

PNEUMOTHORAX FOLLOWING ULTRASOUND GUIDED THORACENTESIS; DOES OPERATOR'S EXPERIENCE MATTER?

Imaad ur Rehman, Sadia Saeed Chaudhary, Abdur Raheem, Mobeen Ahmed, Atif Iqbal Rana, Ahmed Kamal

Department of Diagnostic and Interventional Radiology, Shifa International Hospital (SIH), Islamabad, Pakistan.

PJR April - June 2015; 25(2): 60-63

ABSTRACT

AIM: To determine the frequency of pneumothorax following ultrasound guided thoracentesis in our department and its association with operator's experience in causation of pneumothorax. **MATERIALS AND METHODS:** This descriptive cross sectional study was conducted at the Department of Diagnostic and Interventional Radiology, Shifa International Hospital (SIH), Islamabad from January 2010 to April, 2012. A total of 362 ultrasound guided thoracentesis were performed followed by a chest radiograph between January 2010 and April, 2012 fulfilling the inclusion criteria. All procedures were performed by radiology consultants and residents. Generally 18 and 16 G cannulas were used. A few were done with 16 and 18 G spinal needle and 21G syringe needle. Relevant data was collected from hospital data base system on the performance and was analyzed for demographic variables, frequency of pneumothorax, and its association with operator's experience (residents or consultants) by applying chi square test. P value of < 0.05 was considered significant. **RESULTS:** 309 patients had thoracentesis while performed by residents and 53 by consultants. Pneumothorax occurred in 22 of these 362 cases with an overall frequency of 6 %. Of these 22 cases of pneumothorax, 19 had undergone thoracentesis by residents (6.1%) and 3 by consultants (5.7%). No significant difference was observed in occurrence of pneumothorax between these two groups ($p=0.59$). **CONCLUSION:** Experience of operator does not have any significant effect on causation of pneumothorax ($p=0.59$).

Key words: Ultrasound, pneumothorax, thoracentesis.

Introduction

This as a procedure is relatively simple, well tolerated and quite safe; however complications related to thoracentesis are not uncommon.¹ The process of aspiration of pleural fluid for diagnostic and therapeutic purpose is performed by thoracentesis.² Ultrasound was first described as a technology to guide thoracentesis in 1986. One of the most common complications is pneumothorax and thoracentesis represents one of the most frequent causes of iatrogenic pneumothorax.³ Since then a number of studies have been published showing significant

reduction in frequency of pneumothorax as compared to blind procedure.⁴ The routine use of ultrasonography during thoracentesis has been shown to reduce the frequency of pneumothorax by 19% in one study.^{5,6,7,8,9}

There are certain other factors which have been shown to affect the frequency of pneumothorax in ultrasound guided thoracentesis. Position of the patient during procedure can affect the frequency rate of pneumothorax.¹⁰ Patient's clinical status has also been considered one factor. The risk of pneumo-

Correspondence : Dr. Imaad ur Rehman
Department of Diagnostic and Interventional
Radiology, Shifa International Hospital (SIH),
Islamabad, Pakistan.
Email: imaadur@gmail.com

Submitted 15 April 2015, Accepted 5 May 2015

thorax increases in patients on mechanical ventilator as compared to stable patients.¹¹ Experience of operator is a bit controversial in affecting frequency of pneumothorax. One study shows that the chances of pneumothorax are reduced when the procedure is to be performed by experienced operators¹¹ while another study shows that operator's experience has no effect on the complication rate.¹² The amount of pleural fluid aspirated has also been associated with occurrence of pneumothorax i.e. larger the volume aspirated, higher is the chances of pneumothorax.¹³ There is no published data from our country regarding the frequency of post-thoracentesis pneumothorax and various factors related to it. Identification of modifiable or preventable factors can help to minimize the risk of development of pneumothorax after thoracentesis. This study was conducted to determine the frequency of pneumothorax following ultrasound guided thoracentesis in our department and its association with operator's experience in causation of pneumothorax.

