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MANAGEMENT OF END-STAGE RENAL DISEASE

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Abstract

Introduction: *With a global rise in chronic kidney diseases, there is also a major burden of end-stage renal disease which is difficult to manage. This review briefly discusses various managements of end-stage renal disease with a note on the nursing care involved. The treatment modalities discussed are kidney transplantation, dialysis, and conservative techniques. Psychosocial aspects also play a role in the overall well-being of the patients*

Aim of the Study: *The purpose of the review is to understand the various management techniques for end-stage renal disease.*

Methodology: *The review is comprehensive research of PUBMED from the year 2001 to 2024.*

Conclusion: *This review included several management strategies and provided a brief description of end-stage renal illness. The therapy of choice is a kidney transplant, whether it comes from a living or deceased person. Hemodialysis is used until allograft surgery is feasible if a donor is not available or if an allograft transplant procedure is not feasible. Unfortunately, some people don't respond well to either kind of management; as a result, they depend on palliative care and conservative management.*

Keywords: *End-stage renal disease, chronic kidney disease, renal transplant, hemodialysis, palliative care*

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INTRODUCTION:

It is estimated that approximately 850 million people have kidney disease globally of which the majority live in financially underprivileged countries. A sizable population of them do not have access to even their diagnosis let alone prevention and treatment. A rising incidence of diabetes, hypertension, cardiovascular diseases, and an increasing age of the human population are leading to more cases of chronic kidney diseases worldwide. [1]

Chronic renal disease is defined as having abnormalities in kidney structure or function for longer than three months in addition to both variables (albumin greater than 30 mg per gram of creatinine and glomerular filtration rate [GFR] less than 60 mL/min). A GFR of less than 15 mL/min is considered end-stage renal disease. [2]

The GFR level is taken into consideration while classifying CKD into five phases, as per the KDIGO 2012 clinical practice recommendation. [2]

Stage 1	Kidney damage with normal GFR (greater than 90 ml/min)
Stage 2	Mild reduction in GFR (60-89 mL/min)
Stage 3 a	Moderate reduction in GFR (45 to 59 mL/min)
Stage 3 b	Moderate reduction in GFR (30 to 44 mL/min)
Stage 4	Severe reduction in GFR (15 to 29 mL/min)
Stage 5	Renal failure (GFR less than 15 mL/min)

Table 1: CKD classification (KDIGO 2012) [2]

People with end-stage renal disease typically require kidney transplantation or dialysis to survive. Transplantation of the kidney is the more desirable option but most undergo dialysis. People with limited life expectancy may also opt for palliative management approaches. A list of vaccinations against microorganisms, cancer screening for transplanted individuals, blood pressure control, blood sugar control, and possible malnutrition are all taken into account while managing patients with end-stage renal disease. [3]

Specialized nursing care during dialysis isn't restricted to technical care but also involves patients' psychological well-being. Advanced nursing care planning is needed to address pain, and other symptoms arising during treatment. Nurses undertake end-of-life care plans for people withdrawing from dialysis and having poor life expectancy. With deteriorating health, patients may experience negative feelings and mental depression. Awareness of mortality and access to mental, spiritual, and palliative care become of utmost importance. [4]

Management

Early Diagnosis

Early anticipation of end-stage renal disease before it arises is imperative as it improves outcomes for the patient including survival. It is recommended that if an individual in chronic kidney disease has a GFR (glomerular filtration rate) below 30 mL/minute/1.73m^2, they should be referred to the Nephrology department. Further indications to refer patients to the nephrology department are listed in the table below: [5]

Indications for nephrology referral for CKD patients
Abrupt and persistent reduction in GFR
GFR below 30 mL/minute/1.73m^2
Hereditary Renal Disease
Enduring and substantial albuminuria (Albumin to creatinine ratio > 300 mg/g or albumin excretion rate > 300mg/ 24 hrs
Sustained Hypokalemia or hyperkalemia
Worsening of chronic renal disease (with declining GFR at rate of >5mL /minute / 1.73 m^2/ year)
Extensive or repeated nephrolithiasis
Resistant Hypertension
Using a risk prediction tool such as a kidney failure risk calculator to find the risk of end-stage renal disease to be 10 – 20% within a year.
Persistent urinary red blood cells with more than 20 counts at high power microscope cannot be explained otherwise.

