Effect of Implementing Nursing Intervention Program about Early Detection and Prevention of Acute Kidney Injury on Critically Ill Patients' Clinical Outcome

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Abstract: Acute Kidney Injury is considered as a life threatening condition that affects critically ill patients. It is associated with high morbidity and mortality rate**. Aim**: evaluate the effect of implementing nursing intervention program about early detection and prevention of acute kidney injury on critically ill patient's clinical outcome. **Design**: A quasi experimental research design was utilized. **Subjects**: convenience sample of 60 adult patients at the anesthesia Intensive Care Unit of Tanta University Hospital, divided into two groups (control and study group) 30 patients in each. **Results:** The majority (96.7%) of patients in both control and study group had high level of National early warning sign score (NEWS) on admission. There was a significant difference between control and study patients in relation to renal recovery, referred to nephrologists, Patients who received RRT and hospital mortality with P= 0.004. More than half (53.3%) of the study group had normal urine output ≥0.5 mL/kg per hour for >6 hours after one week compared to low percentage of patients (6.7%) in control group. There was a significant difference between control and study sample to length of hospital stay and status on discharge after one week with p= (0.000 and 0.015) respectively. **Conclusion:** improved patient' clinical outcome in study sample compared with control group**. Recommendations**: Integrating nursing intervention program into plan of care to replace the traditional nursing care plan.

Keywords: AKI, nursing intervention program, Clinical Outcome

Introduction

Acute kidney injury (AKI) is a rapid deterioration in the function of kidney over hours to days. It is under recognized disorder that results in acid-base, fluid and electrolyte imbalance and inability to excrete nitrogenous wastes from the body [(1)]. Recognition of acute kidney injury depend on serum creatinine (Cr) measurement and is clinically manifested as a reversible acute increase in serum creatinine levels and blood urea nitrogen over the course of hours to weeks [(2)].

Evidences suggest that acute kidney injury had replaced the older term and concept of acute kidney failure in clinical practice and if relatively small changes occurred in kidney function, it may results in poor patient outcomes [(3)]. This condition is encountered in 18-65% of the critically ill patients at intensive care unit with compromised diseases. It has serious effects on patients' outcomes and increased mortality rate from 40 to over 70 %[(4-6)].

However, previous studies reported that the incidence of acute kidney injury in acutely ill patients have been limited because there was differences in definition and classification of acute kidney injury [(7)]. Study in Egypt about clinical characteristics and incidence of acute kidney injury in patients admitted at intensive care units of Alexandria university hospitals reported that 11% of acutely ill patients in intensive care unit acquired acute kidney injuries[(8)].

There are many risk factors for developing acute kidney injury in patients admitting into intensive care units including; dehydration, hypovolemia, sepsis, older age, preexisting renal disease, diabetes mellitus, heart failure, and many medications such as ACE inhibitors, vasopressors, aminoglycosides and NSAIDs [(9-10)].

The causes of acute kidney injury are classified as prerenal, intrinsic and post renal causes. However the intrinsic causes of acute renal failure are the most common and comprising 88% of all cases of acute kidney injury [(11-12)]. The clinical manifestation of acute kidney injury including; increased creatinine, urea, metabolic waste retention, fluid accumulation, electrolyte and acid-base imbalance, such as hyperkalemia, hyponatremia. In addition, acute kidney injury is associated with other organ systems dysfunction, including respiratory, cardiovascular and neurologic dysfunction [(13)].

Acute kidney injuries pose a significant burden for the healthcare system.The best approach for an effective early detection and management of acute kidney injuries

relies on early diagnosis, development of a broader definition of AKI, and a marker with more sensitivity than serum creatinine should be identified [14].

Fortunately, new classification systems of acute kidney injury have been developed to solve these problems such as; AKIN (Acute Kidney Injury Network), RIFLE (Risk, Injury, Failure, Loss of Kidney Function, and End-stage Kidney Disease). In addition the discovery of new biomarkers for detection of kidney injury, continuous evaluation of kidney function, administration of appropriate fluid resuscitation and medication strategy, will change the way of management of renal patients [15-17].

Urine output is included in the RIFLE and AKIN classification systems as a criterion for the diagnosis of AKI, however this criterion has been confirmed by a few prospective studies. Although it is recognized that hydration status, use of diuretics and hemodynamic status will affect urine volume and that severe AKI can occur with normal urine output, the ADQI group decided that the use of decline in urine flow might be a sensitive marker of renal dysfunction. Therefore, accurate measuring hourly urine output would be a sensitive marker of acute kidney injury [17, 18].

An effective clinical risk assessment for acute kidney injury in the ICU and prompt intervention is important for early identification of high-risk patients and provides an opportunity to develop strategies for prevention, early diagnosis and treatment of acute kidney injury [19]. Therefore the aim of this study is to evaluate the effect of implementing nursing intervention program about early detection and prevention of acute kidney injury on critically ill patient's clinical outcome.

