An-Najah National University

Faculty of Graduate Studies

Thirty-Days of Survival, Patients Undergoing Intermittent Hemodialysis Versus Sustained Low Efficacy Dialysis for Acute Kidney Injury: A Retrospective Study

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Dedication

بسم الله الرحمن الرحيم

(يَرفعْ الله الّذينَ آمنوا مِنْكُم والذينَ اوتو العِلمَ درَجاتٍ ..)

قال رسول الله صلى الله عليه وسلم (من لا يشكر الناس لا يشكر الله)

الحمد لله رب العالمين حمدا طيبا كثيرا مباركا به

بعون الله وفضله تمت اليوم مناقشة مشروع تخرجي وحصولي على درجة الماجستير في تمريض_العناية_المكثفه

وبهذا اتقدم بجزيل الشكر والعرفان للجنة المشرفه على مناقشتي ممثلةً بكل من

المشرف الأكاديمي الدكتورة Dr Aidah Abu Elsoud Alkaissi

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لكلّ مبدع إنجاز، ولكلّ شكر قصيدة، ولكلّ مقام مقال، ولكلّ نجاح شكر وتقدير، فجزيل الشّكر لكم مني مع فائق الحب والاحترام لما قدمتموه لي في هذا اليوم المميز .

ولا انسى من لهم الفضل الكبير في هذا الانجاز العظيم عائلتي الكريمة زوجي واولادي واهلي واصدقائي وزملائي بالجامعة دمتم جميعا بخير وهداة بال ومن نجاح الى اخر باذن الله .

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Author

Shibli howaida

2021

الاقرار

انا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Thirty-Days of Survival, Patients Undergoing Intermittent Hemodialysis versus Sustained Low Efficacy Dialysis for Acute Kidney Injury: A Retrospective Study

اقر بأن ما اشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخاص، باستثناء ما تم الاشارة إليه حيثما ورد، وان هذه الرسالة ككل آو اي جزء منها لم يقدم لنيل اي درجة او لقب علمي او بحثي لدى أي مؤسسة تعليمية او بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the Researcher`s own work and has not been submitted elsewhere for any other degree or qualification.

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Date: **التاريخ: 2021/5/6**

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Abbreviations and definitions

Abbreviation	Meaning
CHF	Congestive heart failure
SAH	Systemic arterial hypertension
DM	Diabetes mellitus
ATN	Acute Tubular Necrosis
APACHE II	Acute Physiology, Assessment, Chronic Health Evaluation
SOFA	Sequential organ failure assessment score
NNUH	AN Najah National University Hospital
IRB	Institutional review board
SPSS	Statistical package for the social sciences
ICU	Intensive care unit
AKI	Acute kidney injury
RRT	Renal replacement therapy
BUN	Blood urea nitrogen
sCR	Serum creatinine
HD	Hemodialysis
IHD	Intermittent hemodialysis
SLED	Sustained low efficiency dialysis
PD	Peritoneal dialysis
CRRT	Continuous renal replacement therapy
RIFLE	Risk, injury, failure, loss, end stage
AKIN	Acute kidney injury network
KDIGO	Kidney disease improving global outcome
NGAL	Neutrophil gelatinase-associated lipocalin
ESRD	End Stage Renal Disease
GFR	Glomerular filtration rate

Conceptual definition of the terms

AKI: According to KDIGO, AKI is defined as any of the following: increase in serum creatinine by 0.3mg/dL or more within 48 hrs, or increase in serum creatinine to 1.5 times baseline or more within the last 7 days, or urine output less than 0.5 mL/kg/h for 6 hrs (Fujii, Uchino, Takinami, & Bellomo, 2014).

GFR: It is defined as the ability of the kidney to filter the blood from the waste products by the glomerulus portion, decreased in GFR resulting in retention of these products which will alter the fluid regulation, electrolyte, and acid base homeostasis (Zaragoza & Renteria, 2017).

sCr: It is considered as inferior marker of kidney function in critical illness, arise in sCr commonly delayed after decreased renal function (Koeze et al., 2017).

Time of initiation for RRT: It is assessed through serum biomarkers (Urea and sCr), urine volume and time of admission to ICU to the time of starting the use of RRT. In addition, it is divided into early initiation which describe oliguria within 12 hrs and late initiation describes the patient met the criteria for RRT (Negi, Koreeda, Kobayashi, Iwashita, & Shigematu, 2016).

APACHE II scale: It is defined as disease severity on admission to ICU (Abd ElHafeez et al., 2017). APACHE II uses a point score based upon initial values of 12 routine physiologic measurements, age, and previous health status to provide a general measure of severity of disease. An

increasing score (range 0 to 71) was closely correlated with the subsequent risk of hospital death for 5815 intensive care admissions from 13 hospitals. This relationship was also found for many common diseases. When APACHE II scores are combined with an accurate description of disease, they can prognostically stratify acutely ill patients and assist investigators comparing the success of new or differing forms of therapy. This scoring index can be used to evaluate the use of hospital resources and compare the efficacy of intensive care in different hospitals or over time (Knaus, Draper, Wagner, & Zimmerman, 1985).

SOFA score: The SOFA score was designed to provide population level insights into the acute morbidity of ICU patients; however, its application has broadened substantially in recent years. SOFA was based on six different scores, one for each of the respiratory, cardiovascular, hepatic, coagulation, renal and neurological systems each scored from 0 to 4 with an increasing score reflecting worsening organ dysfunction (Lambden, Laterre, Levy, & Francois, 2019). It is associated with the presence of sepsis contributed with mortality rate in critically illnesses in the ICU (Lee et al., 2018).

Survival: It is related to the outcome which is consist of two directions, first direction is mortality rate outcome which means patient death or alive "survival & non-survival" (Kwizera et al., 2016). In addition, the second direction is related to renal recovery which classified into complete, incomplete and absent recovery of kidney functions, whereas recovery of

kidney function will assess only in patients with reference creatinine. Moreover, recovery of kidney function was classified as complete when eGFR within 25% of reference eGFR; incomplete recovery assessed when the patient had a 25 % or greater decline of reference eGFR and who were not treated with dialysis; while the absent recovery assessed as the permanent need for the treatment of RRT for more than three months (De Corte et al., 2016).

Clinical characteristics: it include comorbidity (Diabetes mellitus, Congestive heart failure, infectious status, degree of AKI, Systemic arterial hypertension, Acute Tubular Necrosis, hypovolemia, sepsis), characteristics of admission (type of ICU, timing of admission), Mechanical ventilator, vasoactive drugs use (initial and late dose), renal characteristics include (oliguria, fluid balance, urine output, diuretics, ICU to RRT length of stay in days, RRT modality (IHD and SLED) (B. B. Albino, Balbi, & Ponce, 2014; De Corte et al., 2016).

Demographic data: It includes age, gender, weigh, height, body mass index, smoking status, education level, marital status, residency (Mukakarangwa, Chironda, Bhengu, & Katende, 2018).

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Abstract

Background: Acute kidney injury (AKI) is progressively common and is brought into relation with high costs and un preferably clinical outcomes like complications of RRT which the most common is hypotension that reaches to 30-70%, long length of stay, high mortality rates up to 50-70%, however if the intervention to start renal replacement therapy was made early, it will enhance the outcome and mortality rate. The aim of this study is to determine the mortality rate, clinical characteristics & outcomes of intermittent hemodialysis (IHD) versus sustained low efficiency dialysis (SLED) among critically ill patients with AKI.

Methods: This study was a retrospective cohort design performed at a An-Najah National University Hospital in the west bank which is recruiting 50 patients treated with either IHD or SLED in the intensive care unit (ICU). It included the patient's demographic data, past history, indications for dialysis modalities, hemodynamic parameters and lab test parameters which were tested pre- and post-dialysis for three sessions, complications of dialysis and finally renal outcome which were viewed and analyzed.

Results: Median age was 57.2 years with interquartile range of 8.8 years, 80% of them were 50 years, 68% were male in gender, 66% were on

mechanical ventilation and 40% were on vasoactive drugs, acute physiology, assessment, chronic health evaluation (APACHE) score p value <0.038, median sequential organ failure assessment score (SOFA) score was 0.45 with interquartile range of 0.28. The major complication was hypotension 56%, and 46% of patients were not recovered (died or end stage renal failure).

Conclusion: Our study showed that the recovery of AKI was associated with younger and educated patients while the non-recovery was associated with older patients whom suffering from medical history regarding to the modality was used in the treatment.

Keywords: Acute kidney injury, Intermittent hemodialysis, Sustained low efficiency dialysis, Mortality rate, Clinical characteristics, Outcomes.

Chapter One
Introduction

According to many studies in nephrology, acute kidney injury (AKI) was shown to be associated with severe systemic and kidney complications (Levey & James, 2017), and linked with high rate (40%) of patients being referred to the intensive care unit (ICU) and (15%) of hospitalized patients (Druml, Metnitz, Schaden, Bauer, & Metnitz, 2010; Valente, Soares, Rocha, Cardoso, & Maccariello, 2013). Also, studies have shown that the mortality rates of ICU patients who develop AKI ranged from (46.8%) to (60%) (Kwizera et al., 2016). In addition, AKI is still has a high mortality rate reached (50%) to (70%) (B. B. Albino et al., 2014), and reached up to (85%) in low income/middle income countries (Yang et al., 2018). Moreover, Ponce et al. (2011) pointed that about 8% of the patients in the ICU who develop AKI often die and about 13% of those who survive might require hemodialysis (Ponce, Zorzenon, Santos, Teixeira, & Balbi, 2011). Additionally, such mortality and hemodialysis rates were shown to be unchanged even with renal replacement therapy (RRT) (Ponce et al., 2011).

AKI is associated with instability of hemodynamic, multi organ failure, sepsis, and renal hypotension which affect the length of stay in the hospital and high cost of healthcare (Kwizera et al., 2016). Moreover, several complications could be associated with incidence of AKI and mortality rates. Of those complications, several are directly related to AKI. For example, hypernatremia, hyperkalemia, hypervolemia, and metabolic

acidosis. On the other hand, mortality as a result of AKI could be associated with infection, inflammation, and multi-organ failure (Hoste & De Corte, 2011).

AKI has several definitions. The term can be defined as loss of kidney functions that occur suddenly which is seen as rapid decline in the glomerular filtration rate (GFR). AKI occurs over a period that could range from few hrs to several days. This can result in retention of urea, creatinine, fluids, electrolyte imbalance, and acid-base hemostasis abnormalities (Liang & Palevsky, 2018). Furthermore, Lameire et al. (2005) described AKI as a condition that is subject to great variability and heterogeneity which could be relevant to the hemodynamic instabilities to the renal perfusion and reduction to the GFR without significant parenchymal injury (Lameire, Van Biesen, & Vanholder, 2005). AKI is also defined as reduction in the GFR that occurs suddenly which subsequently result in accumulation of metabolites, instabilities in fluids, electrolytes, and acid-base homeostasis (Lameire et al., 2005). According to the Kidney Disease: Improving Global Outcomes (KDIGO), AKI could be associated with the following: rise in creatinine serum level by 0.3 mg/dL or more within 48 hrs, rise in creatinine serum level to 1.5-fold or more compared to the baseline level within the last 7 day, or urine output of < 0.5 mL/kg/h for 6 hrs (Fujii et al., 2014).

The general causes that lead to AKI summarized into three categories: firstly, pre-renal causes which include hypovolemia, reduced cardiac

output, systemic vasodilation, and drug induction. Secondly, intra-renal causes include vasicular, glomerular or tubular disease. Finally, post-renal causes include bladder obstruction, ureteral obstruction and renal-pelvis stones (Moore, Hsu, & Liu, 2018).

The best management of AKI is identifying the risk factors and prevention via treating the underlying causes, starting with a conservative therapy by improving the hemodynamic status, optimizing the cardiac function, and correcting the electrolytes imbalance through accounting for the deficits in cardiac output, maintaining appropriate intravenous volume, and preventing nephrotoxicity. Finally, if this management steps failed the last step ending with the use of renal replacement therapy (RRT) which consider the cornerstone of supportive management (Zaragoza & Renteria, 2017).

Albino et al and Sankarasubbaiyan et al had declared in their studies that the aim of using RRT involves allowing the elimination of fluid, solutes and waist product that accumulate during renal let-down. Furthermore, the decision to initiate the RRT is unclear but it depends on several parameters including blood urea nitrogen (BUN), creatinine (Cr), fluid over load, electrolytes and acid base abnormalities (B. Albino, Gobo-Oliveira, Balbi, & Ponce, 2018; Sankarasubbaiyan, Janardan, & Kaur, 2013).

RRT is divided into peritoneal dialysis (PD) and hemodialysis (HD). PD is the final option for therapy for patient with End Stage Renal Disease (ESRD) in case they have complication from the HD such as vascular access difficulties or refractory hypotension (Nessim et al., 2015). In addition, it showed that the patient whom treated with PD having low serum albumin level and high lipid profile level than whom treated with HD (Jung et al., 2019). On the other side, this method was shown to be equally effective when compared with IHD and CRRT, especially, when volume control and metabolic parameters are considered. However, this method can have many advantages in contrast to CRRT. These advantages include low cost, less need for anticoagulants, less optimization time, and enabling procedures outside the ICU settings (Kitchlu et al., 2015; Levy et al., 2010; Zhang et al., 2015).

The HD method is divided into other options according to duration, blood flow and dialysate. The HD types include: conventional intermittent hemodialysis (IHD), continuous renal replacement therapy (CRRT), and sustained low efficiency dialysis (SLED) (B. Albino et al., 2018).

The treatment of IHD is administered in short period of time 2-4 hrs in 3-4 times per week while the SLED is administered at longer time 6-12 hrs in 3-6 days per week (Bellomo et al., 2017).

