.

A spontaneous pneumothorax decreases vital capacity, eventually leading to hypoxemia as a result of low ventilation–perfusion ratios and shunting. Patients are often able to compensate for small early pneumothoraces, but larger collections can compromise respiratory reserves and lead to sudden clinical deterioration. ([9]) Therefore, early diagnosis and prompt treatment are needed to ensure good outcomes.

The immediate therapeutic goal is to evacuate air from the affected pleural space, allowing lung re-expansion and symptomatic resolution. This can be achieved either by needle aspiration or tube thoracostomy drainage. Secondary goals are prophylaxis against recurrent episodes.

All the patients received supplemental oxygen, with caution in patients with COPD who may be sensitive to oxygenation. This is in keeping with standard practice guidelines. Supplemental high flow oxygenation has been shown to increase the rate of pneumothorax resportion by 1.5% of the hemithorax volume every 24 hours, four times faster than without oxygen. ([1],[9]) The supplemental oxygen increases the partial pressure of oxygen while decreasing that of nitrogen in pleural capillaries. The result is an increase in the pressure gradient between the pleural capillaries and the pleural cavity, thereby increasing the resorption of air from the pneumothorax. ([1],[9])

Needle aspiration is a simple bedside procedure that carries a low incidence of morbidity. ([1],[9]) There are several advantages over tube thoracostomy, including better patient tolerance, reduced pain scores and shorter duration of hospitalization. ([1],[9],[10]) In centres where adequate facilities and support services are available, small bore (8Fr) catheters may also be passed over the aspiration needle by Seldinger's technique and attached to a three way stopcock for repeated aspiration. ([9],[10])

Needle aspiration results in successful lung re-expansion in 59-83% of patients with PSP. ([9],[10],[15]) Additionally, three randomized controlled trials ([10],[12],[13]) and a Cochrane Database review ([14]) have demonstrated that there is no statisitcal difference between aspiration and thoracostomy tubes in terms of immediate success, early failure or recurrence at 1 year. The high success and low morbidity fueled the BTS recommendations for “simple aspiration as first line treatment for all cases of PSP requiring intervention.” ([1],[5])Even when the initial aspiration failed, repeat aspiration was recommended “unless >2.5L was aspirated during the first attempt.” ([1]) Second attempts at aspiration were successful in 33% of cases. ([1],[14])

There is a greater chance of failure after aspiration of SSPs, with complete lung re-expansion reported in 30–65% of cases. ([11],[12],[15]) Independent predictors of aspiration failure in these cases include age >50 years ([11],[12],[16]) and a radiographic pneumothorax >2cm or 49%. ([1],[11],[12],[16]) In these cases, aspiration failure rates exceed 50%. ([1],[11],[15]) For this reason, the BTS guidelines recommend that aspiration should be the initial treatment of SSP only in “small (<2cm) collections in

minimally symptomatic patients under the age of 50," with facilities for immediate tube thoracostomy if needed. ([1]) Tube thoracostomy was recommended as the more appropriate initial therapeutic procedure in these patients.

In our centres, needle aspiration was an uncommon therapeutic modality. It was the initial therapeutic modality in only one patient with SSP. This patient had many factors that could predict therapeutic failure, including age of 92 years, underlying chronic lung disease (COPD) and bilateral pneumothoraces. Although her management was successful, an initial tube thoracostomy would have probably been a more appropriate initial therapeutic maneouvre, consistent with the BTS guidelines. ([1])

The under utility of simple aspiration in our setting is in keeping with reports in the medical literature where physicians were reluctant to use aspiration as the initial therapy. ([1]) A clinical practice audit performed before the original guidelines were implemented revealed that aspiration was used in only 7.8% of suitable candidates. ([16]) There was an increase in aspiration after publication of the original guidelines, ([5]) with 35-39.5% of appropriate patients who met the criteria having aspiration as the first procedure. ([17]) A concerted effort to increase the awareness of aspiration as a therapeutic option is warranted in our setting.

Tube thoracostomy is an effective method to drain a pneumothorax, although it is more cumbersome due to its invasive nature and the requirement for an inconvenient, bulky underwater seal system. Compared to aspiration, tube thoracostomy is accompanied by reduced patient tolerance, greater pain scores and a longer duration of hospitalization. ([1,9,10]) The incidence of complications is also greater. ([1,21,22]) Immediate complications such as bleeding, surgical emphysema and iatrogenic thoraco-abdominal visceral injury are reported in 4% ([18]) to 6% ([19]) of cases. Delayed complications such as wound infections and thoracic empyema occur in 1% ([18]) to 6% ([1]) of cases.

Without being able to demonstrate a clear advantage of tube thoracostomy as first line treatment, the BTS recommended inserting tubes only "if aspiration was unsuccessful in controlling symptoms." ([1]) The only scenario in which tube thoracostomy was recommended as first line treatment was in symptomatic patients over 50 years with SSP >2cm. ([1]) In our series, tube thoracostomy was the commoner modality of treatment (80/81), in contravention of these guidelines. ([1]) Educational programmes targeting the emergency room physicians, the first responders to this problem, may increase compliance with these guidelines.

