Original Article

Surgical and mediastinal emphysema in critically ill COVID-19 patients: A multicentric experience

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Abstract:

INTRODUCTION: Coronavirus illness 2019, commonly referred to as COVID-19, is a highly infectious disease brought on by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). COVID-19 was declared a universal pandemic in March 2020 by the World Health Organization and is a severe health issue with unprecedented morbidity and mortality rates. Both surgical and mediastinal emphysema have been seen in cases of critically ill COVID-19 patients in several hospitals in the Eastern Province of Saudi Arabia.

METHODS: This was a retrospective, cross-sectional, multicentric study involving several hospitals in the Saudi Arabian Eastern Province. Data were collected from intensive care units (ICUs) in these hospitals from March 2 to August 2, 2020. The inclusion criteria consisted of all patients who tested positive for SARS-CoV-2 and were admitted to a critical care unit.

RESULTS: Thirty patients required thoracic consultation and management, including 26 males (81.3%) and 4 females (12.5%) (1:0.15) who developed surgical and mediastinal emphysema requiring thoracic surgery intervention. Most of the patients were on high ventilation settings, and the mean duration of ventilator support was 16.50 ± 13.98 days. Two patients (6.3%) required reintubation. The median positive end-expiratory pressure (PEEP) was 12 ± 2.80 cmH_2O with a median FiO2 of 70% ± 19.73. On average, thoracic complications occurred on day 3 (±6.29 days) postintubation. Ten patients (33.33%) experienced a pneumothorax associated with surgical emphysema (SE), 1 patient (3.33%) presented with only mediastinal emphysema; 17 patients (56.66%) with only SE, and 1 (3.33%) had mediastinal emphysema associated with SE. We noted a correlation between the duration of ventilator support, the length of ICU stay ($P < 0.001$), and the total length of stay (LOS) in the hospital ($P < 0.001$). Total length of hospital stay showed significant association with the onset of complications ($P = 0.045$) and outcomes ($P = 0.006$). A significant association between PEEP and the duration of ventilator support was also evident with a P value = 0.009 and the onset of complications ($P = 0.043$). In addition, we found a significant association between the group with pneumothorax in combination with SE, and their outcomes, with a $P = 0.002$.

CONCLUSION: Surgical and mediastinal emphysema in the critically ill patients are usually attributed to barotrauma and high ventilations settings. During COVID-19 pandemic, these entities were seen and the pathogenesis was revisited and some attributed its presence to the disease process and destruction on lung parenchyma. The associated with extended LOS and delayed recovery in addition to poor prognosis were seen. Their presence is an indicator to higher morbidity and mortality.

Keywords:

COVID-19, emphysema, mediastinal, pneumothorax, surgical

Since the declaration of the COVID-19 pandemic, the health-care system has faced myriad challenges ranging from viral

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intracellular components to worldwide supply chain issues. Coronavirus illness 2019, commonly referred to as COVID-19, is a highly infectious illness brought on by the severe acute respiratory ailment disease coronavirus 2 (SARS-CoV-2). COVID-19 typically affects the respiratory organs, with the most common symptoms including a cough, fever, and shortness of breath.[1]

A subset of critically ill COVID-19 patients has demonstrated unusual thoracic surgery entities seldom seen in critically ill patients with viral pneumonias. Surgical and/or mediastinal emphysema [Figures 1 and 2] was seen in several critically ill patients admitted to several hospitals throughout the Eastern Province of Saudi Arabia.

Computerized tomography (CT) plays a critical role in the diagnosis and subsequent follow-up of the coronavirus disease. According to CT findings, this illness presents as a reciprocal, wide ground-glass opacification (GGO) with a posterior or peripheral circulation, usually involving the lower lobes.[1] These observations raised the question: are these entities related to ventilator support complications such as barotrauma, or related to the actual disease process?

