Section: Critical Care Medicine

Original Research Article

COMPARISON OF DIAPHRAGMATIC THICKNESS FRACTION VS DIAPHRAGMATIC EXCURSION BY USG FOR DIAPHRAGMATIC DYSFUNCTION ASSESSMENT

Gynendra Kumar Gautam[1], Shubhlesh Kumar[2], Umesh Kumar Verma[3]

[1]*Assistant Professor, Department of Critical Care ICU, PMSSY GSVM Medical College Kanpur, Uttar Pradesh, India*
[2]*Senior Consultant, Medanta Hospital, Patna, Bihar, India*
[3]*Junior Resident, Department of Anaesthesia, G S.V.M Medical College, Kanpur, Uttar Pradesh, India*

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Corresponding Author:
Dr. Umesh Kumar Verma,
Junior Resident, Dept of Anesthesia G S.V.M Medical College, Kanpur, Uttar Pradesh, India
Email: uvgolu@gmail.com

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ABSTRACT

Background: The goals of mechanical ventilation (MV) are to maintain proper gas exchange and to replace the respiratory muscles, which may become overworked in cases of acute respiratory failure, either fully or partially. The objective is to study the comparison of Diaphragmatic thickness fraction (DTF) vs Diaphragmatic Excursion (DE) by USG for Diaphragmatic dysfunction Assessment.
Materials and Methods: This prospective observational study was conducted among the Patient presumed to mechanically ventilate for a prolonged period greater than 7 days in the Department of Anaesthesia at GSVM Medical College and associated LLRH Kanpur over 15 months from January 2023 to March 2024.
Results: At admission, the diaphragmatic thickness fraction was significantly lower in the failure weaning group (83.54±4.0%) compared to the successful weaning group (86.43±4.1%; p=0.044). The diaphragmatic excursion did not differ significantly between the groups at admission (1.29±0.08 cm vs. 1.29±0.08 cm; p=0.889), but significant differences were observed during SIMV mode with spontaneous breath (0.93±0.13 cm vs. 1.20±0.07 cm; p<0.001) and subsequent transitions (p<0.001 for both).
Conclusion: A straightforward technique for assessing DE and the thickness of the muscle in the zone of apposition is diaphragm ultrasound. This method is safe, extremely practicable, and reproducible on the same patients. Evaluation of DTF and DE using diaphragm ultrasonography in M-mode is a novel technique.
Keywords: Diaphragmatic thickness fraction, Diaphragmatic Excursion, USG, Diaphragmatic dysfunction Assessment.

INTRODUCTION

The diaphragmatic excursion (DE) and diaphragm thickening fraction (DTF) are the two diaphragm sonographic predictors that have been used extensively for assessment of Diaphragmatic dysfunction in mechanically ventilated patients. In the anterior subcostal view, a lower frequency curvilinear probe (a 4 MHz probe) is used to assess the DE of supine individuals. Measurements were taken in the M mode while intermittent mechanical and spontaneous ventilation, from the moment of greatest excursion to the baseline.

The diaphragm is visible when the probe is positioned between the anterior and mid-axillary lines, roughly perpendicular to the chest wall, in the vicinity of eight to ten ribs. The hyperechoic pleura and peritoneum are separated by the hypoechoic diaphragm.[1]

According to recent research, diaphragm dysfunction commonly plays a role in weaning failure, [2,3] and when one is released off mechanical ventilation, it is linked to a bad prognosis. [4,5] It has not been convenient to explore the diaphragm at the bedside until lately. This element might account for the rising interest in ultrasonography. Non-invasive indicators of the muscle's structure and function are provided via diaphragm ultrasonography.