For critically ill patients with AKI and hemodynamic instabilities, SLED is the preferred renal replacement method. Despite the fact that SLED is the preferred method, little studies were conducted to evaluate the clinical outcomes of this method. It was proposed that SLED might reduce the hemodynamic instabilities of the IHD and reduce the costs associated with the CRRT (Kitchlu et al., 2015).

With regard to the time of initiation, studies have assessed the timing of initiating RRT in ICU patients with AKI. However, there is no consensus among clinicians that can be used as guidance to clinicians on when RRT can be initiated. Consequently, questions like does early initiation of RRT improve survival rates and renal recovery rates among ICU patients with AKI? remained unanswered. The classic criteria for using RRT in the treatment of ICU patients with AKI include hypervolemia that is resistant to diuretics, metabolic acidosis, hyperkalemia, and uremic conditions that are manifested by encephalopathy, convulsions, and pericarditis. On the other hand, timing of RRT was studied in previous studies using classical biomarkers in the serum like urea, and SCr in addition to other markers like the volume of urine, and the time from admission of the patient to the ICU to the commencement of RRT (Bagshaw et al., 2009; Negi et al., 2016). It is important to note that timing of RRT initiation can be determined using the KDIGO staging criteria (De Corte et al., 2016). When RRT is initiated at KDIGO stage 1 or 2 it can be defined as “early” and when RRT is initiated at KDIGO stage 3 it can be defined as “late”. Oliguria can be

defined as diuresis of < 500 mL over a period of 24 h after RRT initiation (De Corte et al., 2016).

Recovery of AKI depends on the result of kidney disease improving global outcomes criteria which identify changes in kidney functional parameters from minimal to worsening outcome (Bellomo et al., 2017). It classified into three levels based on reference serum creatinine: complete recovery referred to eGFR within 25% of the normal value, while incomplete recovery means 25% or greater decrease in normal eGFR, whereas the last one is the absent recovery which means permanent requirement for RRT more than 3 months (De Corte et al., 2016).

This study is aimed to determine 30-days of survival, the clinical characteristics, the dialysis complications, mortality rate and patients' outcomes of patients undergoing intermittent hemodialysis versus sustained low efficacy dialysis for acute kidney injury in intensive care units.

1.1 Problem statement

According to the outcomes of management AKI in ICUs, some studies related to the use of IHD show limited resources setting, and there is few studies have evaluated the SLED impact on clinical outcomes (Kitchlu et al., 2015; Kwizera et al., 2016).

Admission to ICU put the patient at high risk to develop AKI which can be eliminated by the early evaluation of the patient conditions with early

initiation of IHD and good evaluation of the outcomes which will affect the mortality at ICU patients.

The present study is a retrospective study consisting of two patient groups, one of which is those who underwent treatment with AKI via IHD < 4 h, others who underwent treatment with AKI via SLED care > 4-6 h over an extended 30day duration, which included the assessment of clinical characteristics ,mortality rate and survival recovery.

Relevant studies were not conducted before in Palestine to compare with those conducted in other developing and developed countries. Therefore, the aim of this study was to determine 30-days of survival, the clinical characteristics and mortality rate of patients undergoing intermittent hemodialysis versus sustained low efficacy dialysis for acute kidney injury in intensive care units.

1.2 The significance of the study

This research provides data on AKI prevalence, clinical features, mortality rate, and survival recovery in patients treated with either IHD or SLED in the ICU. The findings of this study could help health care providers improve the quality of management of AKI patients in the ICU, resulting in a reduction in the mortality rate and an improvement in the level of survival during early assessment and treatment of complications.

1.3 Objectives

1) To determine the prevalence of survivals recovery (complete, incomplete, or not complete) among patients with AKI whom treated by IHD in the ICU`s at NNUH.

2) To determine the prevalence of survivals recovery (complete, incomplete, or not complete) among patients with AKI whom treated by SLED in the ICU`s at NNUH.

3) To assess the clinical characteristics among patients with AKI whom treated with IHD in the ICU`s within 30 days at NNUH.

4) To assess the clinical characteristics among patients with AKI whom treated with SLED in the ICU`s within 30 days at NNUH.

5) To assess the demographic data that affecting mortality of patients with AKI whom treated with IHD in the ICU`s within 30 days at NNUH.

6) To assess the demographic data that affecting mortality of patients with AKI whom treated with SLED in the ICU`s within 30 days at NNUH.

7) To assess complications among patients with AKI whom treated with IHD in the ICU`s within 30 days at NNUH.

8) To assess complications among patients with AKI whom treated with SLED in the ICU`s within 30 days at NNUH.

1.4 Research questions

1) What is the prevalence of 30-days of survivals among patients with AKI whom treated by IHD in the ICU`s at NNUH?

2) What is the prevalence of 30- days survivals among patients with AKI whom treated by SLED in the ICU`s at NNUH?

3) What are the clinical characteristics of survivals among patients with AKI whom treated with IHD in the ICU`s within 30 days at NNUH?

4) What are the clinical characteristics of survivals among patients with AKI whom treated with SLED in the ICU`s within 30 days at NNUH?

5) What are the demographic data that affecting mortality of patients with AKI whom treated with IHD in the ICU`s within 30 days at NNUH?

6) What are the demographic data that affecting mortality of patients with AKI whom treated with SLED in the ICU`s within 30 days at NNUH?

7) What are the complications (hypotension, hypokalemia, filter clotting, hypo-phosphotemia) among patients with AKI whom treated with IHD in the ICU`s within 30 days at NNUH?

8) What are the complications (hypotension, hypokalemia, filter clotting, hypo-phosphotemia) among patients with AKI whom treated with SLED in the ICU`s within 30 days at NNUH?

1.5 Hypothesis

1) There is no significant difference at (p = 0.05) level between IHD and SLED in the demographic data (age, gender, weight, height, BMI, educational status, marital status, smoking status and residency) that affecting mortality of patients with AKI at ICU.

2) There is no significant difference at (p = 0.05) level between IHD and SLED in the clinical characteristics* of patients with AKI at ICU.

Clinical characteristics: it include comorbidity (Diabetes mellitus, congestive heart failure, infectious status, degree of AKI, Systemic arterial hypertension, Acute Tubular Necrosis, hypovolemia, sepsis), characteristics of admission (type of ICU, timing of admission), Mechanical ventilator, vasoactive drugs use (initial and late dose), renal characteristics include (oliguria, fluid balance, urine output, diuretics, ICU to RRT length of stay in days, RRT modality (IHD and SLED) (B. Albino et al., 2018; De Corte et al., 2016). SOFA and APACHII.

3) There is no significant difference at (p=0.05) level between IHD and SLED in 30-days of survival among patients with AKI in ICU`s.

4) There is no significant difference at (p=0.05) level between IHD and SLED in reducing mortality rate among patients with AKI in ICU`s.

5) There is no significant difference at (p=0.05) level between IHD and SLED in reducing the dialysis complications (hypotension, hypokalemia, filter clotting, hypo-phosphotemia) among patients with AKI in ICU`s.

6) There is no significant difference at (p=0.05) level between IHD and SLED in Patient outcomes (Recovery of renal function and Chronic dialysis) among patients with AKI in ICU`s.

Chapter Two
Background

2.1 Definition of Acute Kidney Injury (AKI)

Initially, AKI is defined simply as the sudden decline of renal functions which characterized by some factors including decreasing in GFR over hrs to days, the increase of urea and creatinine, retention of fluid, electrolytes and acid base imbalance clinically as a result of three etiologies which will be discussed briefly (Lameire et al., 2005). Additionally, AKI can be defined as a sudden reduction (that occurs within hrs) in the functions of the kidneys that encompasses damage to structure (injury) and loss of functions (impairment to the functions). Therefore, AKI is a health condition that seldomly can be associated with a sole or distinctive pathophysiology. A considerable proportion of the patients who develop AKI have a mixed etiology. However, only the intrinsic AKI is the form of renal disease itself and the other divisions are related to extra renal diseases which lead to decrease in GFR (Makris & Spanou, 2016).

Many consensus-based definitions were developed to set uniform criteria that can be used to diagnose AKI (Machado, Nakazone, & Maia, 2014). The Acute Dialysis Quality Initiative (ADQI) group developed consensus-based guidelines and evidence-based treatment and prevention plan of AKI. These criteria were later labeled as the RIFLE (Risk, Injury, Failure, Loss and End-stage Kidney Disease) criteria (Risk, Injury, Failure, Loss and

End-stage Kidney Disease) (Bellomo, Ronco, Kellum, Mehta, & Palevsky, 2004).

Later, these criteria were modified by the Acute Kidney Injury Network (AKIN) which also include the ADQI group (Liang & Palevsky, 2018). Following modification, the AKI Network (AKIN) classification evolved from the RIFLE criteria. Both original RIFLE and the modified AKIN classification were merged to yield the Kidney Disease Improving Global Outcomes (KDIGO) classification (Ostermann & Joannidis, 2016).

According to Machado et al. (2014), the AKI study group of the KDIGO developed a modified definition of KI that combined the difference in the RIFLE and AKIN definitions (Machado et al., 2014). The RIFLE criteria are shown in Table .

Table 2.1: The RIFLE criteria proposed in 2002.

RIFLE	GFR criterion	Urine output criterion	Sensitivity or specificity
Risk	Rise in sCR by 1.5-fold + a decrease of GFR by ≥ 25%	U/O of less than 0.5 ml/kg/h over a period of 6 hrs	High sensitivity
Injury	Rise in sCR by 2-fold + a decrease in GFR by ≥ 50%	U/O < 0.5 ml/kg/h over a period of 12 hrs	
Failure	Rise in sCr by 3-fold, a decrease in GFR by ≥ 75%, or sCr ≥ 4 mg/dL (acute rise of ≥ 0.5 mg/dL)	U/O < 0.3 ml/kg/h over a period of 24 hrs or anuria over a period of 12 hrs	High specificity
Loss	Persistent ARF: complete loss of renal function for > 4 weeks		
End stage	End-stage kidney disease		

Table 2.2 : The AKIN Criteria proposed in 2005

Staging	sCr criteria	Urine output criteria
1	An increase in serum Cr by 0.3 mg/dL (26.4 μmol/L) or a rise of sCr from baseline by 1.5- to 2-fold	U/O < 0.5 ml/kg/h over a period of 6 hrs
2	A rise in sCr from the baseline by 2-fold	U/O < 0.5ml/kg/h over a period of more than 12 hrs
3	A rise in sCr from the baseline by 3-fold, a sCr of ≥ 4.0 mg/dL (354 μmol/L) with an acute increase ≥ 0.5 mg/dL (44 μmol/L), or a need for RRT	U/O < 0.3ml/kg/h for a period of 24 hrs or anuria over a period of 12 hrs

Table 2.3 : KDIGO Criteria

KDIGO Stages	sCr or eGFR increase	Urine output decrease
1	An increase in sCr from the baseline by 1.5–1.9-fold or 0.3 mg/dL (26.5 μmol/L)	U/O < 0.5ml/kg/h over a period of 6-12 hrs
2	An increase in sCr from the baseline by 2.0–2.9-fold	U/O < 0.5ml/kg/h over a period of > 12 hrs
3	An increase in sCr from the baseline by 3-fold, an increase in sCr by 4.0 mg/dL (353.6 μmol/L), or initiation of RRT	U/O <0.3 ml/kg/h over a period of 24 hrs or anuria over a period of 12 hrs

2.2 Etiology of AKI

Liang and Palevsky (2018) divided AKI into 3 distinctive broad types based on their pathophysiologic: these types are: a) pre-renal, b) intrinsic, and c) post-renal AKI (Liang & Palevsky, 2018). Pre-renal AKI occurs when the kidneys are less perfused (hypoperfusion of the kidneys) that is associated with reduced GFR in the absence of an overt damage to the parenchyma. Pre-renal AKI was shown to be associated with states of overt depletion of volumes and states in which the effective arterial blood volumes (EABV) are severely reduced. Cases of EABV are often seen in patients with heart failure, nephrotic syndrome, and hepatic cirrhosis.

Intrinsic AKI was shown to be associated with many disease conditions that affect the parenchyma of the kidneys. These disease conditions include acute tubular injury, acute glomerulonephritis, acute interstitial nephritis, and acute vascular syndromes like those seen in patients with atheroembolic disease conditions. Acute tubular necrosis (ATN) that results from sepsis, ischemia-reperfusion injury, or nephrotoxicity is the most common cause of intrinsic AKI. Post-renal AKI occurs as a result of acute obstruction of the urinary tract that causes a complete or partial obstruction of the urine flow.

Moreover, Basile et al. (2012) described the categories and etiology of AKI as an adequate renal perfusion means conserving normal GFR level, the kidney receives up to 25% of cardiac output, so pre-renal AKI described as decline in GFR as a result of low perfusion to the kidney without causing parenchymal damage (Basile, Anderson, & Sutton, 2012). Low perfusion caused by hypovolemia due to hemorrhage, vomiting, diarrhea, burns, cardiac disease like congestive heart failure and cardiac tamponade, decreased vascular resistance such as sepsis vasodilator medications or anaphylaxis, this etiology is treated with restoring renal perfusion. In addition, injury to the renal parenchyma causes renal or intrinsic AKI which can be further subdivided into glomerular, tubular, interstitial, and vascular processes according to the injured region of the nephron. The most common cause of this etiology is acute tubular necrosis (ATN) that account 85-90% and which include three categories: nephrotoxic, sepsis, and ischemia-reperfusion injury (Zaragoza & Renteria, 2017). Finally, Post-

renal etiology characterized by obstruction to the urinary tract as a result of benign prostatic hyperplasia, prostatic cancer, cervical cancer, ureteral stones, neurogenic bladder, which will lead to increased intra-tubular pressure, impaired renal flow result in low renal perfusion, in addition to inflammatory process and thus contributing to decrease in GFR. Urinary obstruction characterized by anuria or intermittent urine flow (Basile et al., 2012).

