ORIGINAL ARTICLE

Effect of Acute Disturbance of kidney Function on Weaning from Mechanical Ventilation in Intensive Care Unit Patients

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Abstract

Background: ***One of the leading causes of organ failure, especially in critically ill patients, acute kidney injury (AKI) poses a significant risk of morbidity and mortality with even a single episode, regardless of stage.***

Aim and objectives: ***The goal is to determine how patients in the intensive care unit (ICU) fare after weaning off mechanical ventilation (MV) due to acute renal function disruption.***

Patients and methods: ***Following approval from the Research Ethical Committee, this observational study was carried out from March 2022 to October 2024 on 100 patients undergoing invasive MV in the medical intensive care unit of Al-Azhar University Hospitals.***

Results: ***Longitudinal differences in MV and weaning duration were statistically significant between the two groups. The acute kidney dysfunction group's patients needed MV for longer and were slower to wean from it. Acute renal failure patients were more likely to have weaning failure, whereas those with sufficient renal function had a higher rate of weaning success.***

Conclusion: ***The results of patients receiving MV are greatly affected by acute kidney injury (AKI). In severely sick patients, AKI is linked to a higher mortality rate, a longer MV duration, and a longer weaning period. Results like this highlight how much of a toll AKI takes on both patient recuperation and intensive care unit resources.***

Keywords: Kidney function; AKI; MV

1. Introduction

Immune system depression, acid-base homeostasis disruptions, and volume status imbalances can all have a negative impact on respiratory performance when there is an acute disruption of kidney function.[1]

Extensive research in both the lab and the clinic has shown the intricate web of relationships that form when a wounded kidney contacts other organs, including the lungs, heart, liver, intestines, brain, and blood..[2]

In critically ill patients, acute renal dysfunction often leads to mental status depression and drug metabolite accumulation, which in turn compromises consciousness and hemodynamics, delaying weaning from mechanical ventilation (MV) even further.[3]

When you're healthy or sick, your kidney and lung function are intimately linked. Alterations to the respiratory system mitigate the systemic consequences of acid-base abnormalities in the kidneys, and vice versa.[4]

Accepted 19 December 2024.
Available online 31 March 2025

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https://doi.org/10.21608/aimj.2025.446464

2. Patients and methods

After receiving approval from the Research Ethics Committee, this observational study entailed one hundred patients who were having invasive mechanical ventilation in the medical intensive care unit at Al-Azhar University Hospitals from March 2022 to October 2024.

Inclusion criteria:

Invasive mechanical ventilation, gender (male or female), and age (18–60 years old).

Exclusion criteria:

Patients who have a history of partial or radical nephrectomy, end-stage renal disease (ESRD) on renal replacement therapy, or chronic kidney disease (CKD) are all eligible.

Regarding MV, all patients were treated to the highest standard in accordance with the protocols of the critical care units of the Al-Azhar University hospitals. Once these conditions were met, the strategy and trial to wean off mechanical ventilation may begin:

The patient has a low FiO2 level (<0.5) and a PaO2 level greater than 80 mm Hg, a PEEP level less than 8 cm H2O, hemodynamic stability (requiring little to no vasopressors), good neuromuscular function (initiating spontaneous breaths), and an acceptable conscious level (GSC ≥ 8).

Once these prerequisites were satisfied, a trial of spontaneous breathing was initiated and continued for 30 to 120 minutes. The decision to extubate was based on the absence of signs of respiratory distress and the maintenance of a quick shallow breathing index (the ratio of respiratory rate to tidal volume) below 105. So, it seems like the patient should be able to keep breathing on their own. Patients who did not succeed in the spontaneous breathing trial were only given the task to complete once daily. The duration of weaning from mechanical ventilation (MV) is the time it takes to go from the patient meeting the weaning requirements to being extubated from the ventilator. Within 48 hours following weaning off MV, re-intubation and re-initiation of the ventilator are considered signs of weaning failure.

It was standard practice to record serum creatinine (SCr) and urine output during admission and every 24 hours thereafter. Two groups of patients were formed: Half of the patients in Group "A" (the control group) were able to maintain normal kidney function during their whole time on invasive mechanical ventilation. Half of the patients in Group "B" experienced an acute disruption of kidney function at some point during their time on mechanical ventilation.

