Original Article

Evaluation of safety and efficacy of regional anesthesia compared with general anesthesia in thoracoscopic lung biopsy procedure on patient with idiopathic pulmonary fibrosis

ABSTRACT

Background: Interstitial lung diseases are diseases that need histology diagnosis or obtaining a lung biopsy to establish the diagnosis. Surgical biopsies are performed usually using the thoracoscopy technique under general anesthesia (GA) although this procedure is still associated with morbidity rate. The aim of this study is to determine the effectiveness and safety of regional anesthesia (RA) compared with GA in thoracoscopic lung biopsy procedures done on patients with idiopathic pulmonary fibrosis (IPF).

Subjects and Methods: This is a retrospective qualitative study based on adult cases of video-assisted thoracoscopy (VAT) lung biopsy on patients with IPF admitted in the division of Thoracic Surgery, Department of General Surgery, King Khalid University Hospital, Riyadh, KSA. We included 67 patients with IPF, 26 with RA, and 41 with GA, who underwent this procedure from January 2008 to December 2015. Procedures performed under RA were done using three different approaches, intercostal nerve blocks, extrapleural infusion, and paravertebral block while GA was performed using double-lumen endotracheal tube placement. For statistical analysis, SPSS program, version 21.0. Software used to analyze the obtained data. The statistical significance was defined as $P < 0.05$.

Results: Sixty-seven patients underwent the procedure of thoracoscopic lung biopsy. Twenty-six of them (38.8%) underwent the procedure under RA and 41 (61.2%) under GA. The cross tabulation of the intercostal chest tube duration showed that it was significantly longer in GA group (6.23 ± 5.1 days) compared to RA group (3.12 ± 1.5 days), $P = 0.004$. Furthermore, for the Intensive Care Unit (ICU) stay, it was significantly longer in GA group (3.38 ± 2.1 days) compared to RA group (1.09 ± 0.7 days), $P = 0.019$. Regarding the relation between the number of biopsies taken and type of anesthesia performed, the probability values for GA group as well as RA group come out to be >0.05 (statistically independent) and the results of risk estimate also show that there was no significant association found between them. The cross tabulation of the representation of biopsies taken by the two methods showed that all biopsies taken under both settings were representative of the disease. Of 41 procedures done under GA, 16 of the total showed a number of complications. Likewise, of 26 procedures under RA, five cases showed complications. The significant (two-sided) value was ($P = 0.110$), there was no statistical significance between the risks of complications and the two types of anesthesia.

Conclusion: There was a significant decrease in chest tube duration and ICU stay in RA group compared to the GA group. There was no statistical difference between both types of anesthesia in the number of biopsy, representation, and postoperative complications although the rate of these complications was much less in the RA group. Based on this outcome, we can

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conclude that VAT lung biopsy procedure on patients with IPF under RA is safe, representative, and effective operation. In addition, high-risk patients for GA can go through this procedure under RA as an alternative and safe option with no added complications.

Key words: General anesthesia; idiopathic pulmonary fibrosis; regional anesthesia; thoracoscopic lung biopsy

Introduction

Idiopathic pulmonary fibrosis (IPF) or interstitial lung disease (ILD) are varied group of diseases that are assigned together because they have similar clinical, pathophysiological, and radiological manifestations.[1] When the results of clinical evaluation, laboratory testing, imaging studies, including high resolution computed tomography scanning of the chest and pulmonary function testing do not allow the clinician to make a confident diagnosis of a given type or stage of ILD, then lung biopsy along with careful examination of lung tissue is often necessary.[2] The diagnosis of infiltrative diffuse lung disease may require invasive procedures as taking these tissue biopsies through thoracoscopy or thoracotomy when all noninvasive tools have failed.[3]

Thoracoscopy is a procedure performed usually by thoracic surgeons; it is a useful tool for the diagnosis of several lung diseases.[4] In ILD patients, thoracoscopy is done to collect the samples of lung interstitial by biopsy to get a proper diagnosis.[5] It is used to aid the diagnosis of ILD as per the guidelines of British Thoracic Society of pleural disease.[6] Thoracoscopy is usually assisted by camera and is termed as video-assisted thoracoscopic surgery (VATS). The older technique used was thoracotomy in which the chest had to be exposed for the medical procedure, but it is now near to end since thoracotomy leads to high degrees of postoperative pain and the advancements of video-assisted thoracoscopy (VAT) surgery.[7]