2.3 Biomarkers

Presence of AKI is often indicated by a reduced outflow of urine (< 400-500 mL/day) or a sustained reduced urine out flow (< 20 mL/h) in a patient with high risk in whom hypovolemia is present. According to the definition of the KDIGO, AKI is indicated by a urine outflow of less than 0.5 mL/kg/h for a period of 6 hrs (Khwaja, 2012).

Diagnosis of AKI is made based on biomarkers. AKI is diagnosed when the serum creatinine rises by 0.3 mg/dL (26.5 µmol/l), more over a period of 48 hrs or an increase from baseline by at least 1.5-time within 7 days, or urine outflow volume of < 0.5 mL/kg/h over a period of 6 hrs (Kellum et al., 2015).

AKI is staged based on the maximal change in biomarkers like serum creatinine level or urine outflow. These criteria were investigated in a large study that included more than 32,000 critically ill patients. The study showed that risk of death/renal replacement therapy (RRT) on both short-

and long-term were better predicted when the patients met both criteria and when abnormalities in the patient's biomarkers persisted over a period larger than 3 days (Kellum et al., 2015).

Ostermann and Joannidis (2016) subdivided AKI into 3 stages using the 2012 KDIGO definitions (Ostermann & Joannidis, 2016). AKI stage I: which is indicated by a rise in serum creatinine by 0.3 mg/dL (26.4 µmol/L), a rise in urine outflow from the baseline by 1.5-1.9-fold, or urine outflow of < 0.5 mL/kg/h over a period of 6-12 hrs (Ostermann & Joannidis, 2016). AKI stage II: which is indicated by a rise in serum creatinine from the baseline by 2.0–2.9-fold times or urine outflow of < 0.5 mL/kg/h over a period of 12 hrs. AKI stage III: which is indicated by a rise in serum creatinine from the baseline by 3-fold, serum creatinine level of 4.0 mg/dL (354 µmol/L), or treating the patient with RRT. In patients who are younger than 18 years old, a reduction in GFR to < 35 mL/min per 1.73 m, urine outflow of < 0.3 mL/kg/h over a period of 24 hrs, or anuria over a period of 12 hrs.

Despite the fact that urine outflow is an essential kidney function parameter that is used to identify patients who are at higher risk for incidence of negative outcomes, the pathophysiologic importance of this parameter in the absence of severe oliguria or other indicators of decreased GFR is still controversial. Additionally, it is important to note that patients who develop AKI using the KDIGO criteria for urine outflow regardless of whether the Scr criteria were present or not are at higher risk to develop

fluid overload, especially when the critically ill patients are typically subjected to higher fluid intake (Moore et al., 2018).

Globally, the GFR is the gold-standard marker used in the diagnosis and staging of both acute and chronic kidney disease conditions despite the fact that it is indicative of only one of the affected renal functions. It is important to note that the GFR is rarely, if any, directly measured in clinical settings. However, other biomarkers are often used as surrogates of the kidney functions in clinical settings. Today, the eGFR equations developed in Cockcroft-Gault, MDRD Study, and CKD-EPI cannot be used, especially, when the creatinine levels are not at steady-state as in AKI. These equations were proposed as to allow estimation of the kinetics of GFR when the Scr levels actively change. It is noteworthy mentioning that these equations were not validated for large scale use. For patients with severe AKI (oligoanuric patients), the GFR should be assumed to be < 10 mL/min to indicate a minimal urine outflow (Moore et al., 2018).

2.4 Risk Factors

Several risk factors associated with death of critically ill patients with AKI were reported in the literature. These risk factors include long hospitalized periods, older age, higher score on the Acute Physiology and Chronic Health Evaluation (APACHE II) scale, incidence of sepsis, presence of metabolic acidosis, oliguria, hypovolemia, comorbidities, multiple traumas, use of vasoactive drugs, use of invasive mechanical ventilation (Palevsky, 2006).

Additionally, the literature reported many risk factors for requiring RRT for patients with AKI. These risk factors include being of male gender, older age, being of African-American origin, higher severity of the kidney dysfunction, presence of sepsis, cardiac surgery, decompensated heart failure, liver failure, and use of invasive mechanical ventilation (Hsu, McCulloch, Dudley, Lo, & Hsu, 2013).

2.5 Management of patients with AKI

In both, critically ill and conservative patients with AKI, pharmacological therapy is initiated to delay the progress of AKI and/or improve recovery of the kidney functions. In case the therapy was ineffective, the management remains supportive with focus on improving the fluid balance and prevention of electrolyte and/or acid-base imbalance. Doses of drugs are often adjusted to avoid nephrotoxicity. In about 4% of the patients with AKI, RRT is often required (Uchino et al., 2005).

Many factors determine the ideal RRT for critically ill patients with AKI. These factors include adequate control of solutes, ability to achieve the goals of ultrafiltration without hypotensive states, ability to achieve satisfactory patient outcomes, higher acceptance rate by the caring personnel, simplicity of the procedure, low financial costs, schedules, and allowing access to daytime procedures and laboratory tests (Marshall, Golper, Shaver, Alam, & Chatoth, 2001).

There is controversy about the optimal treatment of AKI regarding modality, dose, and appropriate timing of RRT. RRT for patients with AKI can be subdivided into: intermittent or continuous modalities depending on the duration of the procedure and treatment. Intermittent therapy has a duration of < 4 hrs whereas continuous therapy has a duration of at least 4 hrs or more. Intermittent RRT (IRRT) includes: a) intermittent hemodialysis (IHD) and b) sustained low-efficiency dialysis (SLED). SLED is a hemodialysis procedure that is performed using a conventional dialysis machine over a longer period of time (about 5 hrs). Worldwide in ICU settings, the standard RRT is IHD. However, surveys showed significant variations in the patter of RRT use around the world. Recently, the use of SLED has increased significantly due to its convenience and lower financial costs when compared to continuous renal replacement therapy (CRRT) (Kim & Oropello, 2017).

The currently used RRT modalities for patient with AKI include IHD, CRRT, SLED, high-volume peritoneal dialysis, and hybrid modalities. Studies have failed to demonstrate which method of RRT was superior for patients with AKI. However, all methods have several advantages and disadvantages (Schiffl & Lang, 2013). In the absence of consensus on the ideal RRT for patients with AKI and high-quality evidence for the ideal time to initiate RRT, in clinical practice, selection of the RRT method depends on the etiology, severity, clinical manifestations, comorbidities, and presence of risk factors (Judd & Tolwani, 2017).

IHD is one of the RRT models that is characterized by a high intensity treatment that allows more rapid correction of life-threatening abnormalities which depend on diffusion for the solute clearance over short time interval which is done from 3-6 times a week over 2-4 hrs per session, blood flow rate is 200-300ml/min and dialysate flow rate 500-800 ml/min. The most serious complication of it is hypotension 20-30% of all treatments (Schoenfelder, Chen, & Bleß, 2017).

IHD and CCRTs are associated with several advantages and disadvantages. For example, IHD is more classical technique, therefore, nephrologists and nursing staff are more familiar with this technique. However, modern machinery used in IHD allowed precise control over volumetric ultrafiltration and online production of bicarbonate dialysate. IHD has the advantages of high intradialytic clearance of solutes, allows short treatment periods, and enables patients to go out of the dialysis unit to undergo therapeutic and/or diagnostic procedures. On the other hand, hemodynamic instabilities in critically ill patients as a result of ultrafiltration of substantially large fluid volumes within a short treatment period limit removal of fluid overloads (Mehta, 1997).

For adult patients with AKI who are hemodynamically unstable, sustained low-efficiency diafiltration (SLEDf) which is a hybrid RRT can be used. This method has the advantages of the conventional HD and those of slow contentious methods. SLED makes use of a conventional dialyzer to provide sustained RRT through decreasing the flow rates of dialysate and

blood. In SLED, the therapeutic objectives are achieved through diffusion, convention, and ultrafiltration (Kitchlu et al., 2015). On the other hand, SLEDf has emerged as a novel hybrid RRT to improve removal of large solutes and increase removal rates on the basis of sustained, slow, and low efficiency hemodiafiltration. This can optimize hemodynamic stability and reduce disequilibrium of solutes (Sinnollareddy, Roberts, Lipman, Peake, & Roberts, 2018). SLED has emerged as a cost-effective surrogate to CRRT. SLED has been associated with low costs and less technical complications compared to CCRT (Silva et al., 2017). The features of SLED include performing dialysis over a period of 6-12 hrs per session for 3-6 times per week. The rate of blood flow ranges from 70-250 mL/min and the rate of dialysate flow ranges from 70-300 mL/min (B. Albino et al., 2018).

2.6 Complications

Several complications were reported among in critically ill patients with AKI as a result of dialysis. These complications include hypophosphatemia, hypokalemia, hypotension, and thrombosis (Berbece & Richardson, 2006; Sherman, Daugirdas, & Ing, 2007; Shingarev, Wille, & Tolwani, 2011). Studies have shown that hypotension was the most common complication of dialysis which occurs in more than 20% of patients with AKI (B. B. Albino et al., 2014). In their systematic review, Douvris et al. (2018) showed that hemodynamic instabilities related to RRT (HIRRT) were common among critically ill patients with AKI (Douvris et

al., 2018). HIRRT occur in approximately 30–70% of patients with AKI who are treated with IHD in the ICU. HIRRT was also a common complication of other modalities of RRT, especially, SLED and CRRT.

2.7 Procedure

At ANNH, HD is performed by using SW9.1x dialysis machine which is characterized by surface area of dialyzer is 15m, 18m, 20m. The IHD & SLED characteristics are provided in Table :

Table 2.4 : IHD & SLED characteristics.

Characteristic	IHD	SLED
Session duration	2-4 hrs	6-12 hrs
Frequency	3-6/W	3/W
Blood flow	300ml/min	200ml/min
Dialysate flow	500ml/min	300-400ml/min
Hemodynamic status	Unstable	Unstable
Volume overload	6L	2L
Heparin dose	5000IU	2000IU

2.8 Monitoring

Every patient underwent the treatment of AKI with IHD and SLED must be monitored for the following: demographic data, previous history, APACHE II score, Sequential Organ Failure Assessment score (SOFA), mechanical ventilation, and vasoactive drugs (initial and final dose), indications for dialysis, parameters that were measured pre- post-dialysis during three session, laboratory parameters pre-post-dialysis during three session, complications of RRT during three session, renal outcomes survival that are complete recovery, partial recovery and none recovery (B. Albino et al., 2018; Koeze et al., 2017).

Chapter Three
Literature Review

This chapter discusses different studies that discussed the critical ill patients whom diagnosed with AKI whom treated with either IHD or SLED whom were admitted to the ICU.

Abd El Hafeez, et al (2017) conducted a study in Egypt to evaluate the risks for and prognosis of AKI in patients admitted to the ICU (Abd ElHafeez et al., 2017). Consecutive adult patients who were admitted to the ICU, Alexandria Teaching Hospitals over a period of 6 months were recruited. AKI was defined a per the KDIGO criteria. Participants were followed until earliest discharge from the ICU, death, a period of 30 days from inclusion in the study, or to the end of the study. In their study, 532 patients were included. The median age was 45 (Interquartile range [IQR]: 30–62) years, 41.7% were male, and 23.7% had diabetes. Of those, 39.6% had AKI upon admission to the ICU and 37.4% developed AKI 24 hrs after their admission to the ICU. Having AKI upon ICU admission was predicted by use of diuretics, presence of sepsis, and low educational level. Developing AKI after admission to the ICU was predicted by APACHE II scores. Of the patients, 120 (22.6%) died during the follow up period (30 days). Mortality rates were more prevalent in patients who had AKI upon entry compared to those who had not. The risk for developing AKI was high in critically ill patients and a predictor of poor outcomes.

A study was conducted by Kwizera et al. (2016) in Kampala, Uganda to determine the results of IHD among critically ill patients admitted to the ICU (Kwizera et al., 2016). In this study, authors reviewed the patient records retrospectively. Patients with AKI who were admitted to the ICU and received IHD were included in this study. Authors analyzed demographics of the patients, their clinical variables, laboratory findings, etiology of AKI, hemodialysis variables, and survival rates. In this study, mortality rate was the primary outcome. The results showed that 40 patients had complete registers. The patient's median age was 38.5 years. Results found that the etiology distributed for sepsis 82%, malaria 32% and use of vasopressors 57.5%. In addition, mean APACHE score was 24.5, the majority of patients were with no complications but some were with hypotension in 22.5% of patients and anemia in 17.5%. On the other hand, the outcomes were identified as survivors in 47.5% and non-survivors in 57.5%. The mortality rate was 52.5%. APACHE II, mechanical ventilation and need for vasopressors were statistically significantly associated with mortality. The authors concluded that IHD may be a viable option for RRT in critically ill hemodynamically stable patients in low-resource settings where CRRT may not be available.

Another retrospective study which was done in Canada and performed by Wald et al. (2014), which the major purpose was to determine whether the use of CRRT or IHD is with lower risks for chronic dialysis among survivors (Wald et al., 2014). The results of this study were concluded according to the need for chronic dialysis which was higher when treating

patients with IHD reached to 17% and the risk was reduced when treating patients with CRRT reached to 8%. In addition to the risk of death, it showed similar mortality rate among the patients whom were treated with CRRT result in 11.2%/100 persons/year while whom treated with IHD was 11.4%/100 persons/year. This study had bias when they identified the use of SLED as IHD without differentiating between the two types of modalities by considering both modalities as one.