Methods

This was a retrospective, cross-sectional, multicentric study involving several hospitals in the Eastern Province of Saudi Arabia. Institutional ethics board approval was obtained, and the data were collected from the intensive care units (ICUs) in these hospitals between March and August, 2020. The inclusion criteria included all patients with a positive SARS-CoV-2 test who were admitted to the critical care units and experienced surgical emphysema (SE), mediastinal emphysema, and/or pneumothorax. The exclusion criteria included iatrogenic pneumothorax, traumatic pneumothorax, and both surgical and mediastinal emphysema due to instrumentation or intubation.

The requirement of written consent was waived by the institutional review board committee due to the retrospective nature of this study.

Data measurement and analysis

Data collected from the hospital system included demographics, radiological data, length of hospital stay, ventilation settings, inflammatory markers, thoracic complications, interventions, outcomes, and the patient's prognosis. Data management was conducted through Statistical Package for the Social Sciences (SPSS Inc. Chicago, IL, USA, version 23). Mann–Whitney U test and Fisher exact tests were used to determine the significant association of variables, and a significant level was considered at $P < 0.05$.

In addition, multivariate correlation and linear regression were identified, with the Kruskal–Wallis test used for comparisons between the three disease groups.

Results

Chart reviews were performed on all COVID-19-positive patients admitted to the ICUs of multiple hospitals in the Eastern Province of Saudi Arabia between March 2 and August 2, 2020. Thirty patients required thoracic consultation and management, and of those, 26 males (81.3%) and 4 females (12.5%) (1:0.15) developed SE and mediastinum emphysema requiring thoracic surgical intervention. This typically consisted of unilateral or bilateral thoracostomy tube insertion. Patient data are presented in Table 1, and a descriptive analysis of the patient population is demonstrated in Table 2.

Over 84% of the patients presented with shortness of breath, which was the most commonly-seen symptom, along with a variety of others including: fever (68.8%),

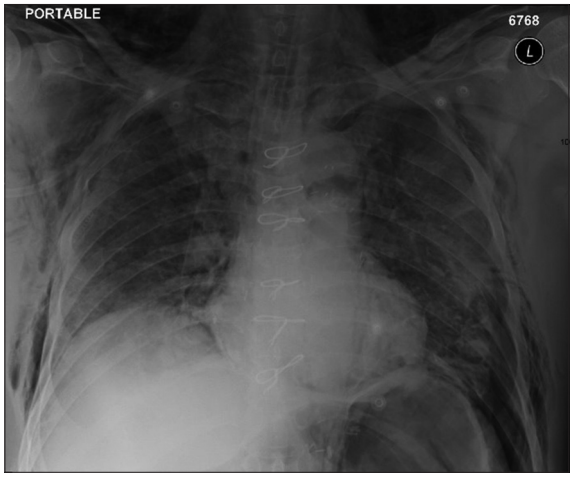

Figure 1: Chest X-ray of bilateral diffuse airspace opacities with bilateral lower zone atelectasis and bilateral subcutaneous emphysema