Significance of the study:

Acute kidney injury (AKI) is recognized as a very common problem in critically ill patients, and is strongly associated with increased resource utilization, and higher short-term and long-term mortality regardless of the underlying cause**.** Therefore early identification and diagnosis of high-risk patients for acute kidney injury provides an opportunity to develop strategies for prevention and early treatment of acute Kidney Injury**.**

Aim of the study:

Evaluate the effect of implementing nursing intervention program about early detection and prevention of acute kidney injury on critically ill patients clinical outcome.

Hypotheses:

H1: Critically ill patients who exposed to nursing intervention program about early detection and prevention of acute kidney injury will exhibit decreased mortality rate and improved renal recovery than patients in control group

H2: Critically ill patients who exposed to nursing intervention program about early detection and prevention of acute kidney injury wil lexhibit normal level of serum creatinine level, blood urea nitrogen, serum potassium, sodium rate and urine output amount than patients in control group

H3: Critically ill patients who exposed to nursing intervention program about early detection and prevention of acute kidney injury will exhibit short duration of ICU stay than patients in control group

Research design: A quasi-experimental research design was utilized in this study.

Setting:

This study was conducted at anesthesia critical care unit affiliated to emergency hospital of Tanta University. The intensive care unit was consisted of 5 rooms and each room had 5 beds.

Subjects:

A convenience sample of 60 patients who were acutely ill, divided into 2 groups, 30 patients in each. Control group 1 received routine unit care, and study group received intervention program for early detection and prevention of acute kidney injury in ICU. The sample size of patients was calculated based on power analysis equation.

Inclusion criteria: Adult Patients' age ranged from (18 to 60) years, newly admitted patients

Exclusion criteria included Patient had acute or chronic renal failure.

Tools of data collection: Two tools were used to collect data pertained to this study.

Tool (I): Patient' physiological health assessment, it was developed by the researcher after reviewing recent literature [17-20] and consisted of three parts:

Part (1): Sociodemographic characteristics and clinical data.

It consisted of two main sections: **the first section** included sociodemographic data such as Patient's age, sex, marital status, educational level, occupation and residence.

The second section covered medical data such as date of admission, diagnosis, duration of ICU stays, previous hospitalization and past medical history, smoking and present medical history and drug used.

Part (2) : Risk Prediction Assessment of Acute kidney Injury[20], this tool was used to assess the risk factors of acute kidney injury and were classified into three categories; medical risk prediction (heart failure, Liver disease, Past history of AKI, diabetes , neurological impairment or disability, hypovolemic, hematological malignancy symptoms or

history of or risk factors long-term catheter, use of iodinated contrast agents and use of nephrotoxic drugs) while surgical risk prediction included post cardiac surgery and emergency surgery and Mixed risk prediction included mix of medical and surgical risk factors.

Part (3): National early warning score (EWS) Tool, this part was developed by Royal College of Physicians (2017) [21] it was used to assess acute-illness severity when patients present acutely to hospital to track their clinical condition, alert the clinical team to any clinical deterioration and trigger timely clinical response.it consisted of six physiological observations (Respiration rate, oxygen Saturations, temperature, systolic Blood Pressure (BP), heart rate, level of Consciousness). Each individual observation generates a score. Each scores 0–3 and individual scores are added together for an overall score.

Scoring system

The score was graded into three trigger levels:

- A low National early warning score (EWS) score (1–4) indicated that patients need prompt assessment by a competent registered nurse or equivalent, who should decide whether a change to frequency of clinical monitoring or an escalation of clinical care is required.
- A medium National early warning score (EWS) score (5–6) is indicated that patients need prompt an urgent review by a clinician
- A high National early warning score (EWS) score (7 or more) indicated that patients need prompt emergency assessment by a clinical team .

National Early Warning Score (NEWS) 2

Physiological Score parameter	3	2	1	Score 0	1	2	3
Respiration rate (per minute	≤8		9–11	12–20		21–24	≥25
SpO2 Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO2 Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg	≤90	91–100	101–110	111–219			≥220
Pulse (per minute	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Tool II: Patients 'Clinical outcome assessment:

This was used three times during the study on admission, 3rd day, and one week post implementation of nursing intervention program. It comprised two parts:

Part (1) Acute kidney injury network (AKIN) Assessment tool. This tool was developed by Mehta et al (2007) [(22)], and adopted by the researcher. It was used to assess severity and stage of acute kidney injury, it depended on two main parameter serum creatinine and urine output. Patients were diagnosed with acute kidney injury by the AKIN when they have at least one of the following within the past 48 hours: by the sudden decrease (in 48 h) of renal function, defined by an increase in absolute serum creatinine level of at least 26.5 μmol/L (0.3 mg/dL) or by a percentage increase in serum creatinine level≥50% (1.5× baseline value), or by a decrease in the urine output (documented oliguria <0.5 mL/kg/h for more than 6 h); it classified into four stage; No acute kidney injury, Risk 1 (early stage), Injury 2(moderate stage) and Failure (sever stage)

Scoring system

-No acute kidney injury: Normal serum creatinine level, or <1.5x from baseline

and urine output ≥0.5 mL/kg per hour for >6 hours

-**Stage 1** (risk class); it considered an absolute increase in SCr ≥26.5 μmol/L (0.3 mg/dL).