Peres et al. (2015) conducted a study to analyze the clinical variables and outcomes of patients with and without AKI. The study evaluated incidence of AKI, mortality rates, and predictors of mortality among patients admitted to the ICU (Peres, Wandeur, & Matsuo, 2015). In this retrospective study, 152 patients who were admitted to a single ICU were included. The variables collected included gender, age, cause of admission to the hospital, risks for ARF, laboratory findings, need for RRT, and mortality. Authors recorded APACHE II, SOFA, and RIFLE scores for the patients on the first day of ICU admission. Logistic regression was used to determine predictors of mortality and incidence of AKI. The mean age of the patients was 57.1 ± 20 years and 60.1% of the patients were male. Non-dialysis dependent AKI was prevalent in 81 patients (53.2%) and patients with ARF who required dialysis were 19 (12.4%). The overall mortality rate in the ICU was 35.9%. Multivariate analysis showed that AKI was predicted by mechanical ventilation, high creatinine and urea levels at admission. ICU mortality was predicated by mechanical ventilation,

clinical diagnosis, high lactate, urea, and sodium levels. The study concluded that mortality among patients with AKI in ICU was high.

A Korean retrospective cohort study performed by Hwang et al. (2019) that was aimed to assess the prevalence of epidemiological changes, mortality rate and clinical characteristics of critically ill patients in the ICU`s (Hwang et al., 2019). The sample was included 1744235 patients whom were 18 years or older were admitted to the ICU for the first time without dialysis history or AKI or any admission to ICU in the year before admission. The study results were summarized as (1) the prevalence of AKI in the population reached to 8% while the prevalence of patients whom treated with RRT was 20.4%, (2) according to mortality rate which was reduced from 32.7% to 28% in 2008 to 2015 for patients treated with RRT regardless to the modality which was chosen for treatment and whom did not treated to 41.7% to 40.9%. The mean age was 64.2 years and more common were among males 57.4% who had more co morbidities and organ dysfunction which devoted to prolonged hospitalization and elevated medical costs, (4) also the need for mechanical ventilation was 22.1% while the use of vasopressors were 11.3%.

A Brazilian retrospective study review that was carried out by do Nascimento et al. (2012) that designed to evaluate mortality rate and renal function recovery for critically ill patients with AKI whom treated with dialysis (do Nascimento, Balbi, Ponce, & Abrão, 2012). The inclusion criteria of this study was patients older than 18 years old were suffering

from AKI as a result of ATN, they divided the patients into two groups according to the BUN levels as G1with BUN < 75 mg/dl and G2 the BUN > 75 mg/dl. Also they defined the renal recovery as complete or partial according to the absent need for dialysis after 30 days of follow up. The results of the study were summarized as hypervolemia in G1= 65.2% and G2= 14.3%, there were no differences among dialysis modalities PD was in G1= 52.8% and G2=68.2%, IHD was 43.5% in G1 and 20.7 in G2, in general the mortality rate was 61.6% while the survivals were 71.4% in G1 and 36.8% in G2. So this study approved that when the dialysis regardless to the modalities which were chosen started early, it carried out low mortality rate with higher renal recovery.

De Corte et al. (2016) conducted a cohort study among patients with AKI in a single center (the ICU of Ghent University Hospital) over a period of 8 years (De Corte et al., 2016). The study aimed to identify the characteristics that were associated with long-term survival rate and renal outcomes and to evaluate major adverse kidney events (MAKE) that was used as a composite endpoint. In this study, MAKE was defined as mortality, incomplete recovery of kidney functions, or developing end-stage kidney disease that was treated with RRT. The appropriate modality to the RRT was selected on the views of the intensivist and nephrologist that were based on the clinical status on the patient, fluid balance, acid-base balance, and respiratory status. The data were extracted from the databases of the hospital which were reviewed prospectively during the hospital stay of the patient. Data generated during follow-up consultations were used to collect

long-term data. Findings of the study showed that AKI-RRT was required for 1292 of 23,665 patients (5.5%) who were admitted to the ICU. With regard to the mortality rate, there was an increase in the rate from 59.7% at the hospital discharge to 72.1% at 3 years of follow-up. The hazard models used showed associated between mortality on the long term with older age, severe illness, and use of CRRT. Of the patients who survived as determined by creatinine measurement, complete renal recovery on the first year was observed in 48.4% and incomplete recovery was observed in 32.6% of the patients. Of the patients, 19.0% were dependent on dialysis. This dependence was associated with older age, diabetic patients, presence of chronic kidney disease, and presence of oliguria when the RRT was initiated. There was a rise in MAKE from 83.1% at hospital discharge to 93.7% at 3 years of follow up. Regression analysis showed absence of association between MAKE at 1 year and preexisting chronic kidney disease, the time on which RRT was initiated, and the modality of the RRT which were classical outcomes. In this study, authors concluded that the long-term survival rate among patients with AKI-RRT was poor and associated with severe illness, modality of the RRT, and timing of RRT initiation. Recovery was limited especially in patients with acute/chronic renal disease. This makes nephrological follow ups necessary to improve survival of patients.

Albino et al. (2014) conducted a prospective randomized clinical trial in Brazil (B. B. Albino et al., 2014). The objective of this study was to assess complications of hemodialysis that can occur during the different periods

of extended daily dialysis sessions among critically ill patients with AKI. The patients included in this study were older than 18 years, had AKI with sepsis, admitted to the ICU, and used noradrenalin in doses within the range of .3 to 0.7 μg/kg/min. The patients were randomly subdivided into 2 groups: a) those who received 6-hrs sessions (n = 38) and b) those who received 10-hrs sessions (n = 37). Of the patients, 75 received 195 EDD sessions during a period of successive 18 months. This study showed that the two groups whom were involved were similar in the complications intra and post dialysis which were summarized into hypotension was the serious one 82.6% followed by filter clotting of 25.3%, then hypokalemia of 20% and hypophosphatemia of 10.6%. Also, it indicates similar results for both groups related to metabolic and fluid balances, similar values of biomarkers besides similar doses (initial and final) of nor-adrenaline which increased according to the need for BP control. They found that post-dialysis complications occurred less constant than intra-dialysis and no significant change between the involved two groups. However, the patients who received 10-hrs sessions showed larger resistance to clinical measures for hypotension. Additionally, the dialysis sessions were discontinued more commonly in those patients. The fluid balance and metabolic control were equal between the 2 groups of patients. The study concluded that the intradialysis hypotension was prevalent among patients with AKI who were treated with EDD. Additionally, there was no significant differences in the incidence of complications of dialysis among patients who undergo EED for different durations. So, this study considered that the dialytic control of

the critically ill patients with AKI is complex because of the multiple organ dysfunction and hemodynamic instability which is correlated to high mortality rate reach to 50-70 %.

Albino et al. (2018) conducted a trial in Brazil (B. Albino et al., 2018). The aim of the study was to assess rates of mortality and recovery of kidney functions in patients with AKI who were managed with prolonged hemodialysis (PHD) sessions (6-hrs vs. 10-hrs). Patients with sepsis-associated AKI who were > 18 years, using norepinephrine (less than 0.7 ug / kg / min) were included. They considered criteria to initiate dialysis based on BUN level> 100mg/dl, fluid overload, potassium >6mEq/L, bicarbonate < 10mEq/L. In this study, 194 patients who were received 531 PDH sessions (G1 = 104 and G2 = 90 patients) were included in this study. The 2 groups included in this study had comparable age and SOFA scores. Significant differences were absence in terms of hypokalemia, hypotension, and use of anticoagulants during the PHD sessions. The 2 groups of patients showed differences in hypophosphatemia, coagulation, and interruptions of treatments. Significant differences were absence in terms of fluid balance (FB) before and after PHD sessions. Mortality and recovery of kidney functions were similar between the 2 groups. Logistic regression showed that positive FB before and after the dialysis sessions was a risk factor for mortality. Additionally, volume overload after 3 PHD sessions and the pre-dialysis creatinine level were negatively associated with recovery of kidney functions at 28-days. They summarized the study results as the main outcomes was death appeared in 81.7% of the sample,

renal recovery measured as survivors whom divided into complete recovery was in 25.7%, partial recovery in 68.5% and non-recovery in 5.7%. According to the metabolic and electrolyte status were assessed after the first three sessions with reduction in the values and varies between the two groups. According to the complications the main one was hypotension which occurred in 50% of the sessions treated with low temperature of dialysate, high sodium concentration and UF not more than 500 ml/h. The second complications were filter clotting and discontinuation of treatment in the same prevalence which occurred in 11.2% and related to the long duration of treatment that made the patients more susceptible for these complications. Hypokalemia and hypophosphatemia were post dialysis complications. The authors concluded that differences in mortality and recovery of kidney function rates among patients with AKI who were exposed to different durations of PHD and sessions lasting 10 hrs showed higher filter coagulation, hypophosphatemia and treatment discontinuations.

A study was conducted by Zhao et al. (2020), this study aimed to assess differences in the rates of mortality and recovery of kidney functions among patients with AKI who were treated with different types of RRT (CRRT/ SLED/ IHD) (Zhao & Chen, 2020). This study systematic review with meta-analysis demonstrated that the rates of in-hospital mortality, ICU mortality, and recovery of kidney functions among patients with AKI who received CRRT or SLED were not statistically different. The study also showed that rates of in-hospital mortality were not statistically different

between patients with AKI who received CRRT or IHD. However, patients who received CRRT had significantly higher mortality rates comparted to patients who received IHD.

Another study of 91 patients with AKI treated with SLED in a tertiary hospital from January 2014 to august 2018, a retrospective nature was conducted by Phongphitakchai et al. (2020) (Phongphitakchai & Boonsrirat, 2020). The study aims to evaluate survival, pre-SLED predictors and complications associated with SLED. The primary outcomes were in-hospital and 30-day mortality. The secondary outcomes were the clinical and laboratory pre-SLED characteristics that were associated with survival and complication of SLED. The result included Approximately half of the AKIs were caused by acute tubular necrosis (ATN) and the most common comorbidity was sepsis. Almost all of the patients required mechanical ventilator and vasopressor. The 30-day mortality rate in AKI patients treated with SLED was 58%. Arrhythmia was found 3.3% and intradialytic hypotension in 13.2% of patients. No patient had bleeding complications.

Another cohort study was conducted by Kitchlu, et al. (2015). The study aimed to compare outcomes of patients who received SLED (target 8 h/session, blood flow 200 mL/min, predominantly without anticoagulation) with patients who received CRRT in 4 ICUs (Kitchlu et al., 2015). Mortality rates at 30 days following initiation of RRT was used as the primary outcome. This primary outcome was adjusted for the

sociodemographic variables, presence of comorbidities, renal function at the baseline, and SOFA score. In this study, long term dependence on RRT at 30 days from the initiation and increase in the SOFA scores or death of the patient (which were used as signs of clinical deterioration) were used as secondary outcomes. The all-cause mortality rates at 30 days were 54% for patients who received SLED and 61% for patients who received CRRT. The short-term recovery of renal function was comparable between the treatment methods. The secondary outcomes were not statistically different between the two groups which included the adjusted risk of dependence on RRT at 30 days and sings of clinical deteriorations within 48 hrs following the initiation of RRT. Additionally, the cumulative fluid removal at 7 days was not statistically different between the treatment methods.

Chapter Four
Methodology

In this chapter, the methods used in the study which include: the study design, settings/site, study population, sample size/sampling method, eligibility/exclusion criteria, data collection procedures, validity/reliability, ethical approval, fieldwork, and analysis of the data.

4.1 Study Design

A retrospective cohort study design was used to achieve the aims of study to determine 30-days of survival, the clinical characteristics, the dialysis complications, mortality rate and patients' outcomes in patients undergoing intermittent hemodialysis versus sustained low efficacy dialysis for acute kidney injury in intensive care units.

This study was included all patients with AKI who treated via IHD and SLED in ICU`s at An-Najah National University Hospital (NNUH) in the period of January 2016 to January 2020. Also, a retrospective review was conducted for the electronic patient systems and medical records from the patients' files.

4.2 Population

This study was included all patients with AKI who treated via IHD and SLED in January 2016 to January 2020 in the ICU`s (Medical ICU, Surgical ICU, and Coronary Care Unit (CCU)) at NNUH in Nablus in the Northern of West Bank- Palestine.

4.3 Study Site and Setting

The study was performed at NNUH which is an academic non-profit medical institution that was established in the year 2013 in collaboration with the faculty of medicine and health sciences at NNU. The hospital consists of 120 beds in general and ICUs contain 18 beds in particular that include the following ICUs (surgical, Medical and Coronary which are receiving patients from all over the nation-the West Bank and the Gaza strip). The NNUH is considered the sole teaching university hospital in Palestine that provides clinical education/training to future and current health providers.

4.4 Sample size and Sampling

The calculation of the sample size was based on a study conducted by Kwizera et al. (2016) (Kwizera et al., 2016). This study showed that the median APACH II ≥ (24) is n (%) 13 (61.9) in patients who did not survive compared to 5 (26.3) in patients who survived Table4-1.

The calculation was performed using the Sample Size Calculator (clincalc.com). We need 58 patients. We took all patients who met the inclusion criteria. There were only 50 patients. As these types of treatment were started at the hospital since 2016.

Table 4.1: Multivariate analysis of the risk factors that can be used as predictors of survival and non-survival in AKI.

	Non-survivors	Survivors		
	n (%)	**n (%)**	**Odds (95% CI)**	**p value**
APACHE II > median (24)	13 (61.9)	5 (26.3)	4.550 (1.181 - 17.524)	0.028
Mechanical ventilation	19 (90.5)	8 (42.1)	13.063 (2.343 - 7.818)	0.003
Use of vasopressors	18 (85.7)	5 (26.3)	16.854 (3.416 - 82.602)	0.001
ARDS			3.733 (0.979 - 14.222)	0.054

Sample was nonprobability- a purposive sample, which contained all patients with age > 18 years and < 60 years, and approximately was included 50 patients whom was divided into two groups retrospectively (Figure), 25 patients whom treated with IHD (short period of time 2-4 hrs in 3-4 times per week) and the other 25 patients with SLED (longer period of time 4-6 hrs in 3-6 days per week).

