Peer review file

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Reviewer A

Major:

Comment 1: Lines 70-72, 211-213, 383-385: the mean hospital length of stay was either statistically significantly shorter or it was not. This sentence is misleading. Please consider rephrasing it as follows, "There was no significant difference in hospital length of stay between the two groups."

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 6, lines 143, to page 7, lines 145)

"The mean hospital day was shorter in the digital group than in the analogue group (17.96 ± 12.23 vs. 18.32 ± 16.64, P=0.902), and there was no statistically significant difference in the hospital length of stay between the 2 groups."

(page 14, lines 326-329)

"The mean hospital length of stay (days) was 18.14 ± 14.53, which was shorter in the digital group than in the analogue group, but there was no statistically significant difference in hospital length of stay between the 2 groups (17.96 ± 12.23 vs. 18.32 ± 16.64, P=0.902)."

(page 20, lines 473-475)

"Although there were no significant differences between the digital thoracic and traditional

analogue suction systems, the digital thoracic drainage system had shorter hospitalization days and indwelling time for chest tube drainage [19-23].”

Comment 2: The Introduction is underdeveloped. Please elaborate on what prior studies have shown in this area. Have these studies focused on post-operative patients or those with pneumothorax similar to your population? Consider removing the historical narrative from the discussion section, shortening it, and inserting it in the introduction.

--Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration. The historical narrative area in the discussion section was shortened and inserted in the introduction as your advice. Actually, we described in the study design and results, all authors only focused on the primary or secondary pneumothorax, not on post-operative management. We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 9, lines 194, to, page 10, lines 226)

“I. Introduction

In the fifth century BCE, the main concept of chest drainage was first advocated by Hippocrates, and he described pleural drainage with a thoracic incision, cautery and insertion of a metal tube for the treatment of empyema. In the 15th century CE, significant advances in the treatment of empyema include rib resection and insertion of a trocar and a metal cannula for thoracic drainage, which was described by Celsius, and these instruments were completely similar to those available nowadays [1-3]. In 1871, a British physician, William Smoult Playfair, reported on the application of continuous subaqueous drainage to treat thoracic empyema in children, and established the principle of the current underwater-seal

suction drainage. He was faced with a patient having an open pneumothorax created by tube thoracostomy, who was successfully treated with continuous subaqueous drainage of the pleural space using a one-compartment bottle system with direct connection to the thoracic drainage tube and a rigid straw immersed approximately 2.0 cm below water which plays an important role as both a one-way valve and a venting valve [4]. His novel idea using a one-compartment bottle system offered a safe and complete egress of air from the pleural cavity to atmosphere during inspiration and prevented a re-entry of air on expiration. In 1875, a German internist and pulmonologist, Gotthard Bülau, demonstrated a more modernized closed water seal drainage system for the treatment of pleural empyema [5]. To date, digital chest tube drainage systems (DCTS) have contributed to quantifying air leaks and determining when to remove chest tubes. Previous studies have demonstrated that compared to traditional systems, these systems aid in clinical determination of chest drain removal timing and further reduce the length of hospital stay in patients with air leaks, which makes these systems useful for managing patients with primary or secondary pneumothorax in a clinical setting. In the field of cardiothoracic surgery, most patients with air leaks into the pleural space should be managed by placement and maintenance of chest tubes. However, the placement and management of chest tubes are relatively complex due to considerable variations and debates among different institutions, especially in a clinical setting [6, 7]. There are some debates on (1) when chest tubes should be removed in patients with radiologically resolved pneumothorax, (2) whether chest tube suction is helpful in shortening the chest tube maintenance, and (3) whether provocation test by chest tube clamping is useful for determining the optimal timing of removal [7-11]. This retrospective study was conducted to evaluate the feasibility and usefulness of a digital thoracic drainage system in patients admitted with pneumothorax at our institution."

Comment 3: Why was a large bore (24 Fr) tube used preferentially when small bore tubes have been shown to be equally efficacious and more comfortable for the patient?