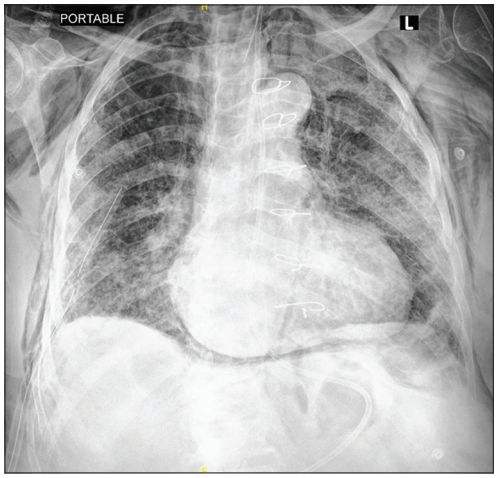

Figure 2: Chest X-ray showing pneumomediastinum with right chest tube

Table 1: Patient data

Age	Gender	Comorbidity	Presenting symptoms	LOS unit (days)	LOS ICU (days)	Length of intubation (days)	Reintubation	Ventilator setting	
								PRVC, %	PEEP
34	Male	Medically free	SOB, cough, fever	NA	7	3	No	50	16
70	Male	DM, HTN, CKD, IHD	SOB, cough, fever	16	52	52	No	70	14
45	Male	Medically free	SOB, cough, fever	3	21	3	No	40	12
52	Male	HTN, DLP	SOB, cough	19	27	27	No	50	10
66	Female	DM, HTN	SOB, cough, fever, loss of appetite	3	6	4	No	50	10
65	Male	DM, HTN, DLP	SOB, cough, fever	21	45	45	Yes	70	18
52	Male	Medically free	SOB, fever	3	41	11	No	60	12
67	Male	DM	Asymptomatic	6	17	17	No	100	14
59	Male	Medically free	SOB	3	9	9	No	70	12
40	Male	Medically free	SOB, fever	NA	7	7	No	70	16
62	Male	CAD, HTN, DSL	SOB, fever	NA	16	16	No	100	10
48	Male	DM, HTN	SOB, cough	NA	15	15	No	100	12
45	Male	HTN, DSL	SOB, cough, fever	NA	27	27	No	70	16
63	Female	DSL, hypothyroidism	SOB, cough, fever	NA	13	13	No	90	16
68	Male	HTN	Loss of appetite	NA	45	45	No	80	16
72	Male	DM, HTN	Hypotensive, decrease level of conscious	2	26	23	No	70	12
75	Female	DM, HTN, DSL, hypothyroidism	SOB, cough, fever	5	41	38	Yes	70	14
62	Female	HTN, BA	SOB, cough, fever	3	8	8	No	100	14
70	Male	HTN	SOB, cough, fever	NA	12	9	No	60	10
44	Male	Medically free	SOB, cough, fever	NA	38	22	No	100	10
66	Male	DM, HTN	SOB, cough, fever	2	12	NA	No	90	7
73	Male	DM, HTN	SOB, Nausea, Fatigue	NA	44	32	No	100	12
44	Male	Medically free	SOB, cough, fever	NA	2	2	No	100	10
30	Male	Medically free	SOB, cough, fever, headache	2	2	NA	No	70	8
61	Male	DM	SOB, cough, fever	NA	14	14	No	70	16
54	Male	SCD	SOB, fever, loss of appetite	NA	9	9	No	50	10
51	Male	HTN	SOB, cough, fever	NA	12	12	No	100	14
81	Male	DM, HTN, CAD s/p CABG	SOB, cough, loss of appetite	NA	13	13	No	60	10
59	Male	Medically free	SOB, fever	NA	10	10	No	50	10
47	Male	Medically free	SOB, fever	NA	9	9	No	50	10

Age	Inflammatory markers					Thoracic complication					Outcome
	LDH	CRP	Procalcitonin	Absolute lymphocyte	Percentage lymphocyte	Type	Onset from intubation	Intervention	Length of chest tube insertion	Reinsertion	
34	1225	16.48	3.79	792×10^3	Low	ME	1	Conservative	NA	No	Died
70	616	9.5	0.3	375×10^3	Low	Pneumothor.ax and SE	11	Thoracostomy	13	No	Alive
45	1223	39.08	5.38	1960×10^3	Low	Pneumothorax and SE	20	Thoracostomy	1	No	Died
52	1042	21.41	5.21	284×10^3	Low	Pneumothorax and SE	1	Thoracostomy	18	Yes	**
66	976	15.04	2.02	477×10^3	Low	SE	3	Thoracostomy	1	No	Died
65	712	18.97	0.32	348×10^3	Low	Pneumothorax and SE	28	Thoracostomy	20	No	Alive

Contd...

Table 1: Contd...