Here is the info that was recorded:

The ages, sexes, and weights of the patients; the grounds for their admittance to the intensive care unit; any co-morbidities, such as diabetes or hypertension; vital signs upon admission, simplified acute physiology score (SAPS II), urine output during a 24-hour period, number of days on mechanical ventilation, number of hours spent weaning off of mechanical ventilation, failure rate during weaning, and mortality rate tests in the lab: ABG every 12 hours, full blood count (CBC) every 24 hours, serum creatinine and urea every hour.

Statistical analysis:

The Anderson-Darling test was used to assess for normality and homogeneity of variances before statistical analysis. Numbers and percentages (N, %) described categorical variables, while means and standard deviations (Mean, SD) represented continuous variables. Researchers compare continuous variables using the independent-samples T-test and categorical variables using the chi-square test. Two-tailed p-values under 0.05 indicated statistical significance. IBM SPSS 20.0 was used for all analyses.

3. Results

Table 1. Distribution of demographic information among the groups under study.

	GROUP A (CONTROL) (N= 50)		GROUP B (N= 50)		P VALUE
	N	%	N	%	
GENDER					
MALE	22	44%	20	40%	0.685
FEMALE	28	56%	30	60%	
	Range	Mean ± SD	Range	Mean ± SD	
AGE (YEAR)	(20-60)	52.24 ± 8.88	(31-60)	53.38 ± 6.98	0.477
WEIGHT (KG)	(57-91)	73.2 ± 9.6	(56-94)	74.8 ± 9.1	0.394

A P-value greater than 0.05 signifies a lack of significance, a P-value less than 0.05 denotes statistical significance, and a P-value less than 0.001 shows strong significance.

Based on demographic information, table (1) indicates that there were no statistically significant differences between the groups under study in terms of age, sex, or weight.

Table 2. Evaluation of renal function distribution among the groups under study.

	GROUP A (CONTROL) (N= 50)		GROUP B (N= 50)		P VALUE
	Range	Mean ± SD	Range	Mean ± SD	
CREATININE AFTER 48 H OF MV (MG/DL)	(0.51-1.14)	0.79 ± 0.14	(1.48-2.7)	1.94 ± 0.25	< 0.001
CREATININE AFTER 1 WEEK OF MV (MG/DL)	(0.46-1.3)	0.87 ± 0.20	(1.5-2.98)	2.01 ± 0.35	< 0.001
GFR AFTER 48	(92.4-	103.6 ±	(29.5-	40.52 ±	< 0.001

H OF ADMISSION (ML/MIN/1.73 M²)	129.2)	10.12	54.1)	5.85	
URINE OUTPUT (ML/DAY)	(807-1572)	1133.54 ± 230.49	(200-895)	453.58-189.11	< 0.001
UREA AFTER 48 H OF MV (MG/DL)	(6-18)	12.6 ± 3.8	(43-69)	56.4 ± 7.6	< 0.001
UREA AFTER 1 WEEK OF MV (MG/DL)	(11-19)	15.3 ± 2.8	(67-112)	89.5 ± 14.4	< 0.001

P values greater than 0.05 indicate no statistical significance, whereas P values less than 0.05 indicate statistical significance and P values less than 0.001 indicate exceptionally high levels of significance. Mechanical ventilation (MV) and glomerular filtration rate (GFR).

Table (2) shows that the groups were significantly different in terms of creatinine after 48 hours of MV, creatinine after one week of MV, glomerular filtration rate (GFR) after 48 hours of admission, urine output, urea after 48 hours of MV, and urea after one week of MV. These variables assess the kidney functions.

Table 3. MV duration distribution among the groups under study.

	GROUP A (CONTROL) (N= 50)		GROUP B (N= 50)		P VALUE
	Range	Mean ± SD	Range	Mean ± SD	
DURATION OF MV IN DAYS	(3-8)	5.5 ± 1.15	(3-10)	8.34 ± 1.64	< 0.001

There is no significance if the P-value is greater than 0.05, statistical significance if the P-value is less than 0.05, and strong significance if the P-value is less than 0.001. Ventilation that is powered by a machine, or MV.

According to MV, the difference in the number of days that MV lasted was highly statistically significant, as shown in table (3).

Table 4. Distribution of ICU mortality between the studied groups.

	GROUP A (CONTROL) (N= 50)		GROUP B (N= 50)		P-VALUE
	N	%	N	%	
	ICU MORTALITY				
ICU MORTALITY	20	40%	33	66%	0.009
SURVIVORS	30	60%	17	34%	

Significance is indicated by a P value between 0.001 and 0.001, with a P value less than 0.05 indicating no significance and a P value more than 0.05 indicating statistical significance.