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration. Actually, we fully recognize that small bore thoracic catheters (e.g. 10/12/16 fr) have a same effect on the thoracic drainage, compared to large bore thoracic catheter (e.g. 24/28/32 fr). Furthermore, in recent years, we commonly use small bore catheters in most of pneumothorax patients. However, our thoracic/cardiovascular center have a relatively long history of more than 50 years, and our masters/seniors are still intensely working, so the preference to the large bore thoracic catheter are a kind of heritage from seniors/masters. For the one more consideration, for the minimization of bias on statistical analyses, we only used only one type of thoracic catheter, 24-fr chest tube, which is most familiar to the thoracic/cardiovascular surgeons.

Comment 4: Consider having a native English speaker review the manuscript, particularly the discussion section, for proper syntax, sentence structure, and word choice.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

Two native English professors, one is in England and the other one is in USA, meticulously revised and critically re-checked our manuscript for the better legibility and readability.

The changes for the English grammatical improvement were highlighted with green color.

Comment 5: Cost-effectiveness is mentioned in the methods section but not analyzed at all in the discussion section. Please add this information as it is relevant for the reader.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 22, lines 520-524)

"Both digital and analogue drainage systems are fully covered by national health care insurance (80 USD and 10 USD, respectively), and cost effectiveness and patient satisfaction are relevant to the shortened drainage time and the shorten length of hospital stay in the digital suction group (Table 1)."

Reviewer B

Minor:

Comment 1: Line 62: Remove "a" after "indwelling."

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 6, lines 134)

"Patients who underwent closed thoracostomy drainage using an indwelling 24-French chest

tube were divided into 2 groups immediately before closed thoracostomy:"

Comment 2: Line 76: Why do you think the drainage amount and ambulation times per day were greater in the digital drainage group?

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 21, lines 493-501)

"In our study, the drainage amount was larger and the time required for full expansion was shorter in the digital suction system than in the closed suction system (209.62 ± 139.63 vs. 162.48 ± 80.42 and 25.64 ± 14.55 vs. 46.52 ± 25.53, respectively), which indicates sufficient squeezing or milking in the digital suction system. These results show that digital suction systems perform adequate drainage control, which regulate the vacuum on the patient's side, not on the device side, but conventional systems regulate only the vacuum on the device side, not on the patient's side. These results also indicate that digital suction systems have no siphon effect due to precise vacuum measurement and automatic hose rinsing function on the patient´s side."

Comment 3: Line 82: Remove the word "up."

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as

follows:

(page 7, lines 156)

"To date, there is no definite consensus and guidelines on the standardized digital suction system in pneumothorax.:"

Comment 4: Line 83: You cannot claim that this single study lead to the establishment of guidelines.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 7, lines 157-160)

"This study proposed the guidelines for the application of digital thoracic drainage systems in pneumothorax and also suggested that digital thoracic drainage systems might be a valuable tool to determine chest tube removal timing and reducing the length of hospital stay in patients with pneumothorax."

Comment 5: Line 95: Remove the word "better."

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 9, lines 213-215)

“Previous studies have demonstrated that compared to traditional systems, these systems ~~better~~ aid in clinical determination of chest drain removal timing and ~~more~~ reduce the length of hospital stay in patients with air leaks,”

Comment 6: Line 96: Remove the word “more.”

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 9, lines 213-215)

“Previous studies have demonstrated that compared to traditional systems, these systems ~~better~~ aid in clinical determination of chest drain removal timing and ~~more~~ reduce the length of hospital stay in patients with air leaks,”

Comment 7: Line 105: Change “would be” to “is.”

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 10, lines 223-224)

“and (3) whether provocation test by chest tube clamping is useful for determining the

optimal timing of removal [7-11].”

Comment 8: Line 124: Remove the period in the middle of the sentence.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 10, lines 222-223)

“(2) whether chest tube suction is helpful in shortening the chest tube maintenance ~~period~~, and”

Comment 9: Line 144: Change “will recruit” to “involved.”

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 11, lines 263, to page 12, lines 266)

“This research involved adult patients admitted to the Department of Thoracic and Cardiovascular Surgery and to the intensive care unit who were diagnosed with primary or secondary pneumothorax requiring chest drainage and management.”