Anesthesia used can be either general or regional. The trend of anesthesia technique is now shifting toward regional anesthesia (RA). There is a growing prevalence currently of using RA for the purpose of thoracoscopy in ILD patients.[8,9] The main reason for changing the type of anesthesia from general to regional is the advantages of RA, i.e., low morbidity, less adverse effects, shorter hospital stays, avoidance of mechanical ventilation, and negligible mortality.[8-11]

In the literature, we often find similar successes of RA over general anesthesia (GA) for the purpose of thoracoscopy. Different authors have hypothesized and listed RA for thoracoscopy as a safe alternative to GA.[12] Pompeo *et al*. in 2013 determined the feasibility and perioperative outcome of video-assisted thoracoscopy done by giving RA to that of GA.[8] They studied that a total of thirty patients had ILD. Those patients underwent awake video-assisted thoracoscopic lung biopsy using RA (thoracic epidural and intercostal nerve [ICN] blocks) and were not intubated and breathed spontaneously. They concluded that awake VATS lung biopsy is feasible, has low range of side effects, and it might be the best and the safest alternative of GA. It also gives accurate samples for histopathological diagnosis and in general terms, earlier diagnosis of ILD patients.[8]

Marchandise *et al*. proposed that for the diagnosis of the patients of ILD, thoracoscopic lung biopsy is a better alternate when compared to open lung biopsy. They studied 33 patients for their research and made a proper diagnosis in all of these without any adverse reaction using the technique of VATS without endotracheal intubation.[13]

Dijkman *et al*. carried thoracoscopy under local anesthesia in 81 cases. Multiple biopsy specimens were obtained. The success of this method was all the specimens provided sufficient microbiological and morphological data to diagnose the patients within 2–48 h of sample collection.[14]

Similarly, Hung *et al*. considered nonintubated thoracoscopic surgery, a state of the art technique. According to their review paper, though the conventional procedure of performing VATS is by GA and intubation, VATS without tracheal intubation is safer alternative and feasible alternative, especially for the patients who are at high risk for intubated GA.[9]

Katlic and Facktor reported 384 cases who had to undergo VATS using RA. They concluded that the use of RA is a quite valuable, well tolerated by patients, and safer for the future indication in other patients. None of the patients required any form of intubation or any nerve blockage. No patient required progression to open thoracotomy (in case of any serious complication) and the diagnosis was easy to make.[15] Intubation with double-lumen tube may lead to tracheal rupture or damage to this major airway. Furthermore, the esophagus as well is liable to damage. However, 182 cases of tracheal rupture were reported by Miñambres *et al*. in a

systematic review and meta-analysis study after intubation.[16] Moreover, there is a greater possibility also of airway dryness. Hence, the current literature available is definitely in the support of use of RA for VATS.[16]

The main aim of this research study is to evaluate the safety and efficacy of RA in compare with GA in thoracoscopic lung biopsy on patients with IPF.

Subjects and Methods

The proposed research work is a retrospective qualitative randomized study based on adult cases of thoracoscopic lung biopsy on patients with IPF, Division of Thoracic Surgery, King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia. Sixty-seven patients with IPF 26 with RA and 41 with GA underwent thoracoscopic lung biopsy from January 2008 to December 2015 are included in this study.

Cardiopulmonary risk index used to predict postsurgical outcome. Each value assigned for each cardiac factor: heart failure, myocardial infarction, arrhythmia, and aortic stenosis. Furthermore, for pulmonary factors, cough, elevated carbon dioxide, poor spirometry function, diffuse wheezing, and smoking. A score of 4 or higher patients have 22-fold chance to develop postoperative complications compared with patients have a score <4. In addition to the routine monitoring during thoracic surgeries which include the followings: body temperature, systemic blood pressure, pulse oximetry, end-tidal capnography, and electrocardiography.[17]

Procedures performed under RA were done using all the three different approaches. The first method was ICN blocks or ports local anesthesia. The second one was extrapleural infusion, and the third approach was paravertebral block which performed percutaneously (blindly or with a nerve stimulator) or using the ultrasound guidance.[18] In the GA group, anesthesia was induced with intravenous (IV) fentanyl and propofol. Trachea was intubated with double-lumen endotracheal tube facilitated with IV rocuronium. The position of the tube was verified using fiberoptic bronchoscope. Anesthesia was maintained with O_2/air/Sevoflurane gas.