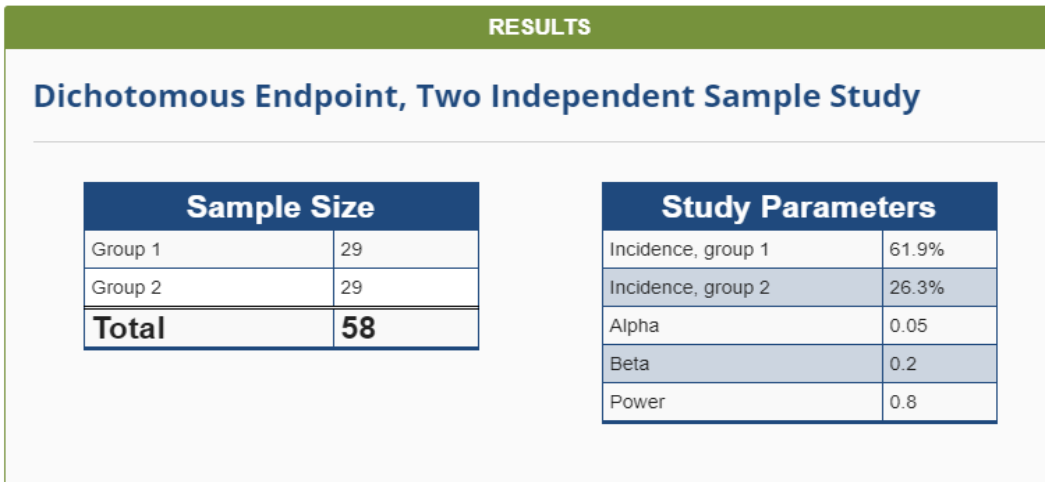

Figure 4.1: Sample size calculation

4.5 Eligibility criteria

4.5.1 Included criteria

1) Patients' ages ranged between 18-60 years regardless of gender.
2) Patients who have AKI treated with either IHD or SLED.

4.5.2 Excluded criteria

1) Patients with End Stage Renal Disease (ESRD).
2) Patients treated with PD or CRRT.
3) Patients with kidney transplantation.
4) Patients whom are suffering from cancer.
5) single kidney patients.

4.6 Variables

4.6.1 Independent variables

- Patient demographics (age, gender, weight, height, BMI, educational status, marital status, smoking status and residency).
- Previous history of the patient (systemic arterial hypertension (SAH), type of diabetes mellitus (DM), congestive heart failure (CHF), sepsis, hypovolemia, infectious status, acute tubular necrosis (ATN)).
- Mechanical ventilation, and vasoactive drugs (initial and final dose).
- Biochemical in addition to hematological variables at the onset of hemodialysis.
- Sequential Organ Failure Assessment score (SOFA).

- Acute Physiology, Assessment, Chronic Health Evaluation scores (APACHE).

4.6.2 Dependent variable

- Clinical characteristics (length of stay, admission to ICU`s).
- Patient survival and mortality rates were collected at 30 days following the initiation of renal support. Renal survival was defined as the patient becoming dialysis-free, or incomplete survival at 30 days after initiation of renal support.

4.7 Data collection procedure

The study was received approval from the institutional review board (IRB) **(provided in Annex 2)** of An-Najah National University (NNU). Approval was obtained **(provided in Annex 3)** based on a permission of research committee of NNUH to facilitate the conduction of the study.

All patients consecutively with AKI who received either IHD or SLED at the period of January 2016 to January 2020 was recruited into the study. The medical records were retrospectively reviewed for every patient from the patients hospital information system and complementary data was filled from patient’s medical file referring to archives under strict confidentiality after obtaining the approval by hospital administration.

Data sheet was structured by the author based on the previous literature (B. Albino et al., 2018; Koeze et al., 2017).

The data sheet divided into different parts (**Annex 1**):

- Part one: includes demographic data that are age, gender, weight, height, BMI, educational status, marital status, smoking status and residency.
- Part two: includes previous history of the patient that is systemic arterial hypertension (SAH), Type of diabetes mellitus (DM), congestive heart failure (CHF), sepsis, hypovolemia, infectious status, acute tubular necrosis (ATN), Acute Physiology, Age, Chronic Health Evaluation score Acute Physiology And Chronic Health Evaluation **II** (APACHE II), Sequential Organ Failure Assessment score (SOFA), mechanical ventilation, and vasoactive drugs (initial and final dose).
- Part three: includes indications for dialysis which are azotemia with uremic symptoms, oliguria, anuria, fluids over load, electrolytes imbalance, acid base imbalance, and rhabdomyolysis.
- Part four: includes parameters that will be measured pre- post-dialysis: weight (wt.), blood pressure (BP), pulse (P), peripheral capillary oxygen saturation (SPO2), temperature (Temp), fluid balance (FB), and ultrafiltration rate (UF).
- Part five: includes laboratory parameters pre-post-dialysis: serum creatinine (sCr), potassium (K), bicarbonate (Bic), PH, blood urea nitrogen (BUN), hemoglobin (Hb), partial thromboplastin time (PTT), international normalized ratio (INR), white blood cells (WBC), platelet (PLT), red blood cells (RBC).

- Part six: includes complications of RRT include hypotension, filter clotting, hypokalemia, hypophosphatemia, use of anti-coagulant, and treatment discontinuation.
- Part seven: includes Renal outcomes survival that are complete recovery, partial recovery and non-recovery.

The severity of illness will be assessed according to APACHE II score based on data recorded on the admission time, and at the time of initiation of dialysis. In addition, the severity of the dysfunction of organs will be assessed by SOFA score, and length of stay in ICU and hospital.

This study will be included two cohorts:

Cohort one: include patients were treated with IHD less than 4 hrs.

Cohort two: include patients were treated with SLED from 4-6 hrs.

4.8 Validity and reliability of the study data sheet:

The data sheets used in the data collection were reviewed by an expert panel composed of one intensivist, three intensive care nurses, one nephrologist and a statistician. The data sheets were reviewed for clarity, accuracy of the measured data, and interpretability which provided a content validity. After essential revision, the data sheets became ready for used. The reliability was checked through performing Cronbach Alpha.

4.9 Pilot testing

A pilot study was conducted to test data collection instruments (5 data sheets), recruitment strategies to prepare for a larger study. A pilot study was conducted to identify potential problem areas. There were no changes, therefore data sheets (No. 5) were included in the study.

4.10 Ethical considerations

The study was endorsed by the Institutional Review Board (IRB) of An Najah National University (NNU). The study adheres to the World Health Organization Declaration of Helsinki for Medical Research on People (World Medical Association (2013). Then the hospital permission approval was obtained to conduct the study. In addition, all the participants in the study were named by code to keep anonymity and confidentiality for all patients. Two observers were collectively checking the mentioned resources with speaking out loud to avoid error, then they filled the data sheet with various information.

4.11 Statistical analysis

Data were entered and analyzed using IBM SPSS v.21.0 (IBM, Armonk, New York). Data were assessed for normality of distribution using Kolmogorov Smirnov Statistics. Because the data were not normally distributed, the data were presented as medians with their interquartile range (IQR). Categorical data were compared using Chi-squared test or Fisher’s exact test. Continuous data were compared using either Mann-

Whitney U test or Kruskal Wallis test as appropriate. Spearman's rho was used to investigate correlations. The p value of ≤ 0.5 was considered statistically significant.

Chapter Five
Results

This chapter describes the results of the study.

5.1 Characteristics of the study patients

This study included patients with AKI who were treated with SLED (n = 25) and IHD (n = 25) at the ICU of NNUH. Detailed characteristics of the patients are shown in **Error! Reference source not found.**. Of the patients, 66% stayed in the hospital for 7 or more days, 80% were 50 years and older, 68% were male in gender, 52% had a BMI of less than 33, 68% had either basic or secondary education, 80% were smokers, 80% were married, 92% had systemic arterial hypertension, 66% had diabetes mellitus, 54% had chronic heart disease, 12% had sepsis, 14% had hypovolemia, 10% had infection, 2% had acute tubular necrosis, 17 (36%) had APACH II. score (mortality) of 25 (53%) and above and 70% had SOFA score (mortality) of 9 (40%) and higher, 66% were on mechanical ventilation, 40% received vasoactive drugs, 58% had oliguria, 34% had anuria, 100% had azotemia with uremic symptoms, 76% had fluid over load, 64% had electrolyte imbalance, 48% had acid base imbalance, 24% had rhabdomyolysis, 56% had hypotension, 32% had filter clotting, 22% had hypokalemia, 38% had hypophosphatemia, 58% used anticoagulants, 30% had their treatment discontinued, 13/50 (26%) completely recovered, 14/50(28%) partially recovered, 11/50 (22%) did not recover (progressed to kidney failure) and 12/50 (24%) died.

5.2 Association between method of treatment and different patient characteristics

Pearson Chi-Square or Fisher's Exact test showed that patients who were treated with SLED stayed significantly longer duration at the hospital (p value = 0.36), were older (p value = 0.037), had higher BMI (p value = 0.01), had systemic arterial hypertension (p value < 0.039), had diabetes (p value < 0.037), had chronic heart disease (p value < 0.022), had higher APATCHE II score (p value < 0.038), had filter clotting (p value < 0.001), used anticoagulants (p value < 0.004), and were less likely to recover (p value < 0.022). Death did not differ between the two treatment methods. Details of these associations are shown in **Error! Reference source not found.**. However, other variables were not significantly associated as shown in table 5.1.

Table 5.1: Characteristics of the study patients and associations between method of treatment and different patient characteristics.

Variable	**SLED**		**IHD**				**Pearson Chi-Square/Fisher's Exact Test**	**p-value**
	n	**%**	**n**	**%**	**N**	**%**		
Length of hospital stay								
< 7 days	5	10	12	24	17	34.0	4.37	0.036
≥ 7 days	20	40	13	26	33	66.0		
Age								
< 50 years	2	4	8	16	10	20.0	4.50	0.037
≥ 50 years	23	46	17	34	40	80.0		
Gender								
Male	16	32	18	36	34	68.0	0.37	0.762
Female	9	18	7	14	16	32.0		
BMI								
< 33	8	16	18	36	26	52.0	8.01	0.010

Variable	SLED		IHD				Pearson Chi-Square/Fisher's Exact Test	p-value
	n	%	n	%	N	%		
≥ 33	17	34	7	14	24	48.0		
Education		0		0				
Basic education	13	26	6	12	19	38.0	4.50	0.124
Secondary education	5	10	10	20	15	30.0		
University	7	14	9	18	16	32.0		
Smoking status								
No	4	8	6	12	10	20.0	0.50	0.725
Yes	21	42	19	38	40	80.0		
Marital status								
Single	2	4	4	8	6	12.0	0.88	0.869
Married	21	42	19	38	40	80.0		
Divorced/widowed	2	4	2	4	4	8.0		
Systemic arterial hypertension								
No	0	0	4	8	4	8.0	4.26	0.039
Yes	25	50	21	42	46	92.0		
Diabetes mellitus								
No	5	10	12	24	17	34.0	4.37	0.037
Yes	20	40	13	26	33	66.0		
Chronic heart disease								
No	7	14	16	32	23	46.0	6.52	0.022
Yes	18	36	9	18	27	54.0		
Sepsis								
No	22	44	22	44	44	88.0	0.00	1.000
Yes	3	6	3	6	6	12.0		
Hypovolemia								
No	23	46	20	40	43	86.0	1.47	0.417
Yes	2	4	5	10	7	14.0		
Infection status								
No	22	44	23	46	45	90.0	0.22	1.000
Yes	3	6	2	4	5	10.0		
Acute tubular necrosis								
No	25	50	24	48	49	98.0	1.00	1.000
Yes	0	0	1	2	1	2.0		
APATCHE II								
< 25 (53%)	12	24	20	40	32	64.0	5.56	0.038
≥ 25 (53%)	13	26	5	10	18	36.0		

Variable	SLED		IHD				Pearson Chi-Square/Fisher's Exact Test	p-value
	n	%	n	%	N	%		
Sequential organ failure assessment score								
< 9 (40%)	9	18	6	12	15	30.0	0.86	0.538
≥ 9 (40%)	16	32	19	38	35	70.0		
Mechanical ventilation								
No	7	14	10	20	17	34.0	0.80	0.551
Yes	18	36	15	30	33	66.0		
Vasoactive drugs								
No	14	28	16	32	30	60.0	0.33	0.773
Yes	11	22	9	18	20	40.0		
Oliguria								
No	11	22	10	20	21	42.0	0.08	1.000
Yes	14	28	15	30	29	58.0		
Anuria								
No	14	28	19	38	33	66.0	2.23	0.232
Yes	11	22	6	12	17	34.0		
Fluid overload								
No	4	8	8	16	12	24.0	1.75	0.321
Yes	21	42	17	34	38	76.0		
Electrolyte imbalance								
No	8	16	10	20	18	36.0	0.35	0.556
Yes	17	34	15	30	32	64.0		
Acid base imbalance								
No	11	22	15	30	26	52.0	1.28	0.396
Yes	14	28	10	20	24	48.0		
Rhabdomyolysis								
No	20	40	18	36	38	76.0	0.44	0.742
Yes	5	10	7	14	12	24.0		
Hypotension								
No	9	18	13	26	22	44.0	1.30	0.393
Yes	16	32	12	24	28	56.0		
Filter clotting								
No	25	50	9	18	34	68.0	23.53	0.000
Yes	0	0	16	32	16	32.0		
Hypokalemia								
No	18	36	21	42	39	78.0	1.05	0.496
Yes	7	14	4	8	11	22.0		

Variable	SLED		IHD				Pearson Chi-Square/Fisher's Exact Test	p-value
	n	%	n	%	N	%		
Hypophosphatemia								
No	18	36	13	26	31	62.0	2.12	0.244
Yes	7	14	12	24	19	38.0		
Use of anticoagulant								
No	5	10	16	32	21	42.0	9.93	0.004
Yes	20	40	9	18	29	58.0		
Treatment discontinuation								
No	17	34	18	36	35	70.0	0.10	1.000
Yes	8	16	7	14	15	30.0		
Completely recovery								
No	20	40	17	34	37	74.0	0.94	0.520
Yes	5	10	8	16	13	26.0		
Partial recovery								
No	21	42	15	30	36	72.0	3.57	0.059
Yes	4	8	10	20	14	28.0		
Non-recovery								
No	9	18	18	36	27	54.0	6.52	0.011
Yes	16	32	7	14	23	46.0		
Death								
No	17	34.0	21	42.0	38	76.0	1.75	0.321
Yes	8	16.0	4	8.0	12	24.0		

The median length of hospital stay for the patients included in this study was 7.5 with an IQR of 4.0 days. The median age of the patients was 57.2 with and IQR of 8.8 years. The median BMI was 31.4 with an IQR of 6.9. The median acute physiology, Assessment, chronic health evaluation score was 22 (0.46) with and IQR of 0.20 and the median sequential organ failure assessment score was 10 (0.45) with an IQR of 0.28. Details of the medians and IQR of the continuous variables are shown in Table 5-2.