Comment 10: Line 183-188: First you state that the requirement for informed consent has been waived, and then the next sentence states that each subject gave his or her

informed consent. Please fix this inconsistency.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 13, lines 304-305)

"This study was approved by the Institutional Ethics Committee/Review Board of Konkuk University Chungju Hospital, which waived informed consent due to its retrospective nature of study (IRB approval No., KUCH 2019-10-031)."

Comment 11: Why the preponderance of male subjects?

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration. Actually, we do not fully understand the exact reason about the preponderance of male subjects. In our study, the male preponderance (male: female=91: 9) was similar, when compared with a previous study in our country by Kim et al. (male: female=56: 6) [1] and by Kim et al. (M: F, 275: 23 and 22: 1) [2]. In our best knowledge, preponderance of male is subject to the relatively old age (53.59 ± 22.14, 52.92 ± 21.17 vs.54.26 ± 23.26), relating to the secondary pneumothorax nature.

[1].

Outcome of Video-assisted Thoracoscopic Surgery for Spontaneous Secondary Pneumothorax.

Kim SJ, Lee HS, Kim HS, Shin HS, Lee JW, Kim KI, Cho SW, Lee WY.

Korean J Thorac Cardiovasc Surg. 2011 Jun;44(3):225-8.

doi: 10.5090/kjtcs.2011.44.3.225.

[2]

Recurrence Analysis after Video-assisted Thoracic Surgery for the Treatment of Spontaneous Pneumothorax

Sung-Wan Kim, M.D., Duk-Sil Kim, M.D., Chang-Young Lim, M.D., Hyeon-Jae Lee, M.D., Gun Lee, M.D., Joon-Hyuk Kong, M.D.

Korean J Thorac Cardiovasc Surg 2010; 43(6): 710-715

Doi:10.5090/kjtcs.2010.43.6.710

Comment 12: Line 198, 211: I think you mean hospital length of stay, instead of hospital day.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 13, lines 312, to page 14, lines 313)

"The baseline parameters in the digital and analogue groups were comparable with no significant differences in hospital length of stay (days) (17.64 ± 12.23 vs. 18.32 ± 16.64, P=0.902),"

(page 14, lines 326-329)

"The mean hospital length of stay (days) was 18.14 ± 14.53, which was shorter in the digital group than in the analogue group, but there was no statistically significant difference in

hospital length of stay between the 2 groups (17.96 ± 12.23 vs. 18.32 ± 16.64, P=0.902)."

Comment 13: Line 234: Empyema, not emphysema.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 9, lines 197-198)

"In the 15th century CE, significant advances in treatment of empyema include rib resection,"

Comment 14: Line 242: Remove the word "in."

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 9, lines 206-207)

"a rigid straw immersed ~~in~~ approximately 2.0 cm below water which plays an important role as both a one-way valve and a venting valve [4]."

Comment 15: Line 257: Indicated should be introduced.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 15, lines 355-356)

"In 1952, Howe introduced the three-compartment system consisting of a collection bottle,"

Comment 16: Line 278: This should start a new paragraph.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 16, lines 375-376)

"positive results on conversion of chest drainage from analogue to digital suction systems.

Complications by chest tube placement include primary and secondary injuries to the"

Comment 17: Line 288-289: Injury to the long thoracic nerve is listed twice.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 17, lines 386-387)

"(i.e., Horner's syndrome, phrenic nerve injury, ~~injury to the long thoracic nerve~~ and injury to the long thoracic nerve), cardiac/vascular injury"

Comment 18: Line 302: How common is it?

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 17, lines 398-400)

"Persistent and prolonged air leak is one of the most frequent complications after cardiothoracic surgery, which ~~is the most common cause that~~ can suppress re-expansion of the lungs, prolong hospital stays and increase hospital costs."

Comment 19: Line 308: It is not the number of bubbles that are measured. Rather, it is the numbered column through which bubbling occurs.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 17, lines 402-404)

"To date, assessment and grading of air leaks have been based on static analog measurement of the numbered column through which bubbling occurs in the collection chamber."

Comment 20: Line 311: Consider rephrasing to, "which impairs decision making

regarding need for continued chest tube drainage, as well as the necessity for pleurodesis or surgical repair."

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 17, lines 405-407)

"This imprecise assessment leads to incorrect decisions about maintenance of chest tube drainage as well as the need for pleurodesis or surgical repair [6, 12]."