Age	Inflammatory markers					Thoracic complication					Outcome
	LDH	CRP	Procalcitonin	Absolute lymphocyte	Percentage lymphocyte	Type	Onset from intubation	Intervention	Length of chest tube insertion	Reinsertion	
52	976	15.04	2.02	477×10^3	Low	SE	1	Thoracostomy	10	No	Died
67	732	25.79	1.24	658×10^3	Low	SE and ME	4	Conservative	NA	No	Died
59	746	15	5	389×10^3	Low	SE	7	Thoracostomy	3	No	Died
40	649	24.87	0.17	432×10^3	Low	SE	7	Conservative	NA	No	Died
62	1231	9.8	0.04	427×10^3	Low	Pneumothorax and SE	10	Thoracostomy	6	No	Died
48	1007	10.48	1.08	1022×10^3	Low	SE	5	Conservative	NA	No	Died
45	3219	1.67	1.05	3760×10^3	High	Pneumothorax and SE	16	Thoracostomy	3	No	**
63	499	23.01	0.11	1588×10^3	Low	SE	9	Thoracostomy	1	No	Died
68	409	55	0.11	597×10^3	Low	Pneumothorax and SE	1	Conservative	NA	NA	**
72	260	67	0.09	1430×10^3	High	SE	1	Thoracostomy	1	No	Died
75	219	11	5.48	1550×10^3	Low	Pneumothorax and SE	1	Conservative	NA	NA	**
62	1185	22.3	NA	740×10^3	Low	SE	2	Conservative	NA	NA	Died
70	5382	47.3	NA	320×10^3	Low	SE	1	Thoracostomy	1	No	Died
44	1625	20.7	NA	660×10^3	Low	Pneumothorax and SE	7	Thoracostomy	20	No	Died
66	653	21.2	NA	790×10^3	Low	SE	8*	Conservative	NA	NA	Died
73	502	43	NA	340×10^3	Low	SE	6	Conservative	NA	NA	Died
44	NA	8.5	NA	370×10^3	High	SE	2	Conservative	NA	NA	Died
30	NA	23.6	NA	2300×10^3	Low	Pneumothorax and SE	2*	Thoracostomy	1	No	Died
61	2292	16.8	NA	330×10^3	Low	SE	3	Thoracostomy	7	No	Died
54	883	12.8	NA	330×10^3	Low	SE	2	Conservative	NA	NA	Alive
51	741	34.5	NA	550×10^3	Low	SE	10	Conservative	NA	NA	Died
81	548	55.9	NA	520×10^3	Low	Pneumothorax and SE	2	Thoracostomy	10	No	Died
59	1498	38.9	NA	470×10^3	Low	SE	3	Conservative	NA	NA	**
47	2661	20	NA	220×10^3	Low	SE	3	Conservative	NA	NA	**

*Day of admission, as the patient not intubated, **Still admitted and slightly improved. ICU=Intensive Care Unit, DM=Diabetes mellitus, HTN=Hypertension, DLP=Dyslipidemia, CKD=Chronic kidney disease, IHD=Ischemic heart disease, CAD=Coronary artery disease, SOB=Shortness of breath, ME=Mediastinal emphysema, SE=Surgical emphysema, LOS=Length of stay, PRVC=Pressure-regulated volume control, PEEP=Positive end-expiratory pressure, LDH=Lactate dehydrogenase, CRP=C-reactive protein, BA=Bronchial asthma, CABG=Coronary artery bypass grafting, NA=Not available, DSL=Dyslipedimia, SCD=Sickle cell disease

Table 2: Descriptive analysis of the patients

General characteristics	Value
Age	
Mean±SD (range)	57.50±12.75 (30-81)
Gender, *n* (%)	
Male	26 (81.3)
Female	4 (12.5)
Comorbidities, *n* (%)	
DM	11 (34.4)
HTN	16 (50.0)
DLP	6 (18.8)
CKD	1 (3.1)
Heart disease	3 (9.4)
Presenting symptoms, *n* (%)	
SOB	27 (84.4)
Cough	19 (59.4)
Fever	22 (68.8)
Asymptomatic	1 (3.1)
Loss of appetite	4 (12.5)
Hospital course, mean±SD (range)	
Length of unit admission (days)	2.93±5.62 (0-21)
Length of ICU admission (days)	20.00±14.80 (2-52)
Ventilation	
Length of intubation (days), mean±SD (range)	16.50±13.98 (0-52)
Reintubation, *n* (%)	
Yes	2 (6.3)
No	28 (87.5)
PEEP, median±SD (range)	12±2.80 (7-18)
PRVC, median±SD (range)	70±19.73 (40-100)
Laboratory, mean±SD (range)	
LDH	1190.39±1078.96 (219-5382)
CRP	25.63±15.99 (1.67-67)
Procalcitonin	1.88±2.14 (0.04-5.48)
Absolute lymphocyte	748.73±719.43 (220-3760)
Thoracic complications	
Onset of complication after intubation (days), median±SD (range)	3±6.29 (1-28)
Type, *n* (%)	
Mediastinum emphysema	1 (3.33)
SE	17 (56.6)
Pneumothorax and SE	11 (33.3)
SE and ME	1 (3.33)
Interventions	
Conservative, *n* (%)	14 (46.7)
Thoracostomy, *n* (%)	16 (53.3)
Reinsertion of thoracostomy, *n* (%)	
Yes	1 (3.1)
No	29 (90.6)
Duration of chest tube (days), mean±SD (range)	3.86±6.30 (0–20)
Outcomes, *n* (%)	
Discharged	3 (9.4)
Deceased	21 (65.6)
Still admitted and slightly improved	6 (18.8)