The major advantage of using double-lumen tube is to provide selective ventilation of the contralateral lung and allow more rapid collapse of the ipsilateral lung in addition to give the opportunity to the surgeon to deflate, reexpand, or suction one or both of lungs at any time during the operation.[19,20]

During the study, the entire patients' information, which were related to age, gender, time spent in surgery, length of postoperative hospital stay, postoperative chest tube time, and length of postoperative (Intensive Care Unit [ICU]) stay, and the occurrence of complications, morbidity, and mortality has been collected, processed, evaluated, and analyzed. For statistical analysis, (SPSS Inc., Chicago, IL, USA) used to analyze the obtained data. The statistical significance was defined as $P < 0.05$.

The Institutional Review Board at the College of Medicine, King Saud University, Riyadh, Saudi Arabia, has reviewed this research and it has been accepted for data collection, number of registration: CMD-305, F5, dated January 26, 2014.

A written consent was taken from participants before conducting the data collection part of the research. The consent form included the purpose of this study, the participant rights to refuse, or withdraw from the study.

Results

Sixty-seven patients underwent VAT lung biopsy. Twenty-six of them (38.8%) underwent the procedure with the usage of RA, and 41 (61.2%) done the procedure under the effect of GA.

The joint frequency distribution of the variables of both groups RA and GA are shown in Table 1. This shows the number of biopsy taken under GA and RA on patient who underwent thoracoscopic lung biopsy. Of 41 procedures done under GA, only eight patients needed one biopsy while 33 others needed two biopsies. Of 26 cases who underwent the procedure under RA, one sample was taken from 8 patients and two biopsies were taken from 18 patients.

The two types of anesthesia performed to take biopsies from patients with ILD are analyzed with the Chi-square statistic [Table 1] to determine whether they both are statistically independent or associated with each other. Since the probability values for GA as well as RA come out to be >0.05,

Table 1: Number of biopsies (cross tabulation)

Type of anesthesia	Number of biopsy taken		Total	*P* (Chi-square tests)
	1	2		
General anesthesia				
Count	8	33	41	0.164
Percentage of total	11.9	49.2	61.1	
Regional anesthesia				
Count	8	18	26	
Percentage of total	11.9	26.9	38.8	
Total				
Count	19	51	67	
Percentage of total	28.4	76.1	100.0	

we can say that both types of anesthesia are independent of each other. The results of the statistical test are therefore nonsignificant, and it means that we cannot reject the null hypothesis. This also shows that both types of anesthesia hold the same value and they are needed depending on the state of the patient undergoing this procedure.

The results of risk estimate also show that there is no significant association present between the types of anesthesia and biopsy taken since the 95% confidence interval comprises the value 1.0 while our result has shown a value of 0.545 (0.175, 1.698). Both types of anesthesia have the probability to be beneficial and hold a risk when applying it [Table 2].

The cross tabulation shown in Table 3 demonstrates the representation of biopsies taken by the two methods. The table shows that all biopsies taken under both settings are representative of the disease.

A cross tabulation is shown in Table 4 demonstrating the number of complications associated with RA as well as GA. The table shows increased number of complications under GA when comparing them with complications under RA (76.2% vs. 23.8%, respectively). Of 41 procedures done under GA, 25 showed no complications after surgery, while 16 of the total who have done the procedure under GA showed a number of complications. Likewise, of 26 procedures under RA, 21 showed no complication and five cases showed complications [Figures 1-3].

Table 2: Number of biopsies (risk estimate)

	Risk estimate		
	Value	95% CI	
		Lower	Upper
OR for type of anesthesia (general anesthesia/regional anesthesia)	0.545	0.175	1.698

CI: Confidence interval; OR: Odds ratio

Table 3: Representation of biopsy (cross tabulation)

Type of anesthesia	Count
	Representation (yes)
General anesthesia	41
Regional anesthesia	26
Total	67

Table 4: Complications of procedures (cross tabulation)

Type of anesthesia	Complication of procedure		Total	*P* (Chi-square tests)
	No	Yes		
General anesthesia				
Count	25	16	41	0.110
Percentage of total	37.3	23.8	61.1	
Regional anesthesia				
Count	21	5	26	
Percentage of total	31.3	7.5	38.8	
Total				
Count	46	21	67	
Percentage of total	68.7	31.1	100.0	

The statistical significance was defined as $P<0.05$

These data were further analyzed with the Chi-square statistic as shown in Table 4 to determine whether both types of anesthesia are statistically significant or nonsignificant that is independent. The (two sided) *P* value was ($P = 0.110$), which is >0.05; thus, there is no statistical significance present between these two types of anesthesia.