Table 5.2 : Median length of hospital stay, age, body mass index, PACHE, and SOFA scores

	SLED		IHD	
Variable	**Median**	**IQR**	**Median**	**IQR**
Length of hospital stay	8.0	5.5	7.0	5.0
Age	59.0	5.5	52.0	9.0
Body mass index	33.3	4.4	30.4	7.4
Acute Physiology and Chronic Health Evaluation II	22	0.18	18	0.18
Sequential organ failure assessment score	10	0.54	10	0.14

The comorbidities of reported in the patient medical files are shown in Figure .

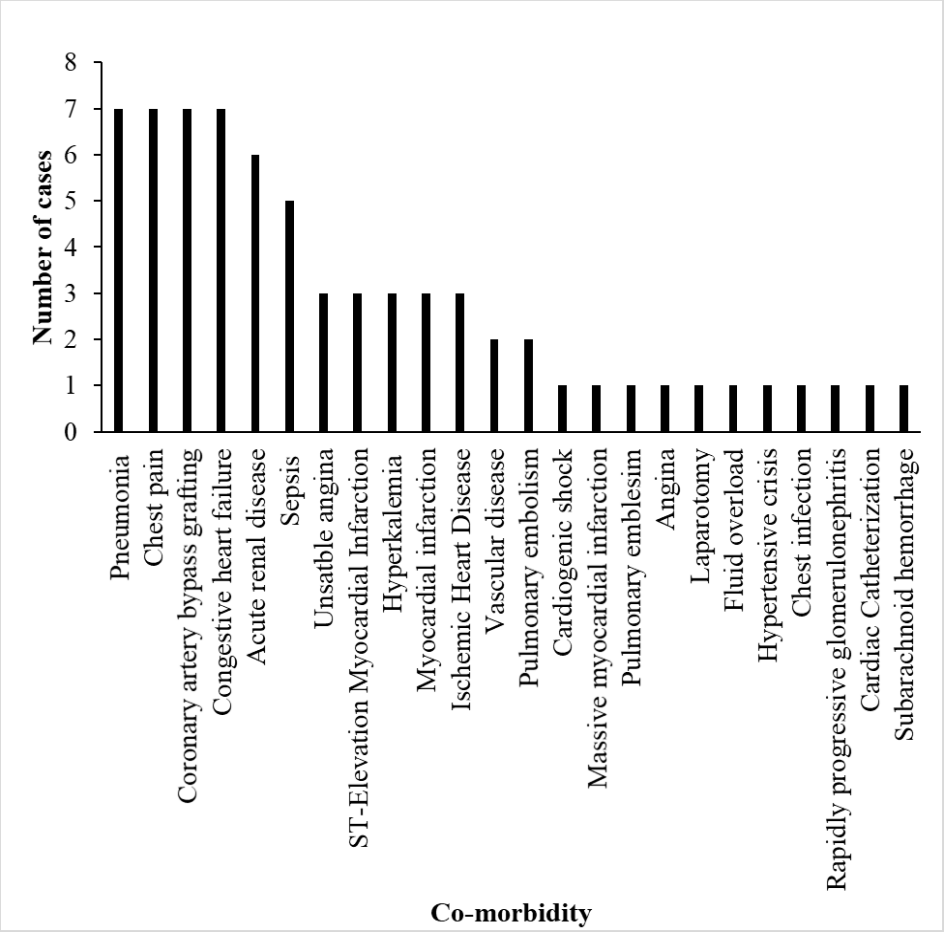

Figure 5.1: Comorbidities reported in the medical files of the patients

The majority of the patients resided in Nablus (36%) and Jenin (20%). The rest of patients were from Tulkarm, Gaza, and Qalqilia as shown in Figure .

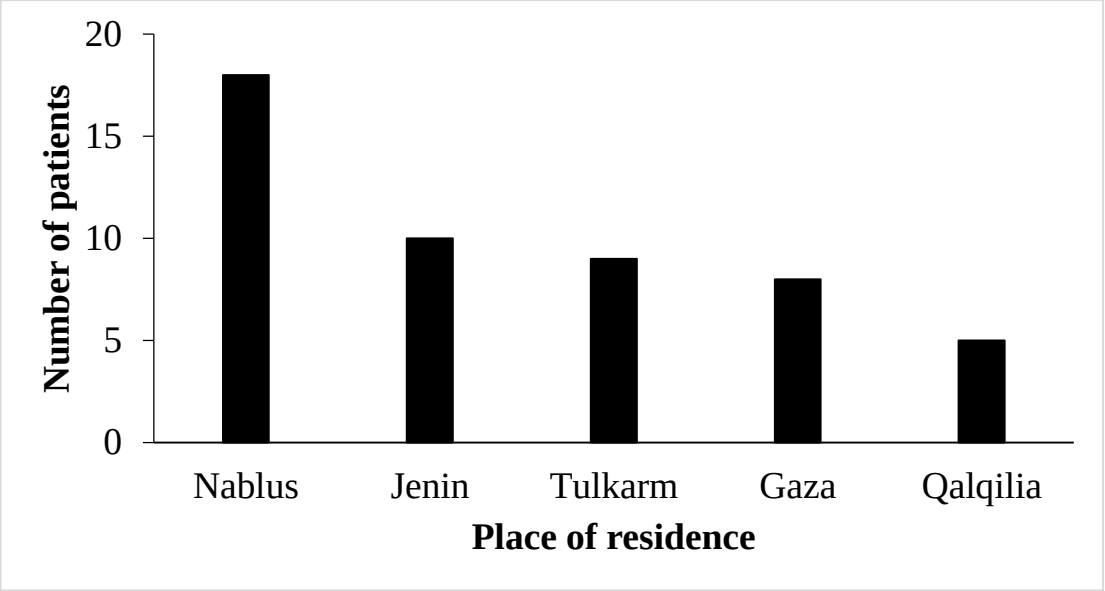

Figure 5.2 : Place of residence of the patients included in the study

Of the patients who received mechanical ventilation, the majority were on SIMV mode (69.7%) and CMV (18.2%). The rest of the patients were on AC or CPAP as shown in Figure .

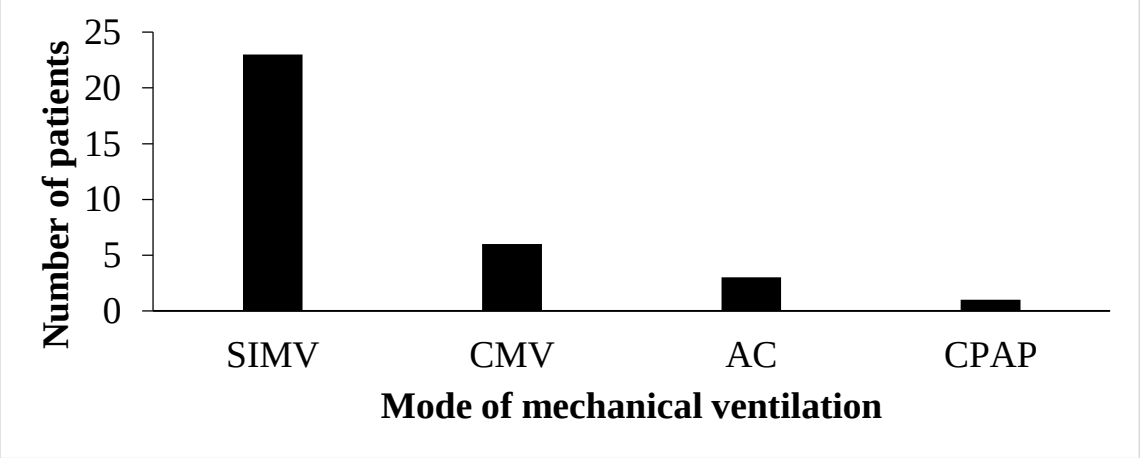

Figure 5.3 : Mode of mechanical ventilation

5.3 Outcomes of the three dialysis sessions

The median differences (post-dialysis – pre-dialysis) in body composition and biochemical variables including weight, systolic arterial hypertension, diastolic arterial hypertension, pulse, peripheral capillary oxygen saturation, temperature, serum creatinine, potassium, bicarbonate, pH, blood urea nitrogen, hemoglobin, partial thromboplastin time, international normalized ratio, white blood cells, platelet, and red blood cells are shown in Table .

Table 5.1 : Differences in body composition and biochemical variables before and after the three dialysis sessions

	Session 1				**Session 2**				**Session 3**			
	SLED		**IHD**		**SLED**		**IHD**		**SLED**		**IHD**	
Variable	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**
Weight	-2.00	1.50	-2.00	1.40	-2.00	1.00	-2.00	1.50	-1.50	1.00	-2.00	1.25
Systolic arterial hypertension	-4.00	16.50	-8.00	9.00	-5.00	-5.00	-7.00	11.00	-6.00	18.00	-9.00	14.00
Diastolic arterial hypertension	-2.00	9.50	-4.00	14.00	-6.00	10.50	-4.00	8.00	3.00	11.00	-2.00	9.50
Pulse	3.00	11.00	4.00	8.50	2.00	16.00	4.00	11.50	2.00	6.00	2.00	4.00
Peripheral capillary oxygen saturation	0.01	0.01	0.01	0.02	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.02
Temperature	-0.20	0.30	-0.30	0.40	-0.40	0.50	-0.30	0.45	-0.10	0.30	-0.30	0.40
Serum creatinine	-0.57	0.72	-0.91	1.17	-0.50	0.63	-0.70	1.32	-0.64	0.35	-1.10	0.87

	Session 1				Session 2				Session 3			
	SLED		IHD		SLED		IHD		SLED		IHD	
Variable	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**
Potassium	-0.40	0.47	-0.50	1.12	-0.30	0.20	-0.57	0.71	-0.29	0.43	-0.51	0.50
Bicarbonate	2.60	1.60	1.50	6.75	1.10	1.30	2.00	3.50	0.80	0.80	1.90	2.70
pH	0.02	0.06	-0.02	0.11	-0.01	0.06	-0.03	0.08	0.03	0.06	-0.02	0.11
Blood urea nitrogen	-2.80	2.00	-6.40	10.50	-2.00	2.40	-5.50	9.80	-5.00	4.00	-7.00	5.35
Hemoglobin	-0.01	0.52	0.10	1.12	-0.03	0.15	0.00	0.45	-0.01	0.18	0.00	0.28
Partial thromboplastin time	0.60	2.02	1.00	4.00	0.30	1.25	1.00	1.85	1.00	2.30	2.00	2.00
International Normalized Ratio	0.04	0.10	0.08	0.20	0.02	0.12	0.08	0.13	0.03	0.10	0.09	0.16
White Blood Cells	0.04	0.43	-0.10	0.34	0.00	0.13	-0.10	0.55	-0.04	0.30	-0.30	0.50
Platelet	0.00	6.00	6.00	44.50	0.00	4.75	0.00	7.00	1.40	5.00	5.00	6.50
Red Blood Cells	-0.01	0.08	0.00	0.54	-0.04	0.06	0.00	0.20	0.02	0.06	0.00	0.30

5.4 Associations between method of treatment and differences in body composition and biochemical variables in the three dialysis sessions.

To investigate if there were significant differences between the medians and IQR of the composition and biochemical variables in the three dialysis sessions, Mann-Whitney U test and Spearman's correlations were used. In session 1, there were significant differences in the systolic arterial hypertension in session 1 (p value = 0.013), serum creatinine in session 1 (p value < 0.037), pH in session 1 (p value = 0.019), and blood urea nitrogen in session 1 (p value < 0.001). In session 2, there were significant differences in bicarbonate (p value = 0.029) and blood urea nitrogen (p value < 0.001). In session 3, there were significant differences in peripheral capillary oxygen saturation (p value = 0.020), temperature (p value = 0.023), bicarbonate (p value = 0.011) and blood urea nitrogen (p value = 0.003). Mean ranks and Spearman's rho are shown in Table 5.4 .

Table 5.4: Associations between method of treatment and differences in body composition and biochemical variables in the three dialysis sessions.