Table 2: Indications for nephrology referral [5]

The underlying reason for early anticipation and referral is to slow down the disease progression, address comorbid conditions such as diabetes and cardiovascular conditions, deliver psychological support, and draw a treatment plan which may include kidney transplantation, dialysis, or other conservative measures. An approach to multidisciplinary care involving doctors, nurses, psychiatrists, and dieticians can improve outcomes for chronic kidney disease patients. [3]

Kidney transplantation

Kidney transplant recipients clearly have a higher chance of survival than those who continue on dialysis. Shi B et al 2023, performed a survival-matched pair analysis of transplanted vs dialysis patients over 70 years of age. They found that an initial higher mortality in the transplant group for 9 months was followed by 80% 5-year survival in the transplant group compared to 53% in the dialysis group. [6]Therefore, if contraindications to a transplant surgery are absent, a patient with end-stage renal disease is referred to a transplant center. Contraindications to a kidney transplant surgery include severe cardiovascular, and pulmonary conditions, cancer, infections, and drug abuse. Unfortunately, patients with end-stage renal disease often carry baggage of comorbidities that require a careful process of patient selection. [7]

Patient selection

Cardiovascular disease: The majority of ESRD patients need a cardiovascular assessment, which includes noninvasive tests for those who are symptomatic or at high risk. Predicting perioperative cardiac events is especially accurate using a dobutamine stress echocardiography. Following a kidney transplant, cardiovascular disease is the main cause of death. Prior to transplant surgery, patients who test positive for noninvasive heart conditions should have cardiac revascularization. [8]

Cerebrovascular Disease: Carotid artery disease should be assessed in patients who have experienced cerebrovascular accidents or transient ischemic episodes. To check for aneurysms, anyone with signs of polycystic kidney disease should undergo a magnetic resonance angiography. Assess the pulses in the femur and pedal regions, and contemplate further imaging (duplex US & CT) and potential referrals for vascular surgery in case of anomalies, history indicative of PVD, or concerns regarding iliac artery inflow. Pre-transplantation revascularization is the optimal scenario. [8]

Pulmonary Disease: To rule out pulmonary hypertension, higher-risk patients, such as those on long-term dialysis, those with cardiac problems, COPD, tobacco use, sleep apnea, or a history of pulmonary embolism, should have pulmonary function tests and potentially an echocardiography. Vasodilators must be used preoperatively to treat severe pulmonary hypertension, and transplant surgery cannot proceed unless pulmonology is cleared. [8]

Other Conditions: Patients who have chronic liver disease or active viral hepatitis should see a hepatologist about the possibility of a combined liver and kidney transplant. Individuals with bleeding diathesis should have a complete coagulation panel, and those with a history of thrombosis should be assessed for hypercoagulable conditions and may need anticoagulation. A kidney transplant is completely contraindicated in cases of active infection, hence complete serology panels for viral diseases and tuberculosis should be performed, as well as current vaccines. In addition, depending on the type of cancer, transplant facilities usually need a cancer-free time ranging from two to five years in order to reduce the possibility of immunosuppressive therapy-induced metastasis or post-transplant recurrence. [8]

Donor selection

Living donor kidney transplantation is the preferred method over deceased donor transplantation since it is a faster process, requires less time for dialysis, results in greater kidney function right away, and has a higher rate of graft survival. Nonetheless, deceased donor transplantation still provides superior survival results than ongoing dialysis for the majority of ESKD patients without a living donor. When multiple donor options are available, personalizing the selection can deliver better long-term outcomes. The following criteria are considered when selecting a donor: [9]

Health factors: All donors must be at least 18 years of age with sound mind in order to voluntarily consent the procedure. A minimum of > 80 mL/min of GFR should be present although a greater donor age is not absolute contraindication. Uncontrolled hypertension, diabetes mellitus, proteinuria >300mg/24 h, individuals with a high risk of a thromboembolic event, a high body max index of over 35kg/m^2, hepatitis, and tuburculosis are contraindicated as donors. [10]