Comment 21: Line 313: By "physicians" do you simply mean any non-thoracic surgeon, or are you talking about a specific group here?

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 17, lines 407, to page 18, lines 410)

"Discrepancies exist ~~between chest surgeons and physicians~~ in patient care such as evaluation of the size of an air leak though a chest tube and the absence or presence of an air leak, despite technological advancement, verified analysis and application of the same air leak classification system [12]."

Comment 22: Line 325: …would be AN important part…

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 18, lines 417-418)

"Therefore, appropriate evaluation of chest tube function and proper maintenance of chest tube suction would be an important part of thoracic treatment."

Comment 23: Line 331: What do you mean by "portable application with proper suction at ambulation?"

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 18, lines 420-424)

"It is considered that these new systems would enable objective and consistent assessment of an air leak by quantifying subjective bedside clinical parameters and could allow for earlier mobilization and ambulation through unique characteristics of portable systems: no need for connecting to a wall-mounted suction system and less difficulty in manipulating the new suction system."

Comment 24: Line 333: Heimlich is misspelled.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 19, lines 425-426)

"Earlier devices, such as Digivent (Millicore A.B., Sweden) and Heimlich valve (Airfix, University of Technology, Graz, Sweden),"

Comment 25: Lines 349-353: Needs citations.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 19, lines 442-445)

"A previous study has demonstrated that the passive suction or gravity mode is sufficient to treat most patients with pneumothorax and to reduce the length of air leak [3-6]. Another study has indicated that dual modalities of active suction at night and patient ambulation in the daytime are sufficient to treat patients with pneumothorax [3-6]."

Comment 26: Line 368: Change "little" to "limited."

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 20, lines 459-460)

"Despite the authors' short knowledge and limited experience, digital thoracic drainage systems offer some advantages over traditional analogue systems.."

Comment 27: Line 380: Insert "the" at the beginning of the sentence.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 20, lines 470-473)

"The most important benefit from the digital thoracic drainage system would be early detection of chest tube clogging frequently causing tension pneumothorax and/or cardiac tamponade, which prevents critical and fatal complication and improves treatment outcome."

Comment 28: Line 382: "Fetal" should be "fatal."

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as

follows:

(page 20, lines 470-473)

"The most important benefit from the digital thoracic drainage system would be early detection of chest tube clogging frequently causing tension pneumothorax and/or cardiac tamponade, which prevents critical and fatal complication and improves treatment outcome."

Comment 29: Lines 389-392: An image or diagram of this might be helpful.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 21, lines 481-489)

"n our study, the drainage amount was larger and the time required for full expansion was shorter in the digital suction system than in the closed suction system (209.62 ± 139.63 vs. 162.48 ± 80.42 and 25.64 ± 14.55 vs. 46.52 ± 25.53, respectively), which indicates sufficient squeezing or milking in the digital suction system. These results show that digital suction systems perform adequate drainage control, which regulate the vacuum on the patient's side, not on the device side, but conventional systems regulate only the vacuum on the device side, not on the patient's side. These results also indicate that digital suction systems have no siphon effect due to precise vacuum measurement and automatic hose rinsing function on the patient´s side."

Comment 30.: Lines 394-397: I don't understand how you draw that conclusion.