Stages 2 (risk injury classes), it considered an increase in SCr >2-3 times from baseline and decrease in urine output <0.5 ml/kg/h for >12 h

Stage 3 (failure classes), Increase in serum creatinine level to >3x from baseline, or ≥4.0 mg/dL (≥354 μmol/L) with acute increase ≥0.5 mg/dL (≥44 μmol/L) and urine output <0.3 ml/kg/h for ≥24 or anuria ≥12 h.

Part (2): Assessment of Patient 'Status on discharge (prognosis) and Renal recovery, this part was developed by the researcher after reviewing the related literature [14,18,19] It include assessment of the mortality rate, renal recovery, renal replacement therapy, referral to nephrologists, lab investigation mainly serum creatinine, blood urea nitrogen, serum electrolyte, urine output, duration of hospital stay and status of patient on discharge.

Method

Ethical consideration: An official permission to conduct the study was obtained from directors of ICU Unit. Written consent was obtained from patients to be included in the study after explanation of the purpose of the study. Each patient has the right to withdraw from the study at any time without any rational. Patients' privacy was respected and confidentiality of each patient was assured through coding of all data.

Content validity: All tools of the study were tested for content validity by five jury specialized in the field of critical care nursing and nephrology medicine from Tanta University and the necessary modifications were done.

The Reliability of tools had acceptable internal consistency by cronback'salpha. Reliability of risk Prediction Assessment of Acute kidney Injury was 0.95, National early warning score (EWS) Tool was **0.91** and Acute kidney injury network (AKIN) Assessment was 89.

A pilot study was conducted on 10% of sample of the study to test the feasibility and applicability of the study tools. The necessary modifications were done accordingly and the pilot study subjects were excluded from the actual study.

Procedure: The study was conducted on three phases which included assessment, implementation and evaluation phase.

1. Assessment phase:-

- A primary assessment was carried out by the researcher on the first day for all patients at the previously mentioned setting to determine who meet the

inclusion criteria of the study. Assessment of patient bio-sociodemographic data was obtained by the researcher from the patient or patient 'medical record using the developed questionnaire (tool I part (1),

- Assessment of risk prediction assessment of acute kidney injury was done by using tool 1 part (2), National early warning score (EWS) was done every day to assess acute-illness severity to track their clinical condition, alert the clinical team to any clinical deterioration and trigger timely clinical response by using tool 1 part (3)

2-Implementation phase:

- In this phase the researcher provided the nursing intervention program from the date of admission until discharge for risk patients. The researcher started the nursing intervention program as follow:
- Patients were screened for predictor variables within 48 h of ICU admission. Baseline and acute risk factors were recorded at the time of screening and serum creatinine was measured daily for up to 7 days.
- Monitoring output charts every shift, using different classification system of acute kidney injury for risk patient and measured by tool II part 1.
- Identification of risk factor through complete patient history, medication history, including over-the-counter medicines and herbal remedies, and including medications taken prior to admission or started after it. Recognizes medications which may increase the risk of AKI in a specific clinical context.
- Baseline assessment of patients including temperature, pulse rate, BP, respiratory rate, oxygen saturation, and AVPU (Alert/ responsive to Voice/Pain/Unresponsive) status in an acutely unwell patient and measured through national early warning score tool.
- Assessing renal function and estimating the serum creatinine and urine output is the first step in assessing the risk of AKI
- Monitors the patient’s fluid and electrolyte levels and physical indicators of potential complications every day from patient 'admission.
- Reducing metabolic rate through encouraged patient 'bed rest and fever and infection are prevented or treated promptly.
- The patient is assisted to turn, cough, and take deep breaths frequently to prevent atelectasis and respiratory tract infection.

- Prevent toxic drug effects, closely monitor dosage, duration of use, and blood levels of all medications metabolized or excreted by the kidneys.

Statistical design: Data was collected and analyzed by computer programmed SPSS (ver.16) **Field work**: Data were collected over a period of six months from May 2019 to October 2019.

3-Evaluation phase: Patient 'outcome was assessed by using tool (II) on 3rd day, and one week post implementation of the nursing intervention program for the study group and routine care for the control group.

Results

Table (1) illustrated that more than one third (36.7%) of control group aged from 30 to less than 40 years old compared to 40.0% of patients in study group, with the mean age was 39.20±9.375 and 41.53±11.20 in control and study group respectively. Also, the majority (80.0%) of control group were male compared to (76.7%) in study one, near to two third (60.0%) of study group were single compared to (43.3%) in control group.

Table (2) shows that more than half (53.3 and 56.7%) of both control and study group respectively had past history of hypertension while diabetes mellitus was reported among (50.0% and 53.3%) of both groups respectively, about two third (60.0%) of control group were smoker compared to one half (50.0%) of study one.

