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Review Article

DENTAL CARE FOR PATIENTS WITH CHRONIC RENAL FAILURE RECEIVING DIALYSIS

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ABSTRACT

Patients with chronic renal failure (CRF) have characteristic systemic and oral findings that require special consideration during dental procedures. In the present era, an increasing number of patients are living with end stage renal failure (ESRF), with supportive dialysis treatment. Before dental treatment, the practitioner should be aware of the patient's medical status. Present status for Hepatitis B, C, and HIV & Tuberculosis should be evaluated. Drugs must be administered with caution. In this article emphasis is made on pathophysiology of chronic renal failure, investigation that should be done before surgical dental procedures and comprehensive review of some of the oral manifestations which are found and being reported. The management with respect to dental care for these patients has been discussed.

Keywords: Chronic renal failure, End stage renal failure, Surgical dental procedures

INTRODUCTION

The terms "dialysis" in clinical practice is defined as the movement of solute and water through a semi permeable membrane separating the blood stream from the solution called the dialysate¹. Dialysis is an artificial means of removing nitrogenous and other toxic products of metabolism from the blood. There are two types of dialysis used to treat CRF patients;

- (a) Hemodialysis
- (b) Peritoneal dialysis

Hemodialysis employs the process of diffusion across a semi permeable membrane (cellulose acetate, supraphane etc.) to remove unwanted substances from the blood while adding desirable components. Arteriovenous fistulas and grafts are commonly used as vascular access for patients receiving hemodialysis. Unfortunately infection, thrombosis, stenosis and aneurysm are common complications of the above mentioned vascular access. During treatment patients are given anticoagulants in the form of regional or systemic heparin to facilitate blood exchange and to maintain access patency.

In peritoneal dialysis, access to the body is achieved via a catheter through the abdominal wall into the peritoneal space. A dialysate from a bag attached to the catheter passes into the cavity, where the peritoneal membrane serves as filter to

remove waste materials from the blood via the local vessels. This procedure can be either intermittent or continuous by the use of cyclical dialyzer. It is comparatively a slower process that hemodialysis and is less often used for long term treatment in patients who cannot tolerate hemodialysis or where it is contraindicated.

Today, renal transplantation is the treatment of choice for patients with irreversible kidney failure. However, the use of transplantation is limited to the availability of organs and the facilities for evaluation and operability.

End-stage renal failure (ESRF) is a stage in CRF which denotes a progressive irreversible destruction of nephrons, the functional unit of the kidneys^{2,3}. Here at this center staging the renal function is done by Creatinine Clearance Rate (CCR). ESRF is considered when CCR<10ml/min. Routine investigation that should be done before any dental procedure specially periodontal surgery and oral surgical procedures include in addition to routine kidney function tests and electrolytes the followings⁴:

- 1) Bleeding time
- 2) Platelet count
- 3) Complete blood count
- 4) Prothrombin time
- 5) Activated Partial Thromboplastin time (APTT)

- 6) Liver function test including Hepatitis B & C
7) HIV screening test.

PATHOPHYSIOLOGY:

Haematologic Effects:

The anemia is multifactorial, resulting from erythropoietin deficiency, decrease erythrocyte survival, inhibition of erythropoiesis, increased blood loss as well as malnutrition. Normochromic, normocytic anaemia due to decreased erythropoietin (EPO) production is common sequelae. Anemia of CRF is also caused by bone marrow depression by uremic toxins. Hemolysis due to poorly defined extra corpuscular effects, intestinal blood loss and some degree of hypersplensim are also contributing factors. The gene for erythropoietin has recently been ascribed to chromosome³. Expression of the patients has been demonstrated in kidney and liver in the macrophage⁴.

Haemostatic Effects:

Causes of the uremic bleeding include anemia, related reduction of platelets adhesiveness, qualitative defects in von Willebrand factor (vWF) and platelet dysfunction, including abnormalities in thromboxane and prostaglandins. No alteration in plasma coagulation factors or aberrations in fibrinolysis have been documented. However, bleeding time is increased. Use of periodic anticoagulation necessary for hemodialysis also causes bleeding in dialysis patients.