	Session 1					Session 2					Session 3				
Variable	**SLED**	**IHD**				**SLED**	**IHD**				**SLED**	**IHD**			
	Mann-Whitney U test			**Spearman's correlation**		**Mann-Whitney U test**			**Spearman's correlation**		**Mann-Whitney U test**			**Spearman's correlation**	
	Mean rank	**Mean rank**	**p-value**	**rho**	**p-value**	**Mean rank**	**Mean rank**	**p-value**	**Rho**	**p-value**	**Mean rank**	**Mean rank**	**p-value**	**rho**	**p-value**
Weight	25.30	25.70	0.921	0.01	0.922	23.70	27.30	0.365	0.13	0.370	27.74	23.26	0.264	-0.16	0.269
Systolic arterial hypertension	30.60	20.40	0.013	-0.35	0.012	28.36	22.64	0.164	-0.20	0.167	28.28	22.72	0.177	-0.19	0.179
Diastolic arterial hypertension	25.14	25.86	0.861	0.03	0.863	23.58	27.42	0.350	0.13	0.355	28.18	22.82	0.193	-0.19	0.196
Pulse	21.98	29.02	0.085	0.25	0.085	26.02	24.98	0.800	-0.04	0.803	26.28	24.72	0.703	-0.05	0.707
Peripheral capillary oxygen saturation	27.18	23.82	0.393	-0.12	0.398	25.82	25.18	0.870	-0.02	0.872	30.04	20.96	0.020	-0.33	0.019
Temperature	25.02	25.98	0.813	0.03	0.816	22.02	28.98	0.088	0.24	0.088	30.14	20.86	0.023	-0.32	0.022
Serum creatinine	29.78	21.22	0.037	-0.30	0.036	27.50	23.50	0.330	-0.14	0.335	28.86	22.14	0.102	-0.23	0.103
Potassium	28.78	22.22	0.111	-0.23	0.112	29.02	21.98	0.086	-0.24	0.086	27.58	23.42	0.312	-0.14	0.317
Bicarbonate	28.18	22.82	0.193	-0.19	0.196	21.00	30.00	0.029	0.31	0.027	20.30	30.70	0.011	0.36	0.010
pH	30.28	20.72	0.019	-0.33	0.018	24.12	26.88	0.502	0.10	0.507	29.18	21.82	0.073	-0.26	0.072
Blood urea	33.60	17.40	0.00	-	0.000	33.80	17.20	0.000	-	0.000	31.56	19.44	0.003	-0.42	0.002

	Session 1					Session 2					Session 3				
Variable	**SLED**	**IHD**				**SLED**	**IHD**				**SLED**	**IHD**			
	Mann-Whitney U test			**Spearman's correlation**		**Mann-Whitney U test**			**Spearman's correlation**		**Mann-Whitney U test**			**Spearman's correlation**	
	Mean rank	**Mean rank**	**p-value**	**rho**	**p-value**	**Mean rank**	**Mean rank**	**p-value**	**Rho**	**p-value**	**Mean rank**	**Mean rank**	**p-value**	**rho**	**p-value**
nitrogen			0	0.56					0.58						
Hemoglobin	25.50	25.50	1.000	0.00	1.000	23.28	27.72	0.276	0.16	0.281	24.72	26.28	0.704	0.05	0.708
Partial thromboplastin time	23.66	27.34	0.371	0.13	0.376	21.90	29.10	0.080	0.25	0.079	23.56	27.44	0.345	0.14	0.350
International Normalized Ratio	23.68	27.32	0.376	0.13	0.382	22.32	28.68	0.121	0.22	0.123	21.96	29.04	0.085	0.25	0.085
White Blood Cells	28.92	22.08	0.097	-0.24	0.097	26.88	24.12	0.499	-0.10	0.505	28.26	22.74	0.178	-0.19	0.180
Platelet	22.66	28.34	0.167	0.20	0.170	27.66	23.34	0.290	-0.15	0.295	21.50	29.50	0.052	0.28	0.051
Red blood cell	24.38	26.62	0.586	0.08	0.591	19.14	31.86	0.002	0.44	0.001	26.76	24.24	0.539	-0.09	0.545

5.5 Association between continuous variables

Spearman's correlations between continuous variables showed that length of hospital stay was positively associated with age (p value = 0.005), Acute Physiology and Chronic Health Evaluation score (p value = 0.003), and Sequential organ failure assessment score (p value = 0.039) as shown in Table .

Table 5.5 : Association between age, Acute Physiology and Chronic Health Evaluation score, and Sequential organ failure assessment score

	Spearman's correlation	
Variable	**rho**	**p-value**
Age	0.39	0.005
Acute Physiology, Assessment, Chronic Health Evaluation	0.42	0.003
Sequential organ failure assessment score	0.29	0.039

On the other hand, Acute Physiology and Chronic Health Evaluation was associated with Sequential organ failure assessment score (p value = 0.006) (Table 5-5) and length of hospital as was previously shown in Table .

Table 5.6 : Association between length of stay, Sequential organ failure assessment score, and age.

	Spearman's correlation	
Variable	**rho**	**p-value**
Age	0.27	0.062
Length of hospital stay	0.42	0.003
Sequential organ failure assessment score	0.39	0.006

5.6 Association between complete recovery, treatment method, and other variables of the patients.

Pearson Chi-Square/Fisher's Exact Test showed that patients who completely recover were younger than 50 years (Pearson Chi-Square/Fisher's Exact Test = 12.33, p value = 0.001), had university degree (Pearson Chi-Square/Fisher's Exact Test = 6.72, p value = 0.012), had no chronic heart disease (Pearson Chi-Square/Fisher's Exact Test = 15.17, p value < 0.001), were single (Pearson Chi-Square/Fisher's Exact Test = 6.22, p value = 0.026), had Acute Physiology and Chronic Health Evaluation score of less than 25 (53%) (Pearson Chi-Square/Fisher's Exact Test = 4.84, p value < 0.040), had no fluid overload (Pearson Chi-Square/Fisher's Exact Test = 4.63, p value = 0.040), had no electrolyte imbalance (Pearson Chi-Square/Fisher's Exact Test = 12.51, p value = 0.001), had no hypotension (Pearson Chi-Square/Fisher's Exact Test = 11.76, p value = 0.001), and had not discontinued their treatment (Pearson Chi-Square/Fisher's Exact Test = 7.38, p value = 0.011). Details of the associations are shown in table.5.7.

Table 5.7: Association between complete with treatment method and other variables of the patients.

	Non-recovery/partial recovery		Complete recovery				Complete/partial recovery		Non-recovery			
Variable	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**
Dialysis method												
SLED	20	40.0	5	10.0	0.94	0.520	9	18.0	16	32.0	6.52	0.022
IHD	17	34.0	8	16.0			18	36.0	7	14.0		
Length of hospital stay												
< 7 days	10	20.0	7	14.0	3.02	0.099	10	20.0	7	14.0	0.24	0.623
≥ 7 days	27	54.0	6	12.0			17	34.0	16	32.0		
Age												
< 50 years	3	6.0	7	14.0	12.33	0.001	9	18.0	1	2.0	6.39	0.014
≥ 50 years	34	68.0	6	12.0			18	36.0	22	44.0		
Gender												
Male	24	48.0	10	20.0	0.63	0.508	19	38.0	15	30.0	0.15	0.767
Female	13	26.0	3	6.0			8	16.0	8	16.0		
BMI												
< 33	17	34.0	9	18.0	2.09	0.202	19	38.0	7	14.0	7.94	0.010
≥ 33	20	40.0	4	8.0			8	16.0	16	32.0		
Education												

	Non-recovery/partial recovery		Complete recovery				Complete/partial recovery		Non-recovery			
Variable	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**
Basic education	18	36.0	1	2.0	6.72	0.012	4	8.0	15	30.0	13.79	0.001
Secondary education	10	20.0	5	10.0			12	24.0	3	6.0		
University	9	18.0	7	14.0			11	22.0	5	10.0		
Smoking status												
No	7	14.0	3	6.0	0.10	1.000	5	10.0	5	10.0	0.08	1.000
Yes	30	60.0	10	20.0			22	44.0	18	36.0		
Marital status												
Single	2	4.0	4	8.0	6.22	0.026	6	12.0	0	0.0	7.10	0.014
Married	31	62.0	9	18.0			18	36.0	22	44.0		
Divorced/ widowed	4	8.0	0	0.0			3	6.0	1	2.0		
Systemic arterial hypertension												
No	2	4.0	2	4.0	1.28	0.561	3	6.0	1	2.0	0.76	0.614
Yes	35	70.0	11	22.0			24	48.0	22	44.0		
Diabetes mellitus												
No	13	26.0	4	8.0	0.08	1.000	11	22.0	6	12.0	1.19	0.372
Yes	24	48.0	9	18.0			16	32.0	17	34.0		

	Non-recovery/partial recovery		Complete recovery				Complete/partial recovery		Non-recovery			
Variable	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**
Chronic heart disease												
No	11	22.0	12	24.0	15.17	0.000	19	38.0	4	8.0	14.03	0.000
Yes	26	52.0	1	2.0			8	16.0	19	38.0		
Sepsis												
No	31	62.0	13	26.0	2.35	0.179	24	48.0	20	40.0	0.04	1.000
Yes	6	12.0	0	0.0			3	6.0	3	6.0		
Hypovolemia												
No	33	66.0	10	20.0	1.18	0.357	22	44.0	21	42.0	0.98	0.430
Yes	4	8.0	3	6.0			5	10.0	2	4.0		
Infection status												
No	33	66.0	12	24.0	0.10	1.000	25	50.0	20	40.0	0.43	0.651
Yes	4	8.0	1	2.0			2	4.0	3	6.0		
Acute tubular necrosis												
No	36	72.0	13	26.0	0.35	1.000	26	52.0	23	46.0	0.85	1.000
Yes	1	2.0	0	0.0			1	2.0	0	0.0		
Acute Physiology and Chronic Health Evaluation												
< 25 (53%)	19	38.0	13	26.0	9.68	0.002	21	42.0	11	22.0	4.84	0.040

	Non-recovery/partial recovery		Complete recovery				Complete/partial recovery		Non-recovery			
Variable	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**
≥ 25 (53%)	18	36.0	0	0.0			6	12.0	12	24.0		
Sequential organ failure assessment score												
< 9 (40%)	9	18.0	6	12.0	2.14	0.170	10	20.0	5	10.0	1.38	0.355
≥ 9 (40%)	28	56.0	7	14.0			17	34.0	18	36.0		
Mechanical ventilation												
No	12	24.0	5	10.0	0.15	0.741	9	18.0	8	16.0	0.01	0.914
Yes	25	50.0	8	16.0			18	36.0	15	30.0		
Vasoactive drugs												
No	21	42.0	9	18.0	0.62	0.522	18	36.0	12	24.0	1.09	0.388
Yes	16	32.0	4	8.0			9	18.0	11	22.0		
Oliguria												
No	16	32.0	5	10.0	0.09	1.000	9	18.0	12	24.0	1.81	0.252
Yes	21	42.0	8	16.0			18	36.0	11	22.0		
Anuria												
No	22	44.0	11	22.0	2.66	0.173	22	44.0	11	22.0	6.27	0.017
Yes	15	30.0	2	4.0			5	10.0	12	24.0		
Fluid over load												

	Non-recovery/partial recovery		Complete recovery				Complete/partial recovery		Non-recovery			
Variable	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**
No	6	12.0	6	12.0	4.63	0.040	10	20.0	2	4.0	5.47	0.024
Yes	31	62.0	7	14.0			17	34.0	21	42.0		
Electrolyte imbalance												
No	8	16.0	10	20.0	12.51	0.001	14	28.0	4	8.0	6.40	0.018
Yes	29	58.0	3	6.0			13	26.0	19	38.0		
Acid base imbalance												
No	16	32.0	10	20.0	4.37	0.037	17	34.0	9	18.0	2.83	0.155
Yes	21	42.0	3	6.0			10	20.0	14	28.0		
Rhabdomyolysis												
No	27	54.0	11	22.0	0.70	0.480	23	46.0	15	30.0	2.71	0.183
Yes	10	20.0	2	4.0			4	8.0	8	16.0		
Hypotension												
No	11	22.0	11	22.0	11.76	0.001	19	38.0	3	6.0	16.57	0.000
Yes	26	52.0	2	4.0			8	16.0	20	40.0		
Filter clotting												
No	25	50.0	9	18.0	0.01	1.000	15	30.0	19	38.0	4.18	0.067
Yes	12	24.0	4	8.0			12	24.0	4	8.0		
Hypokalemia												

	Non-recovery/partial recovery		Complete recovery				Complete/partial recovery		Non-recovery			
Variable	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**	**n**	**%**	**n**	**%**	**Pearson Chi-Square/Fisher's Exact Test**	**p-value**
No	28	56.0	11	22.0	0.44	0.704	22	44.0	17	34.0	0.41	0.733
Yes	9	18.0	2	4.0			5	10.0	6	12.0		
Hypophosphatemia												
No	21	42.0	10	20.0	1.63	0.320	19	38.0	12	24.0	1.75	0.247
Yes	16	32.0	3	6.0			8	16.0	11	22.0		
Use of anticoagulant												
No	14	28.0	7	14.0	1.01	0.346	11	22.0	10	20.0	0.04	1.000
Yes	23	46.0	6	12.0			16	32.0	13	26.0		
Treatment discontinuation												
No	22	44.0	13	26.0	7.38	0.011	22	44.0	13	26.0	3.68	0.070
Yes	15	30.0	0	0.0			5	10.0	10	20.0		

5.7 Association between non-recovery, treatment method, and other variables of the patients.

Pearson Chi-Square/Fisher's Exact Test showed that patients who did not recover were treated with SLED (Pearson Chi-Square/Fisher's Exact Test = 6.52, p value = 0.022), were 50 years and older (Pearson Chi-Square/Fisher's Exact Test = 6.39, p value = 0.014), had a BMI of more than 33 (Pearson Chi-Square/Fisher's Exact Test = 7.94, p value = 0.010), had no university degree (Pearson Chi-Square/Fisher's Exact Test = 13.79, p value = 0.001), had chronic heart disease (Pearson Chi-Square/Fisher's Exact Test = 14.03, p value < 0.001), had Acute Physiology, Assessment, Chronic Health Evaluation score of more than 25 (53%) (Pearson Chi-Square/Fisher's Exact Test = 4.84, p value < 0.040), had anuria (Pearson Chi-Square/Fisher's Exact Test = 6.27, p value = 0.017), had fluid overload (Pearson Chi-Square/Fisher's Exact Test = 5.47, p value = 0.024), had electrolyte imbalance (Pearson Chi-Square/Fisher's Exact Test = 6.40, p value = 0.018), and had hypotension (Pearson Chi-Square/Fisher's Exact Test = 16.57, p value < 0.001). Details of the associations are shown in table 5-7.