Ultrasonography (USG) has emerged as a non-invasive, bedside diagnostic tool that offers realtime assessment of diaphragmatic structure and function. It provides several advantages over traditional methods, is widely available in ICU settings, non-invasive, and free from ionizing radiation, making it a safe option for repeated assessments. USG allows for dynamic evaluation of diaphragmatic motion, thickness, and contractility, providing immediate insights into diaphragmatic function. With adequate training, critical care clinicians can perform and interpret diaphragmatic USG, integrating it into routine patient assessments without significant disruption to workflow. [6-8]

By incorporating USG in the assessment of diaphragmatic dysfunction, clinicians can identify dysfunction early, allowing for timely therapeutic interventions aimed at preventing complications and facilitating successful weaning from MV. We aim to study the comparison of Diaphragmatic thickness fraction vs Diaphragmatic Excursion by USG for Diaphragmatic dysfunction Assessment.

MATERIALS AND METHODS

This prospective observational study was conducted among the Patient on mechanically ventilate presumed for a prolonged period greater than 7 days in the Department of Anaesthesia at GSVM Medical College and associated LLRH Kanpur over 15 months from January 2023 to March 2024

Inclusion Criteria:

- Patients of both sexes aged between 18 and 75 years
- Patients presumed to mechanically ventilate for a prolonged period greater than 7 days.
- Resolution of primary pathology requiring mechanical ventilation.
- Patients who are ready to wean (RSBI<105 breath/min/L, MV<10-15 Lit/min, RR<35/min, Fio2<40%, PaO2/FiO2>200).
- Patients who are hemodynamically stable during minimal or no vasopressor support.

Exclusion Criteria:

- Patient with a neuromuscular disorder, cardiogenic pulmonary oedema,
- Pregnant females in the second and third trimesters
- Patient with intra-abdominal pathology like Tense ascites, pre- and post-perforation peritonitis, acute severe pancreatitis, and solid organ malignancy.
- Hemodynamically unstable patients.
- Patients on continued paralytics and heavy sedation are needed during mechanical ventilation.
- Patient who needs prolonged Anticipated controlled mechanical ventilation.
- Obese patient with BMR>35 kg/m2

Sample size: 41 Patients (In this study we include all the participants found during the study period who fulfil the inclusion criteria and whose attendant or patient gave valid and informed consent)

Study Method/Tools: Baseline diaphragmatic thickness was measured on ICU admission for all patients before mechanical ventilation (MV). Ultrasound measurements for thickness fraction and excursion were performed within 24 hours of the start of MV for the included patients. Subsequent serial recordings were performed when patients took 50% spontaneous breaths on SIMV mode, when patients were shifted to CPAP mode, and when patients were discontinued from mechanical ventilation.

From the baseline to the point of greatest inspiration height, the excursion's amplitude was measured along the vertical axis of the trace. Every measurement was taken with tidal breathing at a rate of 6 ml/kg; deeper or smaller breaths were not taken. In five minutes, the full ultrasound examination was completed. For diaphragmatic dysfunction (DD) detected by ultrasonography, an excursion of less than 10 mm was considered abnormal. The diaphragmatic excursion was measured with a lower frequency curvilinear probe (4 MHz) in the anterior sub-costal view.

The transducer was placed between the midclavicular and anterior sub-costal views, aimed dorsally, cranially, and medially to see the right diaphragm's posterior third, around 5 cm lateral to the inferior vena cava foramen. Measurements were taken in M mode while sniffing and breathing normally, from the moment of greatest excursion to the baseline. Measuring from the maximum to the lowest point of excursion, deep breathing was used. During calm and deep breathing, the normal values with each manoeuvre were 2.5–4 cm and 6-7 cm, respectively (mean increase of diaphragmatic excursion by 54%, range 42–78%).

Using a high-frequency 7-11 MHz ultrasound linear transducer in M mode, diaphragmatic thickness was measured at both ends of maximal inspiration (total lung capacity) and maximal expiration (residual volume). The zone of apposition is the region where the diaphragm attaches to the rib cage. Six consecutive maximum breaths were performed to generate diaphragmatic ultrasonography readings, and the average values were used for analysis. Diaphragm thickness was measured from the middle of the pleural line to the middle of the peritoneal line. The diaphragmatic thickening fraction (DTF) was calculated as a percentage using the formula:

$$DTF = \frac{(\text{Thickness at end inspiration} - \text{Thickness at end-expiration}) \times 100}{(\text{Thickness at end-expiration})}$$

Ethical Consideration: Informed and written consent (in the language best understood by the patients or attendant) was obtained from each subject before data collection. Only volunteers were included, and their data were kept confidential. The study did not impose any burden on the subjects or the institute, thus justifying its ethical basis. The study was approved by the Institutional Ethical Committee.