Immunological matching: It remains the cornerstone when considering a donor among several donors. Blood group matching with ABO compatibility, absence of donor-specific preformed antibodies, and

increased HLA (human leukocyte antigen) matching are preferred criteria. Recipient serum can be mixed with donor cells to assess the degree of crossreaction with pre-existing antibodies against the donor. Several biomedical techniques such as polymerase chain reaction, serological tests, panel reactive antibody tests, and other assays may be employed in the laboratory. [9]

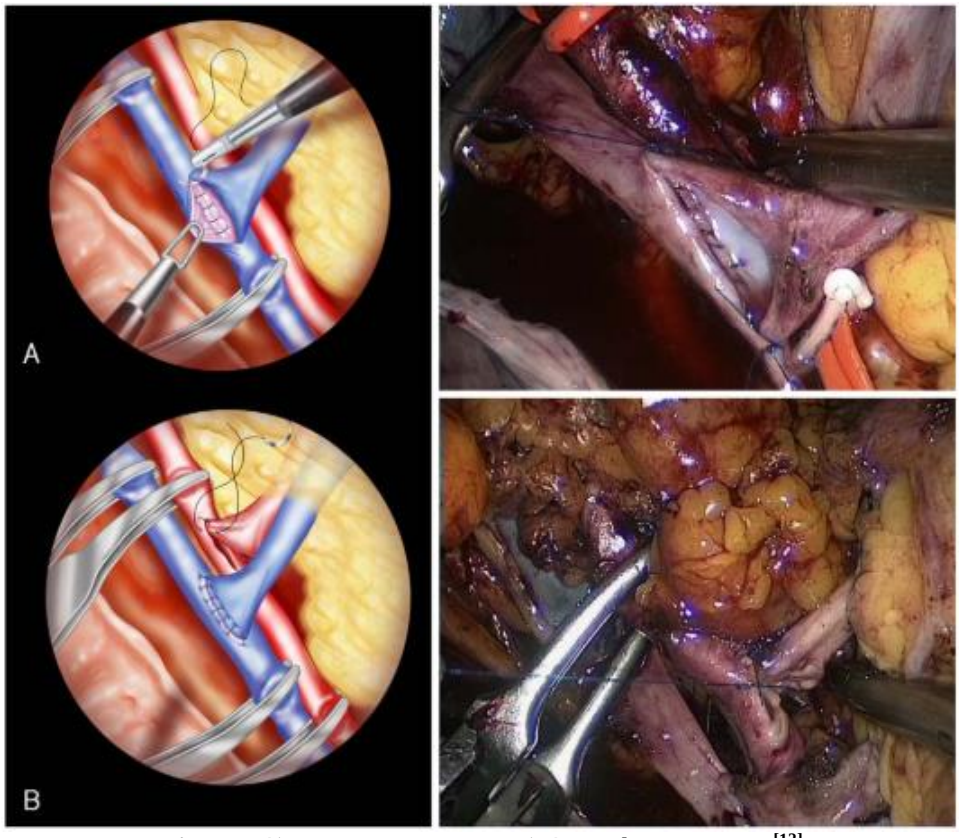
Other factors: Factors such as nephron mass, kidney volume based on computed tomography assessment, and other anatomical considerations such as length of kidney vein, and iliac arterial calcifications may influence the selection of a living donor. [9]

Deceased donors: If living donors aren't available, the next best option is deceased donors. Strohmaier S et al 2022 concluded that kidney transplant patients (from deceased donors) had better survival across all ages when compared to ones on long-term dialysis. [11] Selection of deceased donors can be quite complicated; it considers factors like blood groups, antibody levels, waitlist times, and dialysis times. Several factors are translated into the kidney donor profile index (KDPI) where are lower KDPI fares better than a higher KDPI. The benefit of a transplant must outweigh the risks associated with surgery. [9]

Surgical procedure

Once a graft is retrieved from a donor (living or deceased), maintaining its viability is of utmost importance. The surgery must be planned in coordination with both teams operating on donor and recipient as well as the personell responsible for maintenance and transfer of graft. Several solutions such as the University of Wisconsin solution and Biolosol are available for graft maintenance. The blood from the excised graft is evacuated and irrigated with Ringers lactate solution. [11]