There is a statistically significant distinction in intensive care unit death rates among the research groups, as shown in table (4).

Table 5. Distribution of weaning length among the examined groups.

	GROUP A (CONTROL) (N= 50)		GROUP B (N= 50)		P VALUE
	Range	Mean ± SD	Range	Mean ± SD	
WEANING DURATION (HOURS)	(7-37)	20.08 ± 8.06	(10-50)	38.28 ± 11.3	< 0.001

There is no significance if the P value is greater than 0.05, statistical significance if the P value is less than 0.05, and strong significance if the P value is less than 0.001.

Table (5) indicates that the groups under study differed in a highly statistically significant way based on the length of time they were weaned.

Table 6. Weaning failure distribution among the groups under study.

	GROUP A (CONTROL) (N= 50)		GROUP B (N= 50)		P-VALUE
	N	%	N	%	
WEANING FAILURE	12	24%	24	48%	0.01
WEANING SUCCESS	38	76%	26	52%	

Significance is indicated by a P value between 0.05 and 0.001, with a P value less than 0.05 indicating no significance and a P value greater than 0.001 indicating substantial significance.

Table (6) indicates that the groups under study differed statistically significantly based on weaning failure.

4. Discussion

(AKI) Acute kidney injury is a significant cause of organ failure, especially in critically ill patients, and even a single episode, regardless of its stage, carries a high risk of death and morbidity. [5,6]

In terms of demographic information, there was no discernible difference between the two groups with respect to SAPSII score, co-morbidities, admission cause, or respiratory factors.

We found that the group of patients whose kidney function was suddenly disrupted had a significantly longer duration of MV in days than the group whose kidney function was normal (p-value < 0.001).

Ralib[7] The occurrence, risk factors, and outcome of AKI were investigated in a retrospective study by him and his colleagues at four tertiary intensive care units (ICUs) in Malaysia. Mechanical ventilation was observed to be longer in patients with AKI. Our findings are in agreement with this.

In terms of the time it took to wean off MV, patients with normal renal function had a considerably shorter duration than those with acute abnormalities of kidney function (p value < 0.001). Prolonged hospital stays were observed in patients experiencing acute renal dysfunction.

Vieira[8] Weaning from MV took longer in the AKI group than in the non-AKI group, according to the study by and colleagues. Which is in agreement with what we found.

those experiencing acute disruptions in renal function had a substantially higher risk of weaning failure in our study compared to those with normal kidney function (p value 0.01).

Vieira[8] He and his colleagues found that patients with AKI had a much greater rate of weaning failure from MV compared to patients without AKI when they examined at how AKI affected weaning failure. That is consistent with our findings.

We found that the mortality rates of the two groups were significantly different from one another ($p = 0.009$). Compared to normal renal function, the mortality rate was higher in cases with acute renal failure.

Mohammadi[9] Over the course of a year, he and his colleagues analyzed data from 900 ICU patients using the RIFLE classification to determine the frequency, causes, and consequences of AKI. A considerably greater mortality rate of 58.3% was seen in AKI patients compared to non-AKI patients, who had an average mortality rate of 13.4% ($P < 0.001$). These findings corroborate our own findings about the devastating impact AKI has on survival rates.

Barrantes [10] He and his colleagues conducted a retrospective cohort study in which they looked at 471 individuals who were admitted to a medical critical care unit (ICU). Exclusion criteria for this study included no patients who had previously received renal replacement treatment. Using a data abstraction tool, they examined demographic, clinical, and diagnostic data. Patients meeting the criteria for AKI had a substantially higher mortality rate compared to those without AKI, demonstrating the influence of AKI on outcomes in the intensive care unit.

Limitations: The results of MV duration and fatality rates could have been affected by additional conditions that were not taken into account, such as sepsis and multi-organ failure. Another important consideration in the management of acute kidney injury (AKI) in critically sick patients is the potential influence of renal replacement therapy (RRT), but this effect was not evaluated.

4. Conclusion

(AKI) Acute kidney injury has a significant impact on the outcomes for patients who receive MV. There is an association between AKI and increased mortality, prolonged MV duration, and prolonged weaning period in critically ill patients. Results like this highlight how much of a toll AKI takes on both patient recuperation and intensive care unit resources.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

Funding

No Funds : Yes

Conflicts of interest

There are no conflicts of interest.

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