SD=Standard deviation, HTN=Hypertension, CKD=Chronic kidney disease, SOB=Shortness of breath, CRP=C-reactive protein, LDH=Lactate dehydrogenase, PEEP=Positive end-expiratory pressure, PRVC=Pressure-regulated volume control, ICU=Intensive care unit, DM=Diabetes mellitus, DLP=Dyslipidemia, SE=Surgical emphysema, ME=Mediastinal emphysema

cough (59.4%), and loss of appetite and fatigability. One patient (3.1%) was asymptomatic.

The mean of length of stay (LOS) in the regular unit was 2.9 ± 5.62 days (ranging from 0 to 21 days), and the

mean of the ICU LOS was 20.00 ± 14.80 days (ranging from 2 to 52 days).

Most of the patients were on maximum ventilation settings programmed on pressure-regulated volume control. The mean duration of ventilator support was 16.50 ± 13.98 days (range from 0 to 52 days). Two patients (6.3%) required reintubation. The median positive end-expiratory pressure (PEEP) was set at 12 ± 2.80 cmH_2O (range from 7 to 18), and the median FiO2 was 70% ± 19.73 (range from 40% to 100%). On average, thoracic complications occurred on day 3 (±6.29 days) postintubation (range from 1 to 28 days).

In terms of inflammatory markers, lactate dehydrogenase (LDH) levels ranged from 219 to 5382, with a mean of 1190.39 (standard deviation [SD]: 1078.96). C-reactive protein ranged from 1.67 to 67 with a mean of 25.63 (SD 15.99), and procalcitonin ranged from 0.04 to 5.48, with a mean of 1.88 (SD 2.14). Absolute lymphocytes ranged from 220 to 3760 with a mean of 748.73 (SD 719.43), and all lymphocyte percentages were low other than in two cases, which registered high.

Ten patients (33.33%) experienced a pneumothorax associated with SE, one patient (3.33%) presented with mediastinal emphysema, seventeen patients (56.66%) with SE, and one patient (3.33%) with mediastinal emphysema associated with SE. Fourteen patients (46.7%) were treated conservatively and sixteen patients (53.3%) were treated with indwelling thoracostomy tubes. The mean duration of the tube placement was 3.86 ± 6.30 days (ranging from 0 to 20 days). One patient required a reinsertion of the thoracostomy tube after developing SE following a tracheostomy insertion.

From our study group of patients, three (9.4%) were discharged in good condition, six patients (18.8%) were slightly improved and remained admitted pending manuscript preparation, and three (11.1%) were discharged in a good condition. Twenty-one patients (65.6%) died as a result of disease progression and multiple organ failure.

We extracted multivariate correlations and regressions with varying associations. There was a significant correlation between the duration of ventilatory support, the ICU LOS ($P < 0.001$), and the hospital LOS ($P = 0.019$). The total length of hospital stay showed a significant association with the onset of complications ($P = 0.043$) and outcomes ($P = 0.043$). In addition, a further significant association between PEEP and the duration of ventilatory support was noticed ($P = 0.009$), as well as with the onset of complications ($P = 0.023$) as presented in Table 3.