Fluid, Electrolytes and Hormonal Imbalance

Serum, sodium and volume homeostasis is largely maintained by renal function. Most individuals can tolerate an increased sodium load in diet until their glomerular filtration rate (GFR) decreases to below 10ml/min. Aberration in plasma potassium level to patients with CRF are rare until GFR decreases below 5ml/min. Hyperkalemia secondary to reduced potassium excretion occurs more often than hypokalemia. Changes in serum potassium have serious effects on neuromuscular system and myocardium⁵.

Acid base disturbances may result from changes in the potassium levels due to the rapid cellular H⁺/K⁺ exchange that occur quite rapidly throughout the body. Metabolic acidosis is often attributed to the decrease in the hydrogen buffering capacity of the urine resulting from a decrease NH₃ production. There is also decrease in serum bicarbonate levels and an increase in chloride levels to maintain electro-neutrality contributing to hyperchloremic acidosis.

Calcium and phosphate levels and bone homeostasis represents a balance between G.I. absorption, entry and release from bone stores and urinary excretion. In CRF hypocalcemia results from a decrease in intestinal absorption of calcium. This is due to the inability of the kidney to synthesize active form of Vitamin D, 1, 25-dihydroxy cholecalciferol, a necessary hormone for intestinal absorption of calcium⁵. Serum phosphate levels also begin to increase with impaired renal function enhancing calcium entry in the bone and further exacerbating the hypocalcaemia state. The decrease in calcium level provokes the release of parathyroid hormone and may induce secondary hyperparathyroidism². Renal osteodystrophy secondary to over production of PTH contributes to the development of osteitis fibrosa cystic, osteomalacia, rickets, osteosclerosis and impaired bone growth when occurs in children.

ORAL AND FACIAL MANIFESTATIONS

Patient may develop a number of orofacial changes that are not specific and definitive in the diagnosis of ESRF, but may be secondary related to systemic manifestations.

1. Patient may complain bad odour (halitosis) and metallic taste in mouth. That is due to the high contents of the urea in the saliva and its subsequent breakdown to ammonia.
2. Xerostomia may also be symptom leading to retrograde parotitis. This may be due to restricted fluid intake.
3. Pallor of the mucosa secondary due to anemia is common.
4. Uremic stomatitis in advanced stage are of two types as;
 - a. Erythrompultaceous form which is characterized by red, burning mucosa covered with gray exudates.
 - b. Ulcerative form which is characterized by frank ulceration with redness and a pultaceous covering^{6,7}. These lesions are commonly painful and often appear on the ventral aspect of the tongue and heal spontaneously with correction of the underlying uremia.
5. "Uremic Frost" is white patches seen intra orally and often associated with skin patches.
6. Dental calculus accumulates at an accelerated rate which may be related to altered serum calcium-phosphate product.
7. Gingiva is pale with diminished demarcation of the mucogingival junction. The free gingival margins are often inflamed and has hemorrhagic tendency.
8. Due to renal osteodystrophy and secondary hyperparathyroidism, there is bone demineralization in mandible or maxilla, decreased trabeculations, ground glass appearance, loss of lamina dura, radiolucent giant cell lesion and metastatic soft tissue calcification. In addition with such bone loss patients may have osseous pain, deformities, spontaneous and traumatic fractures of the jaws, as well as increased risk of fracture during oral and periodontal surgical procedure^{2,6}.
9. Other findings in renal osteodystrophy include tooth mobility, malocclusion, enamel hypoplasia and pulp stones.
10. Abnormal bone healing after tooth extraction has been reported.
11. Pulp narrowing of the tooth and calcification as well as delayed altered eruption observed.