Data Collection Procedure: Patients presumed to be mechanically ventilated for a prolonged period greater than 7 hours who met the inclusion criteria were included in the study. A comprehensive methodology was employed, beginning with acquiring an in-depth medical history from each participant. This was supported by a thorough clinical assessment and the execution of required investigations, all methodically arranged according to a well-thought-out proforma.

Statistical Analysis: All patient data were analyzed using the Statistical Package for Social Sciences (SPSS) version 25.0 for Windows. Quantitative data were presented as arithmetic mean ± standard deviation. Qualitative data were presented as frequencies (percentages). The chi-square test was used to compare categorical variables between groups.

RESULTS

The study analyzed the distribution of patients based on age groups. Among the 41 patients, 3 (7.3%) were aged 20 years or younger, while 15 (36.6%) were in the 21 to 30 years age group. The 31-40 years age group included 5 patients (12.2%), and the 41-50 years age group had 10 patients (24.4%). Additionally, 5 patients (12.2%) were in the 51–60 years age group, and 3 patients (7.3%) were older than 60 years. The mean age (year) of the patients was 38.24±15.2 (range 18-70 years).

The study examined the distribution of patients based on gender. Out of the 41 patients, 25 (61.0%) were male, while 16 (39.0%) were female.

The average weight was 59.93 kg with a standard deviation of 5.8. The mean height was 1.61 meters with a standard deviation of 0.61. The average BMI was 22.35 kg/m² with a standard deviation of 1.57.

The study provided details on the hemodynamic vitals of patients at the time of discontinuation from mechanical ventilation. The average heart rate was 77.61 beats per minute with a standard deviation of 12.0. The mean systolic blood pressure (SBP) was 119.59 mm Hg with a standard deviation of 8.3. The average diastolic blood pressure (DBP) was 70.73 mm Hg with a standard deviation of 6.9. The mean Spo2 was consistently 100.0%, with no variation.

Out of 41 patients, 13 (31.7%) experienced failure in weaning from mechanical ventilation, while 28 (68.3%) successfully weaning.

The study compared the age distribution between patients who failed and those who successfully weaned from mechanical ventilation. Among the 13 patients who failed weaning, none were 20 years or younger, while 3 (10.7%) of the 28 successfully weaned patients were in this age group. In the 21–30-year age group, 7 (53.8%) patients failed weaning compared to 8 (28.6%) who succeeded. For the 31–40-year age group, 1 (7.7%) patient failed while 4 (14.3%) succeeded. In the 41–50-year age group, 1 (7.7%) patient failed compared to 9 (32.1%) who succeeded. Both the 51–60-year age group and the over 60-year age group had 1 (7.7%) and 3 (23.1%) patients failing weaning, respectively, while 4 (14.3%) and none succeeded in these groups, showing a significant difference (p=0.032). The mean age of patients who failed weaning was 40.0 years with a standard deviation of 19.6, while the mean age of those who succeeded was 37.43 years with a standard deviation of 13.0, with no significant difference (p=0.621).

The study examined the distribution of patients based on gender about weaning outcomes from mechanical ventilation. Among the 13 patients who experienced failure in weaning, 9 (69.2%) were male and 4 (30.8%) were female. In contrast, of the 28 patients who successfully weaned, 16 (57.1%) were male and 12 (42.9%) were female. The difference in gender distribution between the failure and successful weaning groups was not statistically significant (p=0.460).