By applying linear regression, significant associations were confirmed as mentioned above, between the duration of ventilatory support and ICU stay ($P < 0.001$) and total LOS in the hospital ($P < 0.001$). Total length of hospital stay showed significant association with the onset of complications ($P = 0.045$) and outcomes ($P = 0.006$). A significant association between PEEP and the duration of ventilatory support also was noticed ($P = 0.009$), with the onset of complications ($P = 0.043$), as presented in Table 3.

We also compared three variations of thoracic complications: pneumothorax in association with SE, SE alone, and mediastinal emphysema, with findings of a significant association between the group presenting with pneumothorax in combination with SE and their outcomes, with a $P = 0.002$ [Table 4].

And the question remains; how do COVID-19 patients acquire SE on high ventilator settings in the absence of pneumothorax in most of the cases? Further research is required to clarify this condition.

Discussion

In December 2019, a viral pneumonia resembling SARS was seen in Wuhan, China. This led to the identification of a novel coronavirus, SARS-CoV-2 which causes COVID-19 disease.[1] Since then, much literature has addressed every segment of care pertaining to this disease. Phenomenally, it has been profoundly impacted global economics and presented innumerable political challenges. From earlier experiences with SARS-CoV-1, several observations have been made in regard to both surgical and mediastinal emphysema.[2,3]

Pneumomediastinum is often a self-limiting, benign state, occurring when an excessive amount of luminal gas escapes into the mediastinum. In severe cases of coronavirus, the majority of patients are ventilated mechanically with a tremendous positive strain. This carries a strong risk of dangerous mediastinal emphysema, pneumomediastinum, and pneumothorax with the potential of mimicking cardiac tamponade. Under severe conditions, emphysema has the potential of constricting the primary airway and limiting the flow of blood between the neck vessels and head.[4]

Due to its ease of use and high sensitivity, computerized tomography (CT) of chest is an essential tool in screening potential COVID-19 patients. The most common CT finding in coronavirus pneumonia is a GGO occurring in the subpleural areas of the lower lobes. This is mainly observed during the initial disease stage of patients with suspected COVID-19 pneumonia. Certain cases respond adversely to pharmaceutical therapy, with localized lesions of the lungs advancing to more and diffuse lesions.[5]

Table 3: Multivariant correlations

Variable correlations	LOS ICU	Length of disease	Length of intubation	Reintubation	PEEP	Onset of complication since intubation	Length of tube	Outcome
LOS ICU								
Pearson Correlation	1	0.963**	0.881**	−0.422*	0.340	0.298	0.526**	−0.425*
Significant (two-tailed)		0.000	0.000	0.020	0.066	0.109	0.003	0.019
n	30	30	30	30	30	30	30	30
Length of disease								
Pearson Correlation	0.963**	1	0.889**	−0.494**	0.338	0.367*	0.631**	−0.486**
Significant (two-tailed)	0.000		0.000	0.006	0.068	0.046	0.000	0.006
n	30	30	30	30	30	30	30	30
Length of intubation								
Pearson Correlation	0.881**	0.889**	1	−0.486**	0.471**	0.287	0.462*	−0.601**
Significant (two-tailed)	0.000	0.000		0.006	0.009	0.124	0.010	0.000
n	30	30	30	30	30	30	30	30
Reintubation								
Pearson Correlation	−0.422*	−0.494**	−0.486**	1	−0.351	−0.371*	−0.264	0.408*
Significant (two-tailed)	0.020	0.006	0.006		0.057	0.043	0.158	0.025
n	30	30	30	30	30	30	30	30
PEEP								
Pearson Correlation	0.340	0.338	0.471**	−0.351	1	0.373*	0.061	−0.176
Significant (two-tailed)	0.066	0.068	0.009	0.057		0.043	0.748	0.351
n	30	30	30	30	30	30	30	30
Onset of complication since intubation								
Pearson Correlation	0.298	0.367*	0.287	−0.371*	0.373*	1	0.341	−0.152
Significant (two-tailed)	0.109	0.046	0.124	0.043	0.043		0.065	0.424
n	30	30	30	30	30	30	30	30
Length of tube								
Pearson Correlation	0.526**	0.631**	0.462*	−0.264	0.061	0.341	1	−0.225
Significant (two-tailed)	0.003	0.000	0.010	0.158	0.748	0.065		0.231
n	30	30	30	30	30	30	30	30
Outcome								
Pearson Correlation	−0.425*	−0.486**	−0.601**	0.408*	−0.176	−0.152	−0.225	1
Significant (two-tailed)	0.019	0.006	0.000	0.025	0.351	0.424	0.231	
n	30	30	30	30	30	30	30	30