The estimate of odd ratio of GA and RA as shown in Table 5 is 0.372, that is, lower than 1, which means that there is an association between the risks of complications and the two types of anesthesia might exist although the results of the test are statistically not significant.

The results shown in Table 6 are about days spent in the ICU and days spent with intercostal chest tube (ICT) attached to patient's chest in both GA and RA. We noticed that the mean value of ICU and ICT days was more in GA with mean value equal to 3.38 for ICU days and mean value equal to 6.23 for ICT days as compared to RA with a mean value of 1.09 for ICU days and 3.12 for ICT days.

Furthermore, independent samples test [Table 7] used to compare the difference in the means that is the difference in the frequency of anesthesia used between the two settings. The (2-tailed) *P* value was 0.019 for the number of days stay in ICU sitting which is lesser than <0.05. While 0.004 was the (two-tailed) *P* value of the ICT duration, which is also lesser than <0.05, indicating that the variability in both types of anesthesia used is showing a significant difference in both the ICU stay duration and for the ICT days.

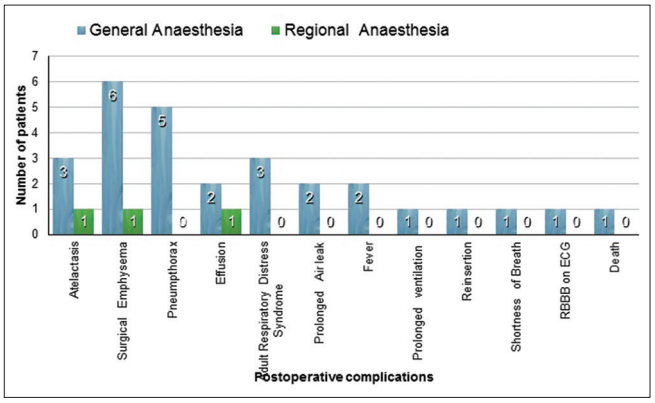

Figure 1: Postoperative complications

Discussion

In our study, both types of anesthesia have been evaluated thoroughly in terms of number of biopsies needed and their representation, complications of procedure, ICT days, and ICU admissions. Our results showed that RA was safer than GA with the cumulative frequency of complications, although was not statistically significant *P*-value =0.110. However The (2-tailed) *P* value was 0.019 for the number of days stay in ICU sitting. While 0.004 was the (two-tailed) *P* value of the ICT duration, which were both statistically significant. However, there was no significant difference in the number of biopsies needed for diagnosis and their representation.

Likewise, the rate of postoperative complication was checked in both types of anesthesia, and they were found to be less in RA (7.5%) than GA (23.8%) as in Table 4. These complications vary from mild as dizziness to severe as death [Figure 1]; the most frequent complications found in GA are surgical emphysema (six cases) and pneumothorax (five cases) [Figure 1]. On the other hand, RA showed one case of emphysema and no cases of pneumothorax [Figure 1].

Along with complication, ICT duration and ICU stay were used to assess safety in both modalities. ICT and ICU independent sample test showed a significant difference in ICT duration (0.004) and significant difference in ICU stay (0.019).

Showing that, our null hypothesis of no difference between the two types is rejected. Since the RA had significant difference in safety, we can assume that RA has the same effectiveness of GA.

However, bias is present here because of number of patients distributed in our sample who underwent the procedure differs from GA to RA. A greater number of procedures were carried out under GA that is 41 while only 26 procedures were carried out under RA. Therefore, the complication rates would be high for GA. Due to this difference in numbers of cases, Chi-square test did not show the presence of any significance. It indicates that no relation exists between the types of anesthesia and their complications. If significance had been present, then a relationship would have existed between the complications and the two types of anesthesia. The researcher could then be 95% confident that the relationship between the anesthesia and complications arisen is not due to chance.