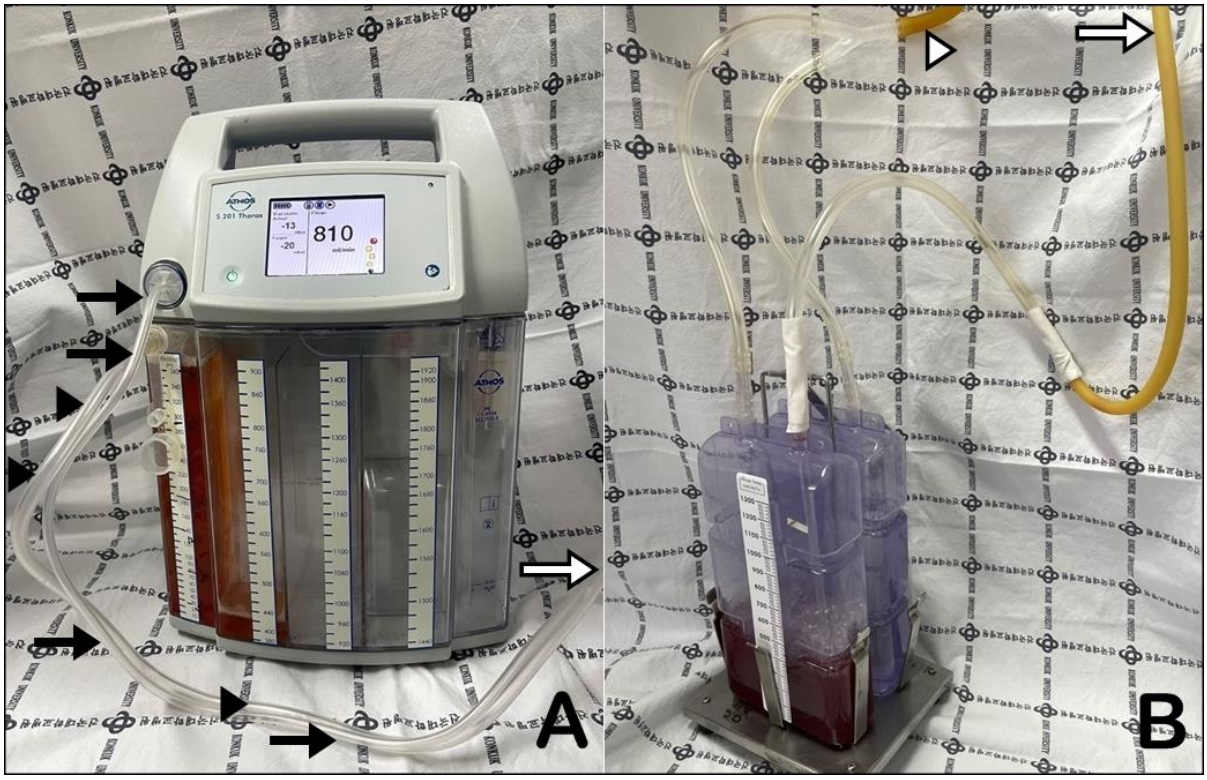
-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

“Figure 4.

Comparison of view between the digital (A) and analogue (B) suction devices in the real clinical setting. The digital system uses a double-lumen hose system, which consists of a measuring/rinsing hose as well as a secretion hose. Black arrows indicate a measuring/rinsing hose with an integrated hydrophobic bacterial filter, which prevents bacteria from entering the device. Black arrowheads indicate a secretion hose, through which secretions and air are suctioned and collected in a fully transparent secretion canister. The digital system has an automatic hose rinsing function, working periodically, 2 rinsing cycles every 3 minutes. The rinsing process transports secretions in the secretion hose to the secretion canister, which prevents accumulation of debris in the secretion hose, ingress of secretions into the measuring/rinsing hose, and creation of syphon effect. The automatic hose rinsing function enables sufficient drainage without milking and/or squeezing. The analogue suction device comprises 2 bottles, water sealed and suction control bottles. It has a thick yellowish rubber which is connected to the chest drainage tube for milking and/or squeezing and is mounted to the wall suction (empty arrowhead with black outline). The empty arrow with black outline indicates the tube connecting to the patient’s chest tube in Figures A and B.



Comment 31: Line 435: The male gender predominance also limits generalizability.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 22, lines 528, to page 23, lines 529)

"This study has several limitations. First, this study was conducted at a single institution and male sex was predominant, which limited the generalizability of the study results."

Comment 32: Line 453: Need a period between sentences.

-Reply:

We agree with the reviewer about that. We would like to thank you for your kind consideration.

We have corrected the sentence in the revised manuscript as the reviewer pointed out as follows:

(page 23, lines 543-548)

“Finally, there may have been errors in the measurement of definite pneumothorax amounts on posterior-anterior (PA) and/or anterior-posterior (AP) chest X-rays, but not on high-resolution computed tomography (HRCT). In several cases, furthermore, correct measurement of pneumothorax size was impossible because the inter-pleural distance was unable to be calculated due to partial collapse and/or adhesion (Figure S1 and Table S1).