The infrequent application of suction to thoracostomy tubes is in keeping with the current standard of practice. ([1,19,20]) The early application of suction may precipitate re-expansion pulmonary oedema due to fluid transudation into the alveoli across capillaries that have been damaged during the pneumothorax. ([1]) This occurs in up to 14% of patients who have suction applied to the thoracostomy tubes ([1,21,22]) and can result in mortality in up to 20% of cases. ([21]) Best practice recommendations suggest that the application of suction should be delayed, if possible, for 48 hours in patients with persistent air leaks. ([1])

Observation alone was recommended as an acceptable alternative in mildly symptomatic patients with small pneumothoraces (<1cm) and serial radiographs that demonstrate no evidence of continued pleural leak. [(1,9,16)] Most failures occur in patients with SSP. ([9]) The patients should be observed in hospital because 18-33% of them will require tube thoracostomy for recurrent or progressive pneumothoraces. ([9]) During this time, the patients are exposed to serious risks, including pneumothorax progression, tension pneumothorax and sudden death. ([9])

Compared to observation alone, both aspiration and tube thoracostomy result in lower rates of recurrent pneumothoraces ([1,9]) because they facilitate faster re-expansion and earlier formation of pleural adhesions, thereby promoting sealing of the offending defect. This may be the reason that observation alone was not practiced in this setting.

In our series, prophylactic procedures were performed in a small number (9.9%) of patients. Generally, they were performed in patients who met the accepted indications ([1]) as outlined in Table 2. However, there were 7 patients (8.6%) who met the criteria for prophylaxis in whom these procedures were not performed. This may have been due partly to the paucity of referral to thoracic surgeons or the relative under-utility of CT to investigate these patients. Chest CT is an important investigation because it can identify ruptured subpleural bullae as the cause PSP in up to 80% of cases. ([1,23]) Unfortunately, CT scanners were not universally available in this setting. At the time this study was performed, only one of these three hospitals (UHWI) had a CT scanner on site.

The options for prophylaxis against recurrent disease include chemical pleurodesis through a thoracostomy tube or

thoracotomy with bleb resection, pleurectomy or gauze abrasion.

Chemical pleurodesis can be achieved by instillation of a sclerosant into the pleural cavity through a thoracostomy tube. Asbestos-free talc powder is commonly used because it is inexpensive and readily available. The technical simplicity using an indwelling thoracostomy tube is attractive, but a recent metanalysis of 684 procedures across 21 studies reported that talc pleurodesis failed to prevent recurrent pneumothoraces in 9% of cases. (25) The recurrence rate with tetracycline pleurodesis is even higher, averaging 16% (25) to 20% (26,27) . These recurrence rates are greater than those seen after open thoracotomy. (1,28,29,30) Therefore, pleurodesis has not been recommended as a first line intervention for prophylaxis against recurrent pneumothoraces. (1) It is generally reserved for "patients who are unwilling or unwell to undergo general anaesthsia for thoracotomy." (1) Chemical talc pleurodesis was the procedure performed in 37.5% (3/8) of patients who had prophylaxis in this series.

A thoracotomy achieves two goals. The first is to achieve closure of the air leak by ligation / suture of any pleural defects. The second goal is to obliterate the pleural space by creating adhesions between visceral and parietal pleura using gauze abrasion or pareital pleurectomy. Both pleural abrasion and pleurectomy yield recurrence rates lower than 0.5% [1,9,28-30] and are accompanied by complications in 3% (28) to 15% (29) of cases. These results are better than those achieved with talc pleurodesis across a thoracostomy tube. (1)

Thoracotomies accounted for 5 (62.5%) of the prophylactic procedures in this series and this is in keeping with current guidelines. The intra-operative procedures were all gauze abrasion pleurodesis, without any reports of bleb excision or ligation. To date, there are several small non-randomized studies that report on the outcomes with these procedures, but there is still insufficient evidence to definitively declare either procedure as the better prophylactic operation. (1)

In keeping with the general trend toward minimally invasive procedures, more of these procedures are being performed through trans-axillary mini-thoracotomies and video assisted thoracosopic surgeries (VATS).

During a trans-axillary mini-thoracotomy, access is achieved by a 5cm axillary incision through which the lung apex is thoroughly inspected and any defects sutured. This can be followed by apical pleurectomy or abrasion. The largest series of trans-axillary mini-thoracotomy reported mean hospitalization of 6 days, 0.4% recurrence and 10% morbidity. (31)

During VATS, thoracoscopic vision allows lung inspection, followed by bullectomy, pleurectomy and/or pleural abrasion, all with success comparable to open surgery. (1,32,35) Several authorities have touted advantages of VATS, including shorter duration of hospitalization, (32,35,39) reduced pain (31,32,34,35) and better pulmonary function (36) in the postoperative period. Opponents suggest that the limited vision through a thoracoscope (31,32) and a less intense pleural inflammatory reaction (34) result in a less effective pleurodesis. This may explain the 5-10% incidence of recurrent pneumothoraces after VATS. (38,39) With higher recurrence rates than open thoracotomy (29) and paucity of strong evidence to support VATS, the BTS did not consider VATS to be superior to open thoracotomy for spontaneous pneumothoraces. (1) There were no reports of minimally invasive procedures being performed in our series. As it stands currently, this is not in contravention of the current guidelines.

CONCLUSION

The under-utility of needle aspiration is in contravention of current evidence based guidelines. Educational programmes targeted at emergency room physicians, the first responders to this condition, may increase compliance with these guidelines.

There should be an increase in referral to thoracic surgeons and the utility of CT to investigate these patients. This may allow more patients who meet the criteria of prophylaxis to be offered these procedures.

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