As regard current diagnosis, it was observed that near to one quarter (23.3%) of control group had respiratory disorders and trauma compared to (26.7% and 23.3%) of the study one. Neuro muscular diseases were encountered among 40.0% of patient in control group compared with 36.7% in study group. Also, previous hospitalization was reported among more than one half (56.7%) and half (50.0%) of both control and study groups respectively.

Table (3) found that no significant difference was observed among control and study group in relation to three categories of acute kidney injury risk prediction. Regarding medical risk prediction, it was observed that all patients (100%) in both control use of nephrotoxic drugs. Also, diabetes mellitus, liver disease were reported among (50.0% and 46.7%) of control group respectively compared to (53.35 and 40.0%) of study group. A significant difference was observed

Table (4) illustrates that the majority (96.7%) of patients in both control and study group had high level of National early warning sign score (NEWS) on admission. This indicates that these

Patients need higher level of care to identify and respond to deteriorating patients. After one week, most (96.7%) of patients in control group had high level compared to (86.7%) of the study one. A significant difference was found among control and study groups after one week where p= 0.005.

Table (5) shows that more than one third (43.3%) of control group classified as risk for acute kidney injury on admission compared to 30% after one week. Also more than half (56.7%) of control group hadn't acute kidney injury on admission and the percentage decreased to (36.7%) after one week of implementation of nursing intervention program.

As for study group, more than half (56.7%) of study group classified as risk for acute kidney injury on admission compared to 26.7% after one week. However more than one third (33.3%) of them hadn't acute kidney injury and the percentage increased to most of them (70.0%) after one week. A significant difference was found among both control and study group post one week of implementation of nursing intervention program P= 0.14

Table (6) shows significant differences among control and study group in relation to sodium level at 3rd day and after one week of study with p= 0.002 and 0.000 respectively. As for potassium level, a significant difference was found among both control and study group after one week of study while p= 0.002.

Also, the mean levels of urea were increased 56.97±18.62, 71.67±22.92 and 80.70±30.59 among control group throughout the three period of study respectively. Moreover, it was 56.97±18.62 and decreased to 44.40±9.68 and 42.30±10.11 among study group along three period of study. In relation to serum creatinine level, significant differences were reported among control and study group through the three period of the study while p= 0.024, 0.000, and 0.000 respectively.

Table (7) shows a significant difference between control and study group in relation to renal recovery, referred to nephrologists, Patients who received RRT and hospital mortality with P= 0.004 . Renal recovery was presented as (66.7%, 76.7%) in control and study group respectively. On the other hand, less than two third (60.0%) of control group was referred to nephrologists compared to (23.3%) among study group. Also, hospital mortality was presented as

(23.3%) and (10.0%) among both control and study group respectively. Regarding urine output, a significant difference was observed among control and study group.

Table (8) shows a significant difference between control and study group to length of hospital stay and status on discharge after one week with p= (0.000 and 0.015) respectively. The mean lengths of hospital stay were 11.10±1.807 in control and 9.20±1.669 in study groups. Also, near to (23.3%) of patient in control group had completely recovery compared to (60.0%) of study group.

Table (9) represents that near to one quarter (23.3%) from patients among control group had hypertension hadn't acute kidney injury and one fifth (20.0%) of them was at risk for kidney injury. As for study group, significant difference was observed in relation to past history and AKI outcome

assessment where p= 0.009, since 13.3% of them who had hypertension, liver diseases and diabetes were classified at risk. While more than one third (40.0% and 36.7%) of them hadn't AKI risk respectively. there was insignificant difference among both groups in relation to smoking and the acute kidney injury network outcome assessment where P >0.05

Table (10) represents that no significant difference was observed in relation to Patients' mortality rate, renal recovery, received RRT and referral to nephrologists among control group with p=0.172. On the other hand a significant difference was reported among study group since near two thirds of patients hadn't risk for acute kidney injury and had renal recovery with p= 0.010

Table (1): Distribution of the studied patients according to their socio demographic characteristics

Characteristics	The studied patients (n=60)				χ^2 P
	Control group (n=30)		Study group (n=30)		
	N	%	N	%	
Age (in years)					
▪ <30	6	20.0	3	10.0	
▪ 30- 40	11	36.7	12	40.0	2.627
▪ 40- 50	9	30.0	7	23.3	0.453
▪ ≥50	4	13.3	8	26.7	
Range	**(22-56)**		**(23-59)**		t=0.875
Mean ± SD	**39.20±9.375**		**41.53±11.20**		P=0.385
Sex					
▪ Male	24	80.0	23	76.7	FE
▪ Female	6	20.0	7	23.3	1.00
Marital status					
▪ Married	9	30.0	4	13.3	
▪ Single	13	43.3	18	60.0	3.796
▪ Divorced	6	20.0	4	13.3	0.284
▪ Widow	2	6.7	4	13.3	
Educational level					
▪ Illiterate	4	13.3	4	13.3	
▪ Read and write	6	20.0	7	23.3	
▪ Basic primary education	4	13.3	3	10.0	0.803
▪ Diploma	5	16.7	7	23.3	0.977
▪ Secondary education	2	6.7	2	6.7	
▪ University education	9	30.0	7	23.3	
Occupation					
▪ Work	20	66.7	19	63.3	FE
▪ Not work	10	33.3	11	36.7	1.00
Residence					
▪ Urban	16	53.3	16	53.3	FE
▪ Rural	14	46.7	14	46.7	1.00

FE: Fisher's Exact Test

Table (2): Distribution of the studied patients according to their clinical data.