A traditional hockey stick incision may be used in the iliac fossa of the abdomen. Care dissection with strict hemostasis is carried out in order to maintain the structures of abdominal muscles. The surgeon then enters the retroperitoneal space, identifies the major blood vessels, and prepares the site for transplantation. The major blood vessels supplying and draining the kidney are carefully anastomosed to the graft. After reperfusion of the graft, the surgeon moves toward urinary reconstruction and finally wound closure. [11]



Picture: A) venous anastomosis B) Arterial anastomosis [12]

Immunosuppression and graft survival

Potent immunosuppressive agents have significantly improved graft survival and reduced the risk of acute rejection with graft survival approaching 96% after one year donated from living individuals. Unfortunately, the long-term survival of graft is not as great due to chronic rejection and chronic allograft dysfunction. The 5-year and 10-year survival of allograft from living donors are 82% and 60%. [11]

Dialysis

Despite kidney transplantation being the best management strategy for end-stage renal disease, a viable allograft isn't easily available, and not every recipient is healthy enough to undergo major surgery. This leaves patients with the option of either hemodialysis or peritoneal dialysis where the former is more commonly used. Many patients who are on the transplant waitlist have to continue with dialysis in the meantime. [13]

Hemodialysis is a highly specialized procedure that involves drawing toxin-laden arterial blood from the patient and pumping it into a dialyzer machine along with heparin to prevent coagulation. Inside the dialyzer, blood and dialysis fluid are separated by a semipermeable membrane which allows water, electrolytes, and smaller toxin molecules to pass through. The constituents of dialysis fluid are adjusted to maintain the desired gradient so that any excess electrolyte or toxin is filtered out and any deficient electrolyte is filtered into the blood. An ultrafilter is used to prevent any pathogens from entering the blood. Once the toxins and excess electrolytes are removed, the blood is infused back into the patient. [14]