Materials and Methods

All patients were prepared and draped in standard fashion after marking the skin over the deepest pocket of pleural fluid. Ultrasound with transducer frequency of 3.5 MHz was used for guidance. Local anesthetic was infiltrated into the track. Before procedure it was verified that patient's International Normalization Ratio (INR) was normal. The type of needle used was based on operator's preference. Different needles used were 18G & 16G cannula, 18G & 16G spinal needles and 21G syringe needles. The posture of patient during procedure was dependant on clinical status of patient. Sitting posture was preferred in stable patients while lateral or semi-lateral posture of patient was adopted in clinically unstable patients. After completion of thoracentesis every patient had chest radiograph to look for pneumothorax as part of departmental protocol.

A descriptive cross sectional study was conducted at the Department of Radiology Shifa International Hospital from January 2010 to April. A total of 362

patients were included in the study through consecutive non probability sampling.

The record of these patients was reviewed in hospital data base system and their data was collected in performa. The data was entered into SPSS version 16 and analyzed for demographic variables, frequency of pneumothorax, and its association with operators experience as well as gauge of needles with frequency of pneumothorax. Descriptive statistics were calculated. Chi square test was used to determine the association of pneumothorax with the operator's experience and gauge of the needles, keeping p value < 0.05 as significant.

Results

Among 362 patients 60.5% (n=219) were males and 39.5% (n=143) were females. The mean age of population was 54.5 years with age range of 8 to 91 years. The pneumothorax rate was 6% (22/362). Among 309 thoracentesis performed by the residents, 19 pneumothorax occurred (06%) while 3 out of 53 (5.7%) cases suffered pneumothorax in whom procedure was performed by consultants. No significant difference was observed infrequency of pneumothorax by two groups of operators when chi square test was applied (p=0.59).

Discussion

The use of ultrasound has significantly decreased the frequency of pneumothorax following thoracentesis. However various factors have been identified which affect the frequency of pneumothorax. The factors can be categorized into those related to the patient, the operator based and that related to the instruments. The patient related factors include clinical status of patient, spontaneous or mechanical ventilation, quantity of pleural fluid and ability of patient to maintain proper posture. Operator based factors include selecting appropriate pleural fluid pocket and direction of needle. Those related to instruments used are size and gauge of needle and resolution of ultrasound. Among these factors, experience of operator is studied and discussed here.

The overall frequency of pneumothorax varies in different centre and in one centre at various times.¹⁴ Colt et al described pneumothorax frequency of 5.4% in his study.¹² Jones et al studied that they observed pneumothorax in 24 thoracentesis out of 941(2.5%).⁶ Raptopoulos et al found 3 cases of pneumothorax out of 188 ultrasound guided thora-centesis with frequency of 3%.⁷ In our study, in 22 out of 362 patients pneumothorax occurred with overall frequency of 6%.

The operator's experience which is studied and related here is the proposed factor to be considered in post thoracentesis pneumothorax. The correlation of operators experience and risk of post thoracentesis pneumothorax are different in literature. A meta analysis by Gordon et al mentions that rate of pneumothorax in pleural fluid aspiration may be reduced when procedure is performed by senior experienced consultant.¹¹ Another study by Barnes et al showed reduced frequency of pneumothorax with ultrasound guided thoracentesis irrespective of experience of operators.¹⁵ A study by Bartter et al reported low frequency of complications in thoracentesis when it is performed by experience operators.¹⁶ Pihlajamaa showed no significant difference among the residents and senior radiologists in causation of pneumothorax in ultrasound guided pleural fluid aspiration.¹⁷ In our study we defined two groups of operators; residents (experience of less than 4 years in radiology) and consultants (more than 4 years experience). There was no significant difference between the two groups in frequency of pneumothorax after pleural fluid drainage having the p value of 0.59.

Study	Sam- ple size	Frequency of Pneumothorax	Operators	P value for pneumothorax versus operator experience
Colt et al ¹²	255	5.4%	Fellows	-
Jones et al ⁶	941	2.5%	Radiologists	-
Raptopoulos et al ⁷	188	3%	Radiologists	-
Our Study	362	6%	Residents & Radiologists	0.59

Table 1: Table showing comparison of frequency of pneumothorax in various studies with operator levels.