Chapter Six
Discussion

In this retrospective cohort study, the clinical characteristics, complications, dialysis outcomes, and 30-day recovery of patients who underwent IHD were compared with those who underwent SLED for AKI in intensive care units of NNUH in the period of January 2016 to January 2020. Studies have been conducted on the associated complications of AKI in difference healthcare systems elsewhere (Druml et al., 2010; Han et al., 2013; Valente et al., 2013). Similarly, studies were conducted to assess mortality and recovery rates among patients with AKI in different healthcare systems around the world (Kwizera et al., 2016; Ponce et al., 2011; Yang et al., 2018). To the best of our knowledge, this is the first study to compare these parameters among patients treated for AKI in Palestine.

The sample included in the study was diversified in terms of place of residence, gender, body weight, height, and BMI, educational level, smoking status, marital status, occurrence of comorbidities, length of hospital stay, acute physiology and chronic health evaluation scores, and sequential organ failure assessment scores. This diversity probably added validity to our analysis and comparison. The clinical characteristics of the sample included in this study reflected the hemodynamic instabilities and incidence of multiple organ failure that were previously reported in AKI (Hoste & De Corte, 2011; Kwizera et al., 2016).

In general, the patients who were included were male in gender, old (80% were older than 50 years), were obese, did not receive higher education, smokers, had hypertension, had diabetes, and had chronic heart disease, all of which are known risk factors for AKI (Finlay et al., 2013). Hemodynamic instabilities and multiple organ failure were also prevalent among the patients included in this retrospective analysis. These hemodynamic instabilities are known to occur among patients with or at risk of AKI (Finlay et al., 2013).

The median age of the patients included in this study was 57.2 with an IQR of 8.8 years. The patients included in this study were comparatively older than those included in a study conducted at Alexandria Teaching Hospitals in Egypt and even older than those reported in a retrospective analysis conducted in Kampala, Uganda (Abd ElHafeez et al., 2017; Kwizera et al., 2016). Interestingly in this study, many clinical variables of the patients were associated with dialysis method used. Findings of this study indicated that SLED was associated with longer stay in the hospital compared to patients who received IHD. Our findings are consistent with those reported in the literature (B. Albino et al., 2018). Probably, this is due to the nature of the treatment method. In general, IHD is often administered for a short period of time (2-4 hrs) in 3-4 times/week. However, SLED is often administered for a longer period of time (6-12 hrs) in 3-6 days/week (Bellomo et al., 2017). Patients who received SLED were older, had higher BMI, had systemic arterial hypertension, had diabetes, had chronic heart disease, had higher PATCHE II score, had filter clotting, used

anticoagulants, and were less likely to recover. Probably, those patients with such clinical conditions are more likely to be bedridden in the ICU and as a result, healthcare providers would opt for SLED as a treatment option (Kitchlu et al., 2015).

Outcomes of the three haemodialysis in improving the hemodynamic status of the patient, correcting electrolytes and fluid imbalances associated with AKI were also compared between the two treatment methods in this study. The dialysis sessions resulted in changes/corrections to the body composition, biochemical, and clinical indices. Both methods resulted in significantly different changes/corrections to the body composition, biochemical, and clinical indices like systolic arterial blood pressure, serum creatinine, pH, blood urea nitrogen, bicarbonate, peripheral capillary oxygen saturation, and temperature, all of which are important indicators of hemodynamic stability and improvement in the health outcomes of the patient.

Interestingly, there was a positive correlation between age, Acute Physiology and Chronic Health Evaluation score, and Sequential organ failure assessment score in this study. Our findings are interesting as male gender, older age, longer hospital stay, high APATCHE II , high Sequential organ failure assessment scores, presence of comorbidities, multiple organ failure, oliguria, and the use of mechanical ventilation were risk factors for AKI among critically ill patients (Hsu et al., 2013; Palevsky, 2006).

Findings of this study were in consistent with those reported among patients in developed countries (Hsu et al., 2013).

Findings of this study indicated that approximately 1 in every 4 patients completely recovered. However, the majority of the patients either partially recovered and needed chronic or prolonged treatment or did not recover (either died or progressed to renal failure). Findings of this study were consistent with those reported in developed countries and were not consistent with the high mortality rates reported in middle- and low-income countries (Yang et al., 2018). Our analysis showed that the patients who recovered were generally younger, had university degree, had no chronic heart disease, were single, had APATCHE II of less than 25 (53%), had no fluid overload, had no electrolyte imbalance, had no hypotension, and had not discontinued their treatment. On the other hand, the patients who did not recover were more likely to receive SLED, older, obese, had no university degree, had chronic heart disease, had APATCHE II of more than 53, had anuria, had fluid overload, had electrolyte imbalance, and had hypotension. These findings were consistent with those reported in previous studies (Abd ElHafeez et al., 2017; B. Albino et al., 2018; B. B. Albino et al., 2014; Berbece & Richardson, 2006; Douvris et al., 2018; Sherman et al., 2007; Shingarev et al., 2011). For example, a study in Egypt showed that previous use of diuretics, sepsis, and lower educational status were associated with AKI (Abd ElHafeez et al., 2017). When the confounding variables were controlled, APATCHE II was an independent predictor of AKI following admission to ICU. Similarly, APATCHE II, use

of mechanical ventilation, and vasopressor drugs were associated with mortality rates among patients with AKI in Uganda (Kwizera et al., 2016).

6.1 Strengths and limitations

This study has a number of strength and limitations. The strengths of this study include:

1. This retrospective study was conducted for the first time in a major tertiary care hospital in Palestine. Clinical characteristics of patients with AKI and predictors of recovery and/or mortality were assessed in different settings around the world. Assessing associations between the different characteristics of patients with AKI in Palestinian healthcare settings and their chances for recovery is of high importance.
2. In this retrospective study, two treatment methods SLED and IHD were compared. Comparing different treatment modalities can show interesting findings that might help healthcare providers decide which method of treatment might suit the patient. Recently, a systematic review with meta-analysis showed that SLED, IHD, and CRRT did not differ statistically in terms of renal recovery status or mortality when used to manage patients with AKI (Zhao & Chen, 2020).
3. Associations between multiple clinical characteristics were investigated in this study. Extensive statistical analysis might be powerful in detecting the biochemical and physiological indices that might change as a result of the treatment method.

The limitations of this study include:

1. The sample size used in this study was comparatively small. The use of larger sample sizes might have higher power.
2. This study was a conducted retrospective cohort design. Prospective clinical trials produce more reliable and less biased results.
3. Due to the small sample size, we could not statistically assess associations between mortality rates and other variables.

Conclusion

Findings of this retrospective analysis showed that recovery rates among patients with AKI treated using SLED or IHD in a tertiary care hospital in Palestine are comparable to those reported in developed countries. Complete recovery from AKI was associated with younger age, having university education, absence of chronic heart disease, having Acute Physiology and Chronic Health Evaluation score of less than 25 (53%), absence of fluid overload, absence of electrolyte imbalance, and absence of hypotension. Non-recovery was associated with older age, being obese, having no university degree, having a chronic heart disease, having Acute Physiology and Chronic Health Evaluation score of more than 25(53%), having anuria, having fluid overload, having electrolyte imbalance, and having hypotension. Patients who met the previously mentioned characteristics were more likely to be severely ill and were more likely to receive SLED as a treatment method.

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(**Annex 1**)

Data Sheet

Date:	**Department:**
Date of admission:	**Length of stay:**
Diagnosis :	
Allergy:	
Demographic Data:	
Age : **Gender :** male female other **Height:----- weight:------- BMI:-------** **Educational status:----------** **Smoking status:----------** **Marital status :** single married divorced widow **Presidency:**	
Past History: **SAH: Yes No** **DM: Yes No Type:** **CHF: Yes No** **Sepsis: Yes No** **Hypovolemia: Yes No Cause:** **Infectious status: Yes No Type:** **ATN: Yes No** **APACHE:** **SOFA;** **MV: Yes No mode type:** **Vasoactive drugs:** **Initial dose:** **Final dose:**	
Indication for dialysis: **Azotemia with uremic symptoms:** **Oliguria:** **Anuria:** **Fluid over load:** **Electrolyte imbalance:** **Acid base imbalance:** **Rhabdomylosis:**	
Parameters will be measured pre & post dialysis during 3 sessions : **Pre-wt: post wt:** **Pre BP: post BP:** **Pre P: Post P:** **Pre SPO2: Post SPO2:** **Pre Temp: post Temp:** **Pre FB: Post FB:** **Pre UF: Post FB:** **Laboratory test pre and post dialysis during 3 sessions:** **Pre sCr: post sCr:** **Pre K: post K:** **Pre Bic: post Bic:** **Pre Ur: post Ur:** **Pre PH: post PH:**	

Pre BUN:	**post BUN:**
Pre Hb:	**post Hb:**
Pre PTT:	**post PTT:**
Pre INR:	**post INR:**
Pre WBC:	**Post WBC:**
Pre PlT:	**post PlT:**
Pre RBC:	**post RBC:**

Complication of RRT:

Hypotension:
Filter clotting:
Hypokalemia:
Hypophosphetemia:
Use of anticoagulant:
Treatment discontinuation:

Renal Outcomes :

Complete recovery:
Partial recovery:
Non-recovery:

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IRB

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الوطنية
كلية الطب وعلوم الصحة
لجنة اخلاقيات البحث العلمي

Ref : Mas 4/20/5

IRB Approval Letter

Study Title:

"30-Days of Survival, Clinical Characteristics and Mortality Rate of Patients Undergoing Intermittent Hemodialysis Versus Sustained Low Efficacy Dialysis for Acute Kidney Injury in Intensive Care Units: A Retrospective Study"

Submitted by:
Howaida Issa Shibli

Supervisor:
Dr. Aidah Abu Elsoud Alkaissi

Date Submitted:
25th Feb. 2020

Date Approved:
15th April 2020

Your Study titled "30-Days of Survival, Clinical Characteristics and Mortality Rate of Patients Undergoing Intermittent Hemodialysis Versus Sustained Low Efficacy Dialysis for Acute Kidney Injury in Intensive Care Units: A Retrospective Study" was reviewed by An-Najah National University IRB committee and was approved on 15th April 2020.

Hasan Fitian, MD

IRB Committee Chairman

IRB

An-Najah National University

جامعة النجاح الوطنية

كلية الدراسات العليا

ثلاثون يوماً من البقاء على قيد الحياة، للمرضى الذين يخضعون لغسيل الكلى لفترة زمنية قصيرة مقابل فترة زمنية أطول لمرضى الكلى الحاد: دراسة رجعية

إعداد

هويدا عيسى داوود ابو طير

إشراف

د. عايدة القيسي

د. وائل صدقة

قدمت هذه الأطروحة استكمالاً لمتطلبات الحصول على درجة الماجستير في برنامج تمريض العناية المكثفة، من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس- فلسطين.

2021

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د. وائل صدقه

الملخص

الخلفية: التهاب الكلى الحاد شائع بشكل تدريجي ويتم ربطه بالتكاليف المرتفعة والنتائج السريرية غير المفضلة مثل مضاعفات غسيل الكلى والتي أكثرها شيوعًا هي انخفاض ضغط الدم الذي يصل إلى 30–70%، وطول مدة الإقامة، ومعدلات وفيات عالية تصل إلى 50–70 %، ولكن إذا تم إجراء التدخل لبدء العلاج السريع لإعادة الاستجابة السريعة مبكرًا، فسوف يعزز النتيجة ومعدل الوفيات. الهدف من هذه الدراسة هو تحديد معدل الوفيات والخصائص السريرية ونتائج غسيل الكلى المتقطع مقابل غسيل الكلى طويل المستمر بين المرضى المصابين بأمراض خطيرة مع التهاب الكلى الحاد.

الطريقة: كانت هذه الدراسة عبارة عن تصميم أترابي بأثر رجعي تم إجراؤه في مستشفى جامعة النجاح الوطنية في الضفة الغربية والذي يقوم بتجنيد 50 مريضًا تم علاجهم إما بـ غسيل الكلى المتقطع أو غسيل الكلى طويل المستمر في وحدات العناية المركزة. تضمنت البيانات الديموغرافية للمريض، والتاريخ السابق، ومؤشرات طرق غسيل الكلى، ومعايير الدورة الدموية ومعايير الاختبارات المعملية التي تم اختبارها قبل وبعد غسيل الكلى لثلاث جلسات، ومضاعفات غسيل الكلى وأخيراً النتيجة الكلوية التي تم عرضها وتحليلها.

النتائج: كان متوسط العمر 57.2 سنة مع معدل الذكاء 8.8 سنة، 80% منهم 50 سنة ، 68% من الذكور في الجنس، 66% كانوا على التهوية الميكانيكية و40% على الأدوية الفعالة في الأوعية، علم وظائف الأعضاء الحادة، التقييم، التقييم الصحي المزمن النتيجة $p < 0.038$، وسيط

SOFA كانت النتيجة 0.45 مع معدل الذكاء 0.28. كانت المضاعفات الرئيسية هي انخفاض ضغط الدم بنسبة 56%، ولم يتم شفاء 46% من المرضى (ماتوا أو فشل كلوي).

الخلاصة: أظهرت دراستنا أن شفاء القصور الكلوي الحاد كان مرتبطًا بالمرضى الأصغر سنًا والمتعلمين بينما كان عدم الشفاء مرتبطًا بالمرضى الأكبر سنًا الذين يعانون من التاريخ الطبي فيما يتعلق بالطريقة المستخدمة في العلاج.

الكلمات المفتاحية: إصابة الكلى الحادة، غسيل الكلى المتقطع، غسيل الكلى منخفض الكفاءة المستمر، معدل الوفيات، الخصائص السريرية، النتائج.