Table 1: Distribution of the studied patients based on gender in failure & successful weaning groups

Gender	Failure weaning (n=13)	Successful weaning (n=28)	p-value
Male	9 (69.2%)	16 (57.1%)	0.460
Female	4 (30.8%)	12 (42.9%)	

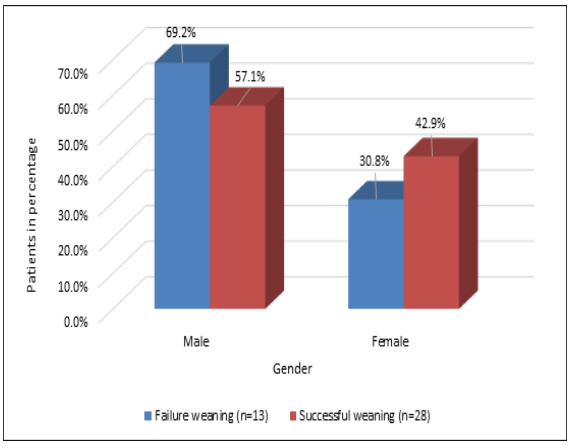


Figure 1: Gender distribution in both groups

Among the 13 patients who failed weaning, the average weight was 58.46 kg with a standard deviation of 5.0, while the 28 successfully weaned patients had an average weight of 57.68 kg with a standard deviation of 6.2, showing no significant difference (p=0.696). The mean height for the failure group was 1.62 meters with a standard deviation of 0.05, compared to 1.60 meters with a standard deviation of 0.06 for the successful group, also not significantly different (p=0.433). The average BMI was 22.2 kg/m² with a standard deviation of 1.3 for the failure group and 22.4 kg/m² with a standard deviation of 1.6 for the successful group, with no significant difference (p=0.795).

Table 2: Details of the studied patients based on anthropometry in failure & successful weaning groups

Anthropometry	**Failure weaning (n=13)**	**Successful weaning (n=28)**	**p-value**
Weight in kg	58.46±5.0	57.68±6.2	0.696
Height in meter	1.62±0.05	1.60±0.06	0.433
BMI (kg/m2)	22.2±1.3	22.4±1.6	0.795

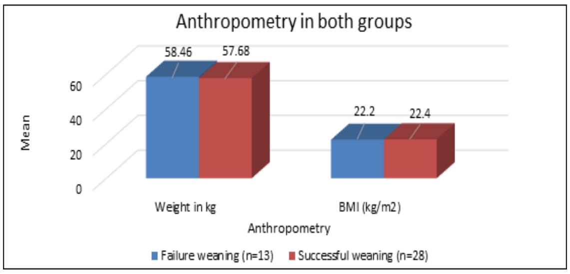


Figure 2: Details of the studied patients based on anthropometry in failure & successful weaning groups

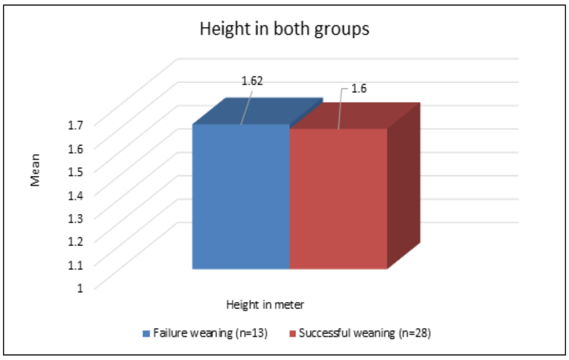


Figure 3: Details of the studied patients based on height in failure & successful weaning groups

The study compared the hemodynamic vitals of patients who failed and those who successfully weaned from mechanical ventilation. Among the 13 patients who failed to wean, the average heart rate was 80.23 beats per minute with a standard deviation of 12, while the 28 successfully weaned patients had an average heart rate of 76.39 beats per minute with a standard deviation of 11, showing no significant difference (p=0.350). The mean systolic blood pressure (SBP) for the failure group was 120.62 mm Hg with a standard deviation of 7.7, compared to 119.1 mm Hg with a standard deviation of 8.6 for the successful group, also not significantly different (p=0.596). The average diastolic blood pressure (DBP) was 69.85 mm Hg with a standard deviation of 6.1 for the failure group and 71.1 mm Hg with a standard deviation of 7.3 for the successful group, with no significant difference (p=0.583). The mean Spo2 was consistently 100.0% for both groups, with no variation (p=1.00).