Clinical data	The studied patients (n=60)				χ^2 P
	Control group (n=30)		Study group (n=30)		
	N	%	N	%	
Hypertension	16	53.3	17	56.7	
Cardiac disease	8	26.7	13	43.3	
Malignancy	6	20.0	5	16.7	0.271
Respiratory disease	18	60.0	14	46.7	0.602
Liver disease	14	46.7	12	40.0	
Diabetes	15	50.0	16	53.3	
Smoker	18	60.0	15	50.0	FE 0.604
Diagnosis of current admission					
▪ Respiratory disorder	7	23.3	8	26.7	1.253
▪ Neuro muscular	12	40.0	11	36.7	0.869
▪ GIT	4	13.3	3	10.0	
▪ Trauma	7	23.3	7	23.3	
▪ Cardiac disorder	0	0.0	1	3.3	
Previous hospitalization					
▪ No	17	56.7	15	50.0	FE
▪ Yes	13	43.3	15	50.0	0.796

FE: Fisher's Exact Test

Table (3): Distribution of the studied patients according to their risk prediction assessment of acute kidney injury among the studied groups.

Risk prediction assessment of acute kidney injury	The studied patients (n=60)				χ^2 P
	Control group (n=30)		Study group (n=30)		
	N	%	N	%	
# Acute kidney injury risk prediction					
1.Medical risk prediction	12	40.0	13	43.3	1.067
2.Surgical risk prediction	1	3.3	4	13.4	0.302
3.Mixed risk prediction	17	56.7	13	43.3	
# Medical risk prediction	8	26.7	13	43.3	
- Heart failure	14	46.7	12	40.0	
- Liver disease	8	26.7	11	36.7	
- Past history of AKI	15	50.0	16	53.3	
- Diabetes	5	16.7	7	23.3	
- Neurological impairment or disability	7	23.3	15	50.0	**4.593**
- .Hypovolemic	6	20.0	5	16.7	**0.032***
- Hematological malignancy	6	20.0	3	10.0	
- Symptoms or history of or risk factors	5	16.7	3	10.0	
- long-term catheter	10	33.3	4	13.3	
- Use of iodinated contrast agents	30	100.0	30	100.0	
Use of nephrotoxic drugs					
- vasopressors	8	26.7	13	43.3	
- diuretics	16	53.3	17	56.7	
- Ca channel blockers	11	36.7	13	43.3	0.067
- ACEI	16	53.3	17	56.7	0.795
- ARB	14	46.7	15	50.0	
- NSAIDs	19	63.3	14	46.7	
- Aminoglycosidesyes	15	50.0	16	53.3	
Surgical risk prediction					
▪ Post cardiac surgery	7	23.3	5	16.7	1.725
▪ Emergency surgery	10	33.3	15	50.0	0.422
▪ None	13	43.3	10	33.3	

More than one answer was chosen. * Significant at level P<0.05.

Table (4): Distribution of the studied patients according to the National early warning score (NEWS) throughout periods of study.

NEWS	The studied patients (n=60)											
	Control group (n=30)						Study group (n=30)					
	On admission		At 3rd day		After one week		On admission		At 3rd day		After one week	
	N	%	N	%	N	%	N	%	N	%	N	%
▪ (5-6) Medium	1	3.3	0	0.0	1	3.3	1	3.3	0	0.0	4	13.3
▪ (≥7) High	29	96.7	30	100.0	29	96.7	29	96.7	30	100.0	26	86.7
χ^2 , P	1.023 , 0.600						5.506 , **0.047***					
Range	**(6-17)**		**(7-18)**		**(6-17)**		**(6-19)**		**(7-17)**		**(6-13)**	
Mean ± SD	**10.53±3.14**		**11.53±2.99**		**10.27±2.97**		**11.00±3.35**		**11.77±2.57**		**8.40±1.85**	
F , P	1.453 , 0.239						**13.181 , 0.000***					
Control Vs Study t P	0.557 0.580		0.324 0.747		**2.922 0.005***							

t : Independent sample test

* Significant at level P<0.05.

Table (5): Distribution of the studied patients according to the AKIN (the Acute Kidney Injury Network (AKIN) outcome assessment throughout periods of study.