Table 5: Complication of procedures (risk estimate)

	Risk estimate		
	Value	95% CI	
		Lower	Upper
OR for type of anesthesia (general anesthesia/regional anesthesia)	0.372	0.117	1.186

CI: Confidence interval; OR: Odds ratio

Table 6: Chest tube duration (cross tabulation)

	Group statistics		
	Type of anesthesia	*n*	Mean
Number of days with ICT	General anesthesia	40	6.23
	Regional anesthesia	26	3.12
Number of days in ICU	General anesthesia	40	3.38
	Regional anesthesia	23	1.09

ICU: Intensive Care Unit; ICT: Intercostal chest tube

Table 7: Chest tube duration and Intensive Care Unit stay duration (independent sample risk)

	t-test for equality of means		
	df	Significant (two-tailed)	Mean difference
Number of days with ICT			
Equal variances assumed	64	0.004	3.110
Equal variances not assumed	49.024	0.001	3.110
Number of days in ICU			
Equal variances assumed	61	0.019	2.288
Equal variances not assumed	39.165	0.008	2.288

The statistical significance was defined as $P<0.05$. ICU: Intensive Care Unit; ICT: Intercostal chest tube

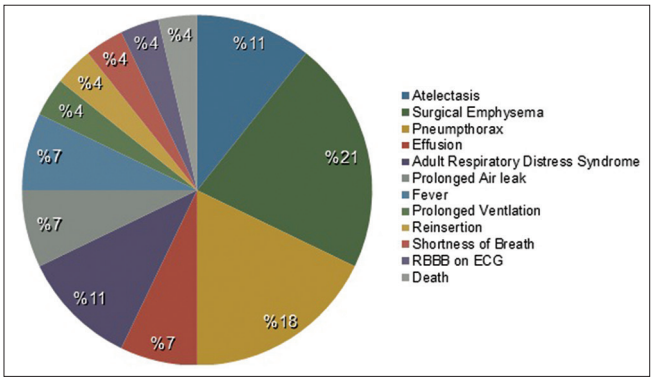

Figure 2: Complications of general anesthesia

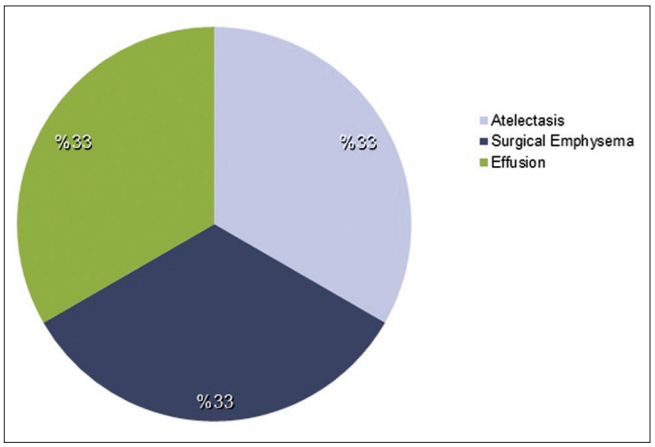

Figure 3: Complications of regional anesthesia

In this study, we hypothesized that the expenditure and the cost of a procedure done under GA would be higher than the cost of a procedure done under RA. And indeed, the business center at KKHU confirmed that the procedure done under GA would cost double what it would have cost under RA due to stay more days in ICU and in the hospital until the chest tube is removed and the patient is discharged home.

As a whole, the results of this study showed statistically significant differences between the two types of anesthesia in safety of performance and postsurgical complications. It also indicates that both methods have no significant statistical difference in the effectiveness and have the same level of biopsy representation. However, it cannot be neglected that RA is a cost-effective method compared with the GA.

Finally, the usage of the two types of anesthesia is dependent on the nature and type of the procedure and the status of the patient itself.

Study limitation

In our retrospective study, some limitations must be taken into consideration. First, the research sample turned to be smaller than expected which caused a difference between the case group and control group. In our research, we included the data of a single hospital, which contributed to the small sample size that we had. In addition, it was not possible to eliminate the effect of comorbidities on postsurgical complications due to insufficient exclusion criteria. Going through medical records was huge obstacle since some data were missing and some files were not available.

Conclusion

We can conclude that VATS lung biopsy procedure on patients with IPF under RA is safe, representative, and effective operation. However, regarding the rate of the complications although they were less in the RA group, statistically were not significant. In addition, patients who are in a state where GA is not an option or high risk due to their state of health can go through this procedure under RA with no added complications.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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