None of the patients in either group had prolonged use of heavy sedation and paralytics or prolonged steroid therapy. Among the 13 patients who failed weaning, 8 (61.5%) were on total parenteral nutrition (TPN), compared to 16 (57.1%) of the 28 successfully weaned patients. None of the patients in either group required vasopressor support. All patients had normal ECG and chest X-ray results. Additionally, all patients had a PaO2/FIO2 ratio greater than 200.

Among the 13 patients who failed weaning, the average hemoglobin level was 11.08 gm/dl with a standard deviation of 1.5, while the 28 successfully weaning patients had an average hemoglobin level of 11.0 gm/dl with a standard deviation of 1.3, showing no significant difference (p=0.870). The mean total leukocyte count (TLC) was 7387.6 cells/mm³ with a standard deviation of 954 for the failure group, compared to 7146 cells/mm³ with a standard deviation of 673 for the successful group, also not significantly different (p=0.357). The average platelet count was 2.07 Lac cells/mm³ with a standard deviation of 0.42 for the failure group and 1.86 Lac cells/mm³ with a standard deviation of 0.42 for the successful group, with no significant difference (p=0.148).

The study compared the total number of days on mechanical ventilation between patients who failed and those who successfully weaned. Among the 13 patients who failed weaning, 1 (7.7%) was on mechanical ventilation for 7-10 days, 2 (15.4%) for 11-15 days, 6 (46.2%) for 16-20 days, and 4 (30.8%) for more than 20 days. In contrast, among the 28 successfully weaned patients, 26 (92.9%) were on mechanical ventilation for 7-10 days, 1 (3.6%) for 11-15 days, and 1 (3.6%) for 16-20 days, with none exceeding 20 days. The mean duration of mechanical ventilation was significantly longer for the failure group at 18.62 days with a standard deviation of 4.6, compared to 8.46 days with a standard deviation of 2.1 for the successful group (p<0.001).

Table 3: Distribution of the studied patients based on the total number of days on mechanical ventilation in failure & successful weaning groups

Total no days on Mechanical ventilation		Failure weaning (n=13)	Successful weaning (n=28)	p-value
No. of days	7-10 days	1 (7.7%)	26 (92.9%)	<0.001
	11-15 days	2 (15.4%)	1 (3.6%)	
	16-20 days	6 (46.2%)	1 (3.6%)	
	>20 days	4 (30.8%)	0 (0.0%)	
Mean±SD		18.62±4.6	8.46±2.1	<0.001

At admission, the diaphragmatic thickness fraction was significantly lower in the failure weaning group (83.54±4.0%) compared to the successful weaning group (86.43±4.1%; p=0.044). During SIMV mode with 50% spontaneous breath, the failure weaning group showed markedly lower diaphragmatic thickness (38.0±4.4%) compared to the successful weaning group (72.4±7.4%; p<0.001), which persisted during transitions to CPAP mode and discontinuation from mechanical ventilation (p<0.001 for both). The diaphragmatic excursion did not differ significantly between the groups at admission (1.29±0.08 cm vs. 1.29±0.08 cm; p=0.889), but significant differences were observed during SIMV mode with spontaneous breath (0.93±0.13 cm vs. 1.20±0.07 cm; p<0.001) and subsequent transitions (p<0.001 for both).