AKIN AKI outcome	The studied patients (n=60)												
	Control group (n=30)						χ^2 P	Study group (n=30)						χ^2 P
	On admission		At 3rd day		After one week			On admission		At 3rd day		After one week		
	N	%	N	%	N	%		N	%	N	%	N	%	
▪ Not AKI														
▪ Risk (early)	17	56.7	11	36.7	11	36.7		10	33.3	14	46.7	21	70.0	
▪ Injury	13	43.3	15	50.0	9	30.0	**15.36**	17	56.7	13	43.3	8	26.7	**8.587**
(moderate)	0	0.0	4	13.3	8	26.7	**0.018***	3	10.0	3	10.0	1	3.3	**0.045***
▪ Failure (sever)	0	0.0	0	0.0	2	6.7		0	0.0	0	0.0	0	0.0	
Control VS Study χ^2 P	5.348 0.069		0.646 0.724		**10.628 0.014***									

* Significant at level P<0.05.

Table (6): Mean scores of lab investigation among the studied groups throughout periods of study.

Investigation outcomes	Range Mean ± SD							
	Control group			F P	Study group			F P
	On admission	At 3rd day	After one week		On admission	At 3rd day	After one week	
Sodium level (Na)	(131-148) 140.07±4.64	(136-155) 143.57±4.68	(135-155) 145.77±4.11	**12.334 0.000***	(131-148) 140.07±4.64	(133-148) 139.87±4.27	(133-148) 139.77±4.40	0.036 0.965
Control Vs Study t P	0.000 1.00	**3.198 0.002***	**5.460 0.000***					
Potassium level (K)	(3.3-5.3) 4.29±0.63	(3.3-5.4) 4.23±0.64	(3.3-5.9) 4.72±0.74	**4.649 0.012***	(3.3-5.3) 4.41±0.64	(3.3-5.3) 4.29±0.63	(3.3-5.3) 4.16±0.60	1.171 0.315
Control Vs Study t P	0.690 0.493	0.387 0.700	**3.190 0.002***					
Blood Urea nitrogen	(32-99) 56.97±18.62	(6-110) 71.67±22.92	(6-170) 80.70±30.59	**7.143 0.001***	(32-99) 56.97±18.62	(31-66) 44.40±9.68	(31-66) 42.30±10.11	**10.434 0.000***
Control Vs Study t P	0.00 1.00	**6.003 0.000***	**6.529 0.000***					
serum Creatinine level	(0.0-2.9) 1.13±0.82	(0.2-3.1) 1.75±0.79	(0.0-3.3) 2.25±0.83	**14.267 0.000***	(0.0-2.3) 0.70±0.63	(0.0-2.0) 0.69±0.55	(0.0-2.0) 0.79±0.59	0.269 0.765
Control Vs Study t P	**2.323 0.024***	**6.039 0.000***	**7.854 0.000***					

t : Independent sample test * Significant at level P<0.05.

Table (7): Distribution of the studied patients according to their renal function recovery outcome post one week of implementation of nursing intervention program.

Outcome	The studied patients (n=60)				χ^2 P
	Control group (n=30)		Study group (n=30)		
	N	%	N	%	
Patient' mortality.	7	23.3	3	10.0	
Renal Recovery.	20	66.7	23	76.7	**8.297**
Patients who received RRT	6	20.0	3	10.0	**0.004***
Referral to Nephrologists	18	60.0	7	23.3	
Urine output					
• ≥0.5 mL/kg per hour for >6 hours	2	6.7	16	53.3	
• <0.5 mL/kg per hour for >6 hours	9	30.0	14	46.7	**30.976**
• <0.5 mL/kg per hour for >12 hours	17	56.7	0	0.0	**0.000***
• <0.3 mL/kg per hour for ≥24 hours, or anuria for 12 hours	2	6.7	0	0.0	

* Significant at level P<0.05.

Table (8): Distribution of the studied patients according to length of hospital stay and prognosis post one week of implementation of nursing intervention program.

	Control group (n=30)		Study group (n=30)		
Length of hospital stay					
Rangse	(8-15)		(7-14)		**t=4.230**
Mean ± SD	11.10±1.807		9.20±1.669		**P=0.000***
Prognosis					
▪ Refereed	16	53.3	9	30.0	**8.40**
▪ Complete recovery	7	23.3	18	60.0	**0.015***
▪ Died	7	23.3	3	10.0	

Table (9): Comparison between the acute kidney injury network (AKIN) Assessment outcome and past medical history among the studied groups post one weak of implementation of nursing intervention program.