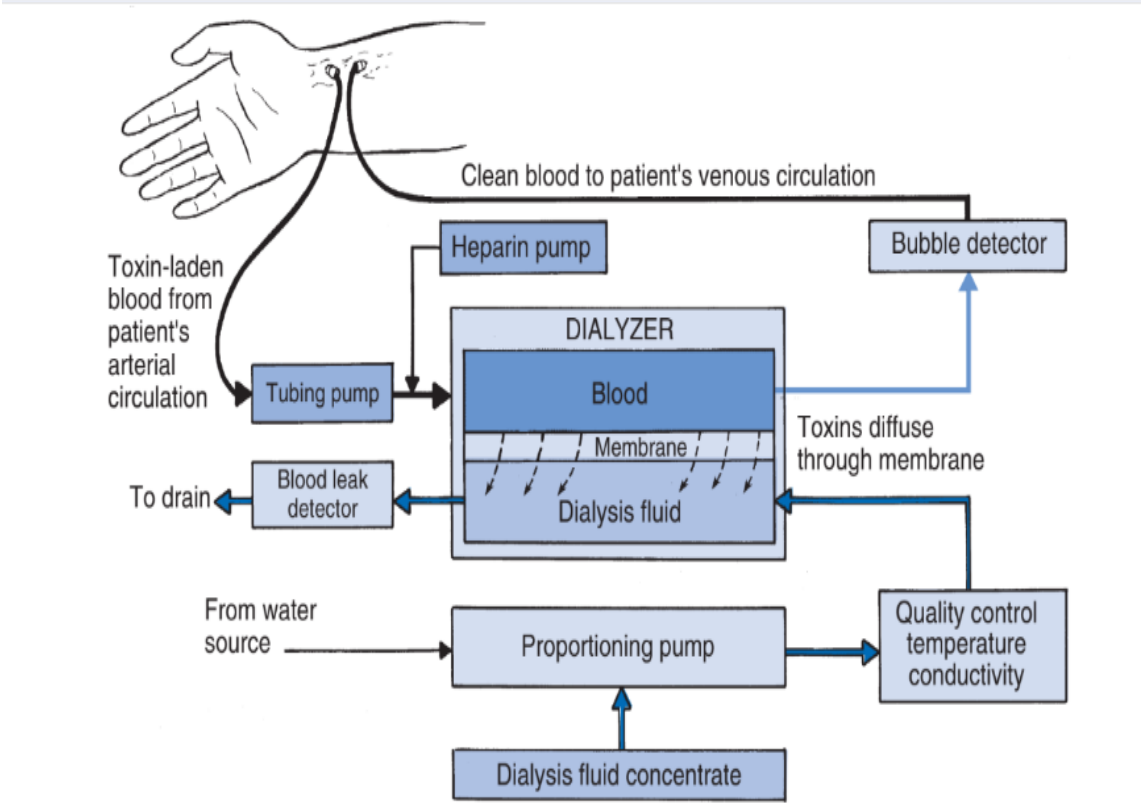


Figure: Schematic representation of hemodialysis [14]

Complications

Despite hemodialysis improving blood contents via filtration, it can often lead to other complications. Gastrointestinal bleeding due to heparin use, hypertension, malnutrition due to amino acid losses during dialysis, electrolyte abnormalities, and sepsis are some common complications. A study by Chandrashekhar A in 2014 estimated a mortality rate of 19.8% within the first 2 years of maintenance dialysis. [15,16]

Nursing care hemodialysis

The complications due to hemodialysis lead to symptoms of nausea, vomiting, cramps, skin itching,

low blood pressure, and low body temperature. Such symptoms can occur suddenly and nursing staff must be prepared to handle them. [17]

When concerned with hypotension, nursing staff need to monitor the vitals, hematocrit, and hydric condition of the patient. Fluid replacement, hydrating the patient, avoiding sudden position changes, and Trendelenburg positioning can improve blood pressure. As for nausea and vomiting, nursing staff lowers contributing factors, delivers appropriate antiemetics, and maintains personalized nutrition that favors the patient in the best way possible. Certain physical support of oro-nasal hygiene and cleaning may also be required. [17]

For muscle cramps, administration of glucose solution and hypotonic saline may be beneficial. Itching usually arises due to uremic toxins building under the skin, and are present due to renal disease, but unfortunately, hemodialysis doesn't always improve it. Anti-itching creams may be applied, and patients' nails must be kept trimmed to avoid physical injury. [17]

Due to the prolonged duration of dialysis where blood is exposed to cold environments, hypothermia may occur. Nursing staff constantly monitor the body temperatures of the patients undergoing dialysis and also look out for signs such as weakness, confusion, tremor, and color changes in the skin. Blankets, external application of warm bottles, administration of heated intravascular fluids, and arm oral liquids can avoid hypothermal episodes. [17]

The use of complicated machinery during hemodialysis also requires the nursing staff to be aware of the technical operations involved. Chances of infection during the procedure are high and the nursing staff must maintain aseptic conditions to avoid any unfortunate episodes of infection. [17]

Each session of dialysis can last 3-4 years and is conducted on alternate days which also involves multiple venipunctures that can potentiate feelings of pain, frustration, and mental discomfort. The nursing staff spends the most amount of time with these patients during the procedure. They try to make each session as painless as possible and sympathize with each patient to ease their physical and mental fatigue. [17]

In short, the nursing staff plays the role of health care provider, manager, educator, researcher, and psychosocial sympathizer for patients undergoing treatment for end-stage renal disease. [17]

Conservative management & Palliative care

Unfortunately for many patients suffering from end-stage renal disease, dialysis offers no benefits in terms of survival or life quality. These patients must resort to conservative and palliative care to ease their journey through life. Such programs support patients to live as actively and happily as possible until their deaths. [18]

Conservative management usually includes a personalized dietary plan limiting protein intake to improve urea levels. Analgesics for pain relief, anti-emetics for nausea/vomiting, antihistamines for pruritis, fluid restrictions to lessen fluid overload on kidneys, and psychosocial counseling to improve overall well-being. Conservative management slows down the eGFR loss, reduces hospital visits, and helps people maintain habits with an active lifestyle until death. [18]

CONCLUSION:

This review described end-stage renal disease in brief and discussed various modalities of management. Kidney transplant whether from a live or deceased individual is the choice of treatment. If a donor is unavailable or an allograft transplant surgery isn't possible, then hemodialysis is carried out until allograft surgery becomes possible. Unfortunately for some individuals, neither management modality is helpful and thus they rely on conservative management and palliative care.

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