Table 4: Details of the studied patients based on diaphragmatic thickness & diaphragmatic excursion in failure & successful weaning groups

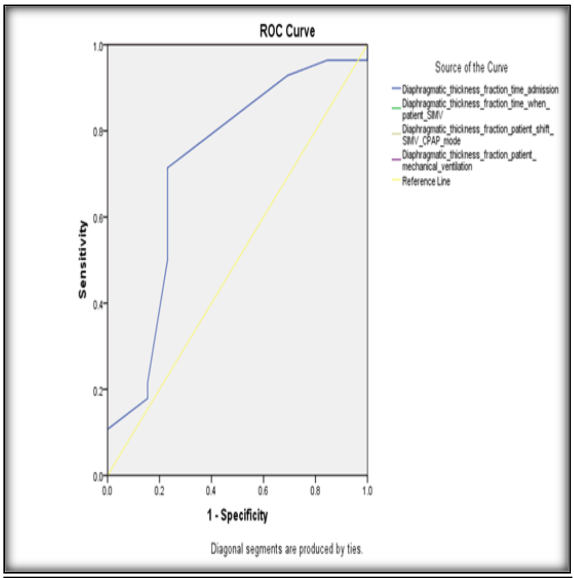
Variables	Failure weaning (n=13) (Mean±SD)	Successful weaning (n=28) (Mean±SD)	P value
Diaphragmatic thickness fraction at time of admission in %	83.54±4.0	86.43±4.1	0.044
Diaphragmatic thickness fraction at the time when a patient is on SIMV mode and takes 50% spontaneous breath	38.0±4.4	72.4±7.4	<0.001
Diaphragmatic thickness fraction when patient shifts from SIMV to CPAP mode	28.08±3.2	66.43±7.1	<0.001
Diaphragmatic thickness fraction at the time when the patient discontinues mechanical ventilation	25.69±3.0	64.68±7.8	<0.001
Diaphragmatic Excursion at time of admission in cm	1.29±0.08	1.29±0.08	0.889
Diaphragmatic Excursion at the time when the patient is on SIMV mode and takes 50% spontaneous breath	0.93±0.13	1.20±0.07	<0.001
Diaphragmatic Excursion when the patient shifts from SIMV to CPAP mode	0.77±0.09	1.16±0.06	<0.001
Diaphragmatic Excursion at the time when the patient discontinues mechanical ventilation	0.77±0.09	1.16±0.05	<0.001

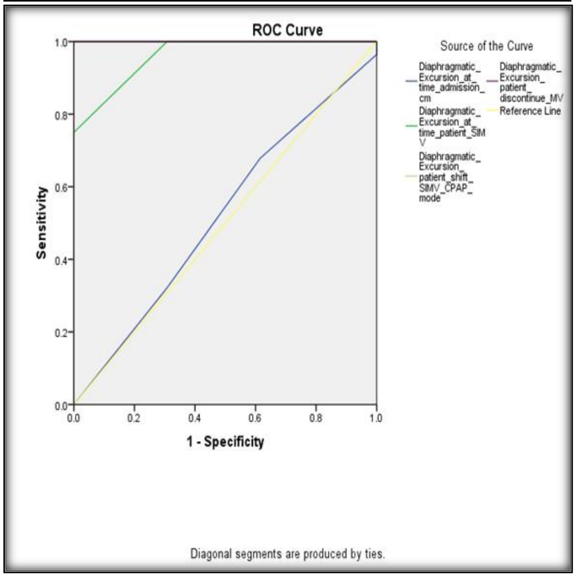
Table 5: Receiver operating characteristics curve (ROC) for diaphragmatic thickness fraction to differentiate between successful weaning and failure weaning

Parameter	Accuracy	Cut off point	Sensitivity	Specificity
Diaphragmatic thickness fraction at time of admission in %	72.3%	83.0%	89.3%	38.5%
Diaphragmatic thickness fraction at the time when a patient is on SIMV mode and takes 50% spontaneous breath	100.0%	51.0%	100.0%	100.0%
Diaphragmatic thickness fraction when the patient shifts from SIMV to CPAP mode	100.0%	44.0%	100.0%	100.0%
Diaphragmatic thickness fraction at the time when the patient discontinues mechanical ventilation	100.0%	38.5%	100.0%	100.0%