Past medical history and comorbidities	The studied patients (n=60) AKI outcome assessment															
	Control group (n=30)								Study group (n=30)							
	Not AKI		Risk		Injury		Failure		Not AKI		Risk		Injury		failure	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1.Hypertension	7	23.3	6	20.0	3	10.0	0	0.0	12	40.0	4	13.3	1	3.3	0	0.0
2.Cardiac disease	3	10.0	2	6.7	3	10.0	0	0.0	9	30.0	3	10.0	1	3.3	0	0.0
3.Malignancy	1	3.3	2	6.7	3	10.0	0	0.0	3	10.0	2	6.7	0	0.0	0	0.0
4.Respiratory disease	8	26.7	5	16.7	5	16.7	0	0.0	10	33.3	3	10.0	1	3.3	0	0.0
5.Liver disease	5	16.7	4	13.3	3	10.0	2	6.7	8	26.7	4	13.3	0	0.0	0	0.0
6.Diabetes	5	16.7	6	20.0	3	10.0	1	3.3	11	36.7	4	13.3	1	3.3	1	3.3
χ^2 , P	4.204 , 0.240								**9.403 , 0.009***							
Smoker	6	20.0	5	16.7	6	20.0	1	3.3	11	36.7	3	10.0	1	3.3		
χ^2 , P	1.044 , 0.791								1.548 , 0.461							

* Significant at level P<0.05.

Table (10): Comparison between the acute kidney injury network (AKIN) Assessment outcome and patient' mortality rate, renal recovery, receiving renal replacement therapy and referral to nephrologists post one weak of implementation of nursing intervention program.

Items	The studied patients (n=60) acute kidney injury network (AKIN) Assessment outcome													
	Control group (n=30)								Study group (n=30)					
	Not AKI		Risk		Injury		Failure		Not AKI		Risk		Injury	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1. Patients' mortality.	3	10.0	2	6.7	2	6.7	0	0.0	3	10.0	0	0.0	0	0.0
2. Renal Recovery.	8	26.7	6	20.0	5	16.7	1	3.3	19	63.3	4	13.3	0	0.0
3.Patients received RRT	0	0.0	3	10.0	2	6.7	1	3.3	0	0.0	3	10.0	0	0.0
4.Referral to Nephrologists	1	3.3	8	26.7	7	23.3	2	6.7	2	6.7	5	16.7	0	0.0
χ^2 , P	5.00 , 0.172								**9.167 , 0.010***					

* Significant at level P<0.05.

Discussion

Acute kidney injury is an increasingly common and potentially catastrophic complication in critically ill patients. Therefore nursing intervention program about early detection and prevention of acute kidney injury for critically ill patients is very important to improve patient's clinical 'outcome. The current result showed that there was no statistically significant differences between both study and control groups concerning patients' sociodemographic characteristics. This indicated the homogeneity of the two selected groups; therefore any difference between them can be due to the applied of nursing intervention program of early detection and prevention of acute kidney injury. However the present finding found that more than one third of patients of control and study group aged ranged from 30 to less than 40 years old and were male. This result was in congruent with Shamali (2016)[23] who stated that the majority of studied critically ill patients were at this mean age

Cigarette smoking increasing risk for acute kidney injury and causes a decrease in GFR in diabetic patients with normal or near-normal renal function. In this regard, the current study showed that, more than half of both control and study group had hypertension, diabetes mellitus and were smoker which increased risk for occurrence of acute kidney injury. The same finding was reported by Maddatu et al. (2017) [24] who stated that heavy smoker patients are at risk for the development and progression of diabetic nephropathy.

Regarding current diagnosis, the findings of the present study showed that the most common diagnosis of both groups had respiratory disorders, trauma and neuro muscular diseases. These medical problems may increase risk of acute kidney injury in critically ill patients. This finding was similar with Panitchote et al. (2019) [25] concluded that severe acutely illness, diabetes, respiratory disorders and acidosis were associated with development of acute kidney injury.

Early identification of patients at risk for acute kidney injury can provide adequate strategies for prevention and treatment. The result of this study revealed that diabetes mellitus, nephrotoxic drugs, liver disease and emergency surgery were predictors of acute kidney injury in our study. No significant difference was observed among two groups in relation to surgical risk prediction. This result was consistent with Neyr (2018)[19] and Malhotra et al (2017) [20] who found that congestive heart failure, nephrotoxic exposure, chronic liver disease and sepsis

were identified as a risk prediction score for acute kidney injury in the intensive care unit.

Regarding distribution of the studied patients according to the National early warning sign score (NEWS). It was found that the majority of patients in both control and study group had high level of national early warning sign score (NEWS) on admission which indicated that patients need prompt emergency assessment by a clinical team. However, national early warning sign score was decreased in study group than control group after one week. This indicated good prognosis of patients in study group who managed by nursing intervention program since National early warning sign score (NEWS) assess acute-illness severity. Similarly Scott et al (2019) [(26)] reported that Early Warning Scores (EWS) are widely recommended for recognizing patients at risk and deterioration of patients condition and higher scores indicating that a patient is more unwell.

Regarding distribution of the studied patients according to the acute kidney injury network outcome assessment (AKIN). The current study showed that a significant difference was found among control and study group after one week where majority of patients in study group hadn't acute kidney injury compared to only one third of patients in control group. Also nearly one third of patients in control group had classified as risk Injury (moderate) to acute kidney injury compared to only three percent of patient in study group. This may be attributed to the effect of nursing intervention program about early detection and prevention of acute kidney injury. This finding was consistent with Shafie et al. (2016) [(8)] who used kidney injury network scale to classify degree of acute kidney injury and reported that more than one third of study sample classified as risk and nearly on half of sample classified as injury for acute kidney injury .