DENTAL CONSIDERATION AND MANAGEMENT:

In the present era of advanced medicine and technology, dentists are increasingly involved to treat the patients with ESRF. In this group, things of particular concern are excessive bleeding, hypertension, anaemia, drug intolerance and synergism, increased susceptibility to infection and various oral manifestations associated with CRF itself and with dialysis treatment. Before starting emergency or elective dental procedure, the following important questions should be answered:

- 1) What is the cause of ESRF?
- 2) Present cardiovascular status and other co morbid conditions.
- 3) Medication and Medical management under Nephrologists care.
- 4) History of anemia, infection, abnormal bleeding, psychiatric disorder and bone involvement.

5) Details of dialysis regime.

High risk group of patients for developing bacterial endocarditis are those having valvulopathies, particularly calcific valvular disease due to secondary hyperparathyroidism. Most of the dental procedures can safely be performed after stabilization of medical condition. As such there is no contradiction to patients on dialysis except on peritoneal dialysis who have acute peritoneal infection.

ELECTIVE DENTAL PROCEDURES:

Most of the physicians, nephrologists are of the opinion that all elective dental procedures is best performed the day after dialysis so that the effects of heparinization have sufficiency worn off, also uremic metabolites and excess volume have been removed that might otherwise put the patient at increased chance of hemorrhage or cardiovascular risk. Stroke, angina, myocardial infarction and arrhythmias have been documented as possible side effects of dialysis induced hypotension³.

PHARMACOLOGICAL CONSIDERATION:

Prescribing medications for patients with renal failure who are undergoing hemodialysis poses a challenge to dentist. The therapeutic regimen must be maintained within a narrow range avoiding toxicity at one end and sub therapeutic dosing at the other end. Some of the drugs are nephrotoxic in nature, these must be avoided. Also excessive accumulation of drugs in the patients with renal failure should be avoided by lengthening the interval between doses according to the degree of elimination. The list of drugs commonly used in dentistry is given in Table 2.

IMMUNOLOGICAL CONSIDERATION

There is increased risk of infection in CRF patients already in an immunodeficient state due to altered cellular immunity and malnutrition resulting from protein-restricted diet. Hence these patients have significant morbidity and potential mortality following. Bacteremia due to dental manipulation. So every effort is to be made to eliminate oral sources of infection including maintaining frequent oral hygiene with regular antimicrobial and anti fungal mouth rinses.

PROPHYLAXIS AGAINST INFECTIVE ENDOCARDITIS

Patients on hemodialysis have an increased susceptibility to the development of infective endocarditis. It is said that changes in fluid volume and hemodialysis itself affect heart behavior creating mechanical stress that may play a role in the development of infective endocarditis. Thus antibiotic prophylaxis prior to dental care needs to focus on preventing infective endocarditis^{8,9}. The American heart Association protocol for prevention should be followed but modified according to the severity of renal failure.

Source I, (A & B)

The drug of choice is Vancomycin infused during dialysis^{10,6} because of renal impairment the antibiotic will protect the patient for up to seven days.

PRECAUTION ON DENTAL CHAIR

1. Place the patient in a comfortable Trendelenberg 45° angulated position.
2. If the procedure is lengthy, let the patient walk or stand to minimize risk of vascular access obstruction.
3. Arteriovenous access sites must not be jeopardized.

4. Dentist should monitor blood pressure before and during treatment.
5. If necessary sedatives can be given prior to dental procedures.
6. The use of full barrier technique should be practiced to avoid the transmission of hepatotropic viral infection such as hepatitis B & C, tuberculosis and human immunodeficiency viruses³.

SPECIAL CONSIDERATION FOR ADEQUATE HEAMOSTASIS

Most of the elective oral, periodontal endodontic surgical procedure can be performed safely after stabilization of the medical condition. Bleeding following surgical procedures may be anticipated. In addition to prothrombin time and partial thromboplastin time tests, a platelet count should be obtained and if elevated it may be signal for possible impending hemorrhage¹¹, because of its association with prostacycline levels. The addition of a bleeding time test may be useful when treating, because it is often elevated in the uremia patients, indicating platelet aggregation anomalies. Capillary fragility¹², is another potential cause of bleeding in this population.