Table 6: Receiver operating characteristics curve (ROC) for diaphragmatic excursion to differentiate between successful weaning and failure weaning

Parameter	Accuracy	Cut off point	Sensitivity	Specificity
Diaphragmatic Excursion at time of admission in cm	51.9%	1.25	67.9%	38.5%
Diaphragmatic Excursion at the time when a patient is on SIMV mode and takes 50% spontaneous breath	96.2%	1.15	75.0%	100.0%
Diaphragmatic Excursion when the patient shifts from SIMV to CPAP mode	100.0%	1.0	100.0%	100.0%
Diaphragmatic Excursion at the time when the patient discontinues mechanical ventilation	100.0%	1.0	100.0%	100.0%





DISCUSSION

The study was conducted on 41 mechanically ventilated patients with a mean age of 38.24±15.2 years and male predominance (16 females and 25 males). Our findings were comparable to the findings of Saad MA et al7 who reported that they studied 60 mechanically ventilated patients with a mean age of 46.73 years and a mean BMI of 25.80 kg/m2, including 18 females and 42 men.

In the present study, the diaphragmatic thickness fraction was significantly lower in the failure weaning group (83.54±4.0%) compared to the successful weaning group (86.43±4.1%; p=0.044). During SIMV mode with 50% spontaneous breath, the failure weaning group showed markedly lower diaphragmatic thickness (38.0±4.4%) compared to the successful weaning group (72.4±7.4%; p<0.001), which persisted during transitions to CPAP mode and discontinuation from mechanical ventilation (p<0.001 for both). The diaphragmatic excursion did not differ significantly between the groups at admission (1.29±0.08 cm vs. 1.29±0.08 cm; p=0.889), but significant differences were observed during SIMV mode with spontaneous breath (0.93±0.13 cm vs. 1.20±0.07 cm; p<0.001) and subsequent transitions (p<0.001 for both). Our findings were in concordance with the findings of Alam MJ et al8This displays the bivariate connection between clinical indicators at baseline and the result of extubation. Individuals who did not have any coexisting conditions and spent less time in the MV had a higher chance of successful extubation. While RSBI revealed no significant correlation, DE and DTF both had a significantly significant association with effective extubation. Ferrari G et al,[9] reported that Except RR and RSBI, which were lower in the Success group, DTLC (diaphragm thickness at total lung capacity), DRV (diaphragm thickness at residual volume), DTF (diaphragm thickening fraction), respiratory rate, maximum inspiratory pressure, Vte (expiratory tidal volume), and HDU (high dependency unit) were significantly higher in successful weaning than failed weaning (p<0.05). Similar findings were also reported by Saad MA et al,[7] in their investigation of the relationship between weaning results and ultrasound-measured diaphragmatic dysfunction in sepsis patients on mechanical ventilation in the critical care unit.

In the present study, at admission, the diaphragmatic thickness fraction had an accuracy of 72.3%, with a sensitivity of 89.3% and specificity of 38.5% at a cutoff of 83.0%. During SIMV mode with 50.0% spontaneous breaths, accuracy improved to 100.0%, with both sensitivity and specificity reaching 100.0% using a cutoff of 51.0%. This perfect performance was maintained during the transition from SIMV to CPAP mode and when discontinuing mechanical ventilation, with cutoffs of 44.0% and 38.5%, respectively. Whereas diaphragmatic excursion at admission had an accuracy of 51.9%, with sensitivity of 67.9% and specificity of 38.5% at a cutoff of 1.25 cm. On SIMV mode with 50.0% spontaneous breaths, accuracy increased to 96.2%, with sensitivity at 75.0% and specificity at 100% using a cutoff of 1.15 cm. Similarly, during the transition from SIMV to CPAP mode and when discontinuing mechanical ventilation, diaphragmatic excursion achieved 100% accuracy, sensitivity, and specificity with a cutoff of 1.0 cm in both instances, indicating perfect differentiation between successful and failed weaning.