*Correlation is significant at the 0.05 level (two-tailed), **Correlation is significant at the 0.01 level (two-tailed). LOS=Length of stay, ICU=Intensive care units, PEEP=Positive end-expiratory pressure

Table 4: Significant differences between pneumothorax in association with surgical emphysema and surgical emphysema regarding outcomes

Thoracic complications Outcome	*n*	Mean rank	Sum of ranks	*P*
Pneumothorax and SE	11	10.58	137.50	0.002
SE	17	18.59	297.50	
Total	28			

SE=Surgical emphysema

The usual pathophysiology is related the onset of increased intra-alveolar pressure. Coughing, sneezing, or ventilator support can lead to such entity. Several patients presented with SE and ME before assisted ventilation, which raises questions regarding the actual pathophysiology of the disease and its complications. COVID-19 causes lung parenchymal and extraparenchymal disease.[1] And as well, inappropriate processes during endotracheal intubation may destroy the trachea walls, potentially resulting in subcutaneous emphysema.

The airways of elderly patients with chronic obstructive pulmonary disease are often more vulnerable during tracheal intubation compared to younger demographics. It is, therefore, important to note whether such a patient has undergone previous thoracotomies, as our findings suggest that a history of thoracotomy is a leading factor in extensive subcutaneous emphysema seen in such a patient.[6] This is demonstrated radiologically in alveolar and interstitial patterns. Other reported patterns include flagstone, air bronchogram, vascular enlargement, airway changes, pleural changes, and halo and inverted halo signs, along with pericardial and pleural effusions. Thoracic surgery entities are also seen, including SE, ME, and pneumothorax.[2]

The most common pattern observed in COVID-19 patients is ground-glass opacities scattered randomly with

preference to the posterior segments of lower lobe.[3] The virus gains access to airways by reaching through the terminal alveolar wall and septal interstitium. Cellular lymphocytic injury results in alveolar damage and an ability to rupture with the slightest increase in pressure, causing interstitial emphysema, mediastinal emphysema, SE, or pneumothorax.[5,7] This alveolar damage seems to be the result of cellular lymphoytic injury rather than an outcome of virus replication. This is evident by the subsequent onset of SE and ME, which typically occurs on or around day 14 postintubation, whereas viral replication usually peaks around day 4. The significance of SE and ME is that they aggravate respiratory failure, resulting in worse outcomes as seen in several studies and case reports.[6,8] The resulting hospital LOS and recovery are much slower and longer in patients with these entities.

A study completed by Obeso Carillo GA *et al*. revealed that patients with a radiologically identifiable Earth-Heart sign were at a higher risk of developing a tension pneumomediastinum. In those cases, the main differential diagnosis included cardiac tamponade caused by pericardial effusion.[9] Thus, early interventions are recommended for patients who present with this sign.

We did not identify the presence of the Earth-Heart sign in any of the patients in our study.

There are multiple earlier studies examining the relationship between mediastinal emphysema and a surgical presence in patients with coronavirus. For instance, C.M. Chu reported in his 2004 study on SARS patients, that only crest serum LDH was related to the advancement of spontaneous pneumomediastinum ($P = 0.001$).[5]

Conclusion

Surgical and mediastinal emphysema in the critically ill patients are usually attributed to barotrauma and high ventilations settings. During COVID-19 pandemic, these entities were seen and the pathogenesis was revisited and some attributed its presence to the disease process and destruction on lung parenchyma. The associated with extended LOS and delayed recovery in addition to poor prognosis were seen. Their presence is an indicator to higher morbidity and mortality.

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Conflicts of interest
There are no conflicts of interest.

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