Bleeding environment is best managed with local hemostatic procedures, good surgical technique, and primary wound closure. Whenever possible, hemostatic agents like microfibrillar collagen, topical thrombin as well as the use of electro cautery are good initial measures. Also important in the prevention of uremia bleeding is appropriate dialysis, which has been shown to improve platelet function. In controlled studies preoperative IV (0.3 gm/Kg) or intranasal (0.3 gm/Kg) dDAVP(1-deamino-8-D-arginine Vasopressin) temporarily corrected the increase in bleeding time up to 4 hours. It can also be used as a therapeutic modality in acute post surgical hemorrhage¹³. Cryoprecipitate has a peak effect in 4 to 12 hours and duration of 24 to 36 hours¹⁴. It is reserved for acute bleeding that is not easily managed in patients with renal failure.

Conjugated estrogen which has the duration of up to 30 days and peak effects in approximately 2 to 5 days may be used¹⁵. Red blood cell transfusions are acceptable for persistent bleeding. However this is not advocated until the hematocrit level becomes dangerously low and all other modalities have been exhausted.

It is recommended that immediate preoperative administration of dDAVP may provide the safe and most effective control of hemorrhage in CRF patients about to undergo minor surgical procedures. Cryoprecipitate and blood transfusion should be reserved for severe, persistent bleeding because of their disease transmission potential. Tranexamic acid and anti fibrinolytic in the form of a mouth rinse, have shown to significantly reduce operative and post operative bleeding^{16, 13}.

SOURCE¹⁸: NOTE – I (A)

Vancomycin (1.0gm) infused over one hour during dialysis the day before dental treatment. Amoxycillin (3.0gm per mouth) one hour before dental procedure; a second dose is not needed. Erythromycin Ethyl Succinate (500mg) or Erythromycin Stearate (1.0gm per mouth) 2 hours before the dental procedure, then half the dose 6 hours after the initial dose.

Clindamycin (300mg per mouth) one hour before the dental procedure, then 15-mg 6 hours after initial dose.

NOTE – I (B)

DOSES SUGGESTED FOR CHILDREN BELOW 13 YEARS¹⁹

Vancomycin 20mg/Kg infused over one to two hours during dialysis the day before dental treatment. No repeat dose is necessary.

Amoxycillin 50mg per KG body weight (max 2gm) one hour before dental procedure; a second dose is not needed.

Clindamycin (20mg/Kg), within 30 minutes before procedure.

Table I: Staging of Patients with Renal Failure

Stage	Creatinine Clearance Rate%	Condition
---	> 90%	> 90%
I	50 – 90%	50 – 90%
II	30 – 50%	30 – 50%
III	10 – 30%	10 – 30%
IV	Below 10%	Below 10%

Table II: Common Drugs Used In Dentistry & Doses Adjustment In Renal Failure¹⁷

Drug Name	Route	Adjustment Dosing Intervals (Hrs) or Dose% GFR/ml/min.			Supplement After Dialysis
		>50%	10-50%	<10%	
Antibiotics					
Amoxycillin	R, H	8	8-12	12-14	HD
Ampicillin	R, H	6	6-12	12-16	GD
Dicloxacillin	R, H	N	N	N	N
Penicillin-G	R, H	N	75%	25-50%	HD
Cephalexin	R	6	6	8-12	HD, PD
Gentamycin*	R	8-12	12	>24	HD, PD
Clindamycin	H	N	N	N	N
Erythromycin	H	N	N	N	N
Metronidazole	R, H	N	N	50%	HD
Tetracycline	R, H	12	12-18	18-24	N
Vancomycin*(IV)	R	24-72	72-240	240	24-72
Analgesics					
Acetaminophen	H	4	6	8	HD
Aspirin	H, R	4	4-6	A	HD
Ibuprofen	H	N	N	N	N
Diclofenac	H	N	N	N	N
Lidocane	H	N	N	N	N
Others					
Morphin	H	N	75%	50%	N
Codeine	H	N	75%	50%	N
Diazepam	H	N	N	N	N
Chlordiapoxidine	H	N	N