Table 7: Comparison between diaphragmatic excursion and diaphragmatic fraction with different studies.

Studies	Measures	Cut-off	Accuracy
Jiang JR et al10	DE	11mm	Sensitivity 84.4%, specificity 82.6%
Kim WY et al11	DE	14mm	Sensitivity of 60%, specificity of 76%, AUC = 0.68

DiNino E et al12	DTF	30.0%	Sensitivity of 88%, specificity of 71%, AUC = 0.79
Ferrari G et al9	DTF	36.0%	Sensitivity of 82%, specificity of 88%
Ali ER and Mohamad AM13	DE DTF	15mm 30.0%	Sensitivity of 88.7%, specificity of 84.3% Sensitivity of 97.3%, specificity of 85.2%
Alam MJ et al8	DE DTF	11.43 mm22.33%	Sensitivity of 77.8%, specificity of 84.6% Sensitivity of 61.1%, specificity of 84.6%
Present	DTF	38.5%	Sensitivity of 100.0%, specificity of 100.0%

Consistent with previous research, the length of time on mechanical ventilation before weaning was found to be statistically significant for DE, DTF, and the weaning outcome. This implies that the longer the days on mechanical ventilation, the lower the DE and DTF, the higher the likelihood of weaning failure, the higher the likelihood of requiring a tracheostomy, and the higher the probability of mortality (Kim WY et al and Jiang JR et al).[10,11]

A similar result was found in the study of Spadaro S et al Using a cut-off value of ≤14 mm, an AUC of 0.82, sensitivity, specificity, PPV, 91.3%, sensitivity, 88.2%, and specificity, 61.8%. Farghaly S and HasanAA DT, DTF, and DE, the diaphragmatic parameters, were assessed in 54 patients who had passed SBT. With an AUC of 0.879, he discovered that when the cut-off value of DE was ≥10.5 mm, the sensitivity was 87.5% and the specificity was 71.2%. Regarding DTF, a better outcome was seen in the investigation of Osman AM and Hashim RM, 88.9% sensitivity, 100.0% specificity, 96.2% NPV, and 100.0% PPV were demonstrated using a cut-off value of 28.0%.[12-16]

Phrenic nerve stimulation and trans-diaphragmatic pressure (Pdi) measurement are the two standard techniques used to evaluate diaphragm function. Furthermore, electromyography and fluoroscopy have been extensively utilized. All of these techniques, meanwhile, involve radiation exposure or are intrusive and painful for the patients. Diaphragm ultrasonography is a quick, easy, repeatable, non-invasive diagnostic that gives valuable information on the respiratory system's functioning and may be performed on a patient several times without danger. Our findings indicate that, like other known weaning measures and tests, DTF may be useful in predicting patients who would not succeed in their weaning attempts.

Weaning Failure group also achieved good diaphragmatic thickness fraction but failed to wean from mechanical ventilation due to various causes other than diaphragmatic dysfunction. All patients who were successfully extubated have high DTF & DE values above than cutoff levels imparting the high positive predictive value of both the techniques.

CONCLUSION

In patients receiving extended mechanical ventilation, the diaphragm's function as determined by ultrasonography can be utilized to predict the result of weaning by measuring the diaphragmatic thickness fraction and diaphragmatic excursion. In our study, Diaphragmatic thickness fraction measurement technique appears to be more sensitive & specific in comparison with Diaphragmatic Excursion measurement for prediction of weaning failure and successful weaning from mechanical ventilation. Straightforward technique for assessing DE and the thickness of the muscle in the zone of apposition is diaphragm ultrasound. This method is safe, extremely practicable, and reproducible on the same patients. Evaluation of DTF and DE using diaphragm ultrasonography in M-mode is a novel, simple-to-obtain weaning index that might be implemented as a bedside technique in clinical practice if more research validates it. Both technique of diaphragmatic dysfunction assessment are highly specific for prediction weaning failure from mechanical ventilation due to diaphragmatic dysfunction.

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