Since this was a retrospective study, other factors such as patient's clinical status, position of patient

during procedure, amount of fluid aspirated and number of punctures could not be studied. This is a limitation of our study.

Conclusion

As per statistics of our study the experience of operator does not have any significant effect on causation of pneumothorax (p=0.59).

References

1. Nathan Janzen, MD; Richard Nataraj; Chris Hergott; Darcy Marciniuk. Thoracocentesis complication rates on the medical clinical teaching unit: Does ultrasonography makes a difference? Chest 2011; **140**: 4-10
2. Ahmad A, Khan AZ, Ahmed B, Rabbi F, Ahmed Y. Diagnostic outcome of large and massive pleural pleural effusion. Pak J chest med. 2008; **14**(4): 4-10.
3. Kohan JM, Poe RH, Israel RH, Kennedy JD, Benazzi RB, Kallay MC. Greenblatt DW. Value of chest ultrasonography versus decubitus roentgenography for thoracentesis. Am Rev Respir Dis. 1986; **133**: 1124-6.
4. Feller-Kopman, D. Ultrasound-Guided Thora-centesis. Chest 2006; **129**: 1709-14.
5. Jones PW, Moyers JP, Rogers JT, Rodriguez RM, Lee YC, Light RW. Ultrasound-guided thora-centesis: is it safer method? Chest. 2003; **123**: 418-23.
6. Raptopoulos V, Davis LM, Lee G, Umali C, Lew R, Irwin RS. Factors affecting the development of pneumothorax associated with thoracentesis. AJR Am J Roentgenol. 1991; **156**: 917-20.
7. Pankaj A Patel, PharmD; Frank R Ernst; Candace Gunnarsson, EdD. Evaluation of hospital complications and costs associated with thoracocentesis with or without ultrasound guide. Chest. 2010; 138.

8. Mercaldi CJ, Lanes SF. Ultrasound guidance decreases complications and improves the cost of care among patients undergoing thoracentesis and paracentesis. *Chest*. 2013; **143**: 532-8.
9. Grogan DR, Irwin RS, Channick R, Raptopoulos V, Curley FJ, Bartter T, Corwin RW. Complications associated with thoracentesis. A prospective, randomized study comparing three different methods. *Arch Intern Med*. 1990; **150**: 873-7.
10. Soldati G, Smargiassi A, Inchingolo R, Sher S, Vanlente S, Corbo GM. Ultrasound guided pleural puncture in supine or lateral recumbent position- feasibility study. *Cip Respir Med*. 2013; **8**: 18.
11. Gordon CE, Feller-Kopman D, Balk EM, Smetana GW. Pneumothorax following thoracentesis: a systemic review and meta- analysis. *Arch Intern Med*. 2010; **170**: 332-9.
12. Colt HG, Brewer N, Barbur E. Evaluation of patient-related and procedure-related factors contributing to pneumothorax following thoracentesis. *Chest*. 1999; **116**: 134-8.
13. Josephson T, Nordenskjold CA, Larsson J, Rosenberg LU, Kaijser M. Amount drained at ultrasound guided thoracentesis and risk of pneumothorax. *Acta Radiol*. 2009; **50**: 42-7.
14. Hussain S, Aziz A, Fatima H. Pneumothorax occurrence of 146 adult cases admitted at a University Teaching Hospital. *J Pak med Assoc*. OCY 1999; **49(10)**: 243.
15. Barnes TW, Morgenthaler TI, Olson EJ, Hesley GK, Decker PA, Ryu JH. Sonographically guided thoracentesis and rate of pneumothorax. *J Clin Ultrasound*. 2005; **33**: 442-6.
16. Bartter T, Mayo PD, Pratter MR, Santarelli RJ, Leeds WM, Akers SM. Lower risk and higher yield for thoracentesis when performed by experienced operators. *Chest*. 1993; **103**: 1873-6.
17. Pihlajamaa K, Bode MK, Puumalainen T, Lehtimäki A, Marjelund S, Tikkakoski T. Pneumothorax and the value of chest radiography after ultrasound-guided thoracentesis. *Acta Radiol*. 2004; **45**: 828-32.