Regarding Mean scores of lab investigation among the studied groups throughout periods of study**,** our result revealed an improved of Na and K level among study group after one week compared with control group. Also, the mean levels of urea and serum creatinine level were improved among study group after one week compared with control group. This indicated improved renal function. This result was agreed with Work Group KDIGO (2013) [(27)] who confirmed that serum creatinine level has been used for many years as a marker of renal function in both acute and chronic kidney failure.

Also Potter et al. (2017)[28] stated that Potassium and Sodium bicarbonate were shown to be more responsive markers in acute kidney injury than serum creatinine and NEWS. On the other hand Makris (2016) [29] reported that serum creatinine level is not an ideal molecular marker for the diagnosis of acute kidney injury and also didn't differentiate between changes in kidney function and structural kidney damage.

Concerning distribution of the studied patients according to their renal function recovery outcome after one week**.** The present finding revealed that there was a significant difference between control and study group in relation to renal recovery, referred to nephrologists, Patients who received renal replacement therapy and patients' mortality rate. Most of the patients in study group that received nursing intervention program had renal recovery and low percentage of them had low mortality rate and referred to nephrologists compared to control group. Similarly, Meier et al. (2011) [30] concluded that low hospital mortality rate for the patients with hospital acquired acute kidney injury who received continues evaluation and intervention and Patients with fully recovered HA-AKI during their hospital stay had lower mortality rate. Also Balasubramanian et al. (2011)[31] reported that timely nephrologic interventions to prevent acute kidney injury improved renal outcomes.

Regarding urine output, more than half of the study group had normal urine output ≥0.5 mL/kg per hour for >6 hours after one week compared to low percentage of patients in control group with significant difference was observed among control and study group. In this regard Allen et al. (2020)[32] stated that urine output can detect acute kidney injury eleven hours earlier than serum Creatinine level and urine output was included in the diagnostic criteria for acute kidney injury. On the other hand, Macedo et al (2011)[18] concluded that there was no significant difference between assessing urine output every hour for the detection of episodes of oliguria, and identifying patients with AKI.

Concerning distribution of the studied patients according to length of hospital stay and status on discharge after one week**.** There was a significant difference between control and study group to length of hospital stay and status on discharge after one week. The mean lengths of hospital stay were longer in control group compared to study group. Near to two third of study group had completely recovery compared to control group.

Kellum et al. (2017) [33] reported that the shortest hospital lengths of stay were associated with best prognosis and completely recovery. Similarly Huber et al. (2018) [34] concluded that acute kidney injury (AKI) is associated with a prolonged ICU and hospital stay. Furthermore, patients suffering from AKI have higher rates of short- and long-term mortality.

According to comparison between the acute kidney injury network outcome assessment and past medical history and comorbidities after one weak of study. The present findings illustrated a significant difference was observed among study group in relation to past history and acute kidney injury network outcome assessment, where one third of patients that had hypertension hadn't risk to acute kidney injury . This could be due to effect of nursing intervention program that included continuous observation and management of patient who at risk for acute kidney injury.

However, only minority of the patients who had hypertension, liver diseases and diabetes compared to one fifth of control group that classified as risk for acute kidney injury. This can be explained as hyperglycemia induces release increased production of reactive oxygen species that increase risk of acute kidney injury. This is congruent with Bennet et al. (2010) [35] who confirmed that the comorbidities associated with acute kidney injury and classified as risk for acute kidney injury including hypertension, diabetes mellitus, vascular disease, and chronic renal disease.

Regarding comparison between the acute kidney injury network outcome assessment and patients' mortality rate, renal recovery, receiving renal replacement therapy (RRT) and referral to nephrologists. The present result showed that the patients' mortality rate, renal recovery, Patients who received RRT and referral to nephrologists was not different among patient reaching risk to injury in control group. This findings were in agreement with Ali et al. (2007) [36] who reported that there were no significant differences in relation to RRT requirement, mortality among patient had risk to injury and concluded that acute kidney injury assessment outcome did not, predict the long-term outcomes of mortality. Similarly, Mandelbaum et al. (2011)[37] stated that there was no clear risk difference between the patients with stage I and II of acute kidney injury and risk of mortality rate

Conclusions

The majority of patients in both control and study group had high level of National early warning sign score (NEWS) on

admission which indicates that these Patients need higher level of care to identify and respond to his deterioration. The length of hospital stay in control group was long relatively than study group. Application of early identification and prevention of acute kidney injury program decreased patients' mortality rate, receiving of renal replacement therapy, improved renal recovery and urine output per day compared with control group.

Recommendations

Based on the findings of this study, the following recommendations are suggested; nursing intervention program about early detection and prevention of acute kidney injury for critically ill patients should be implemented routinely for risk patients in intensive care unit. Integrating nursing intervention program into plan of care to replace the traditional nursing care plan. Replication of the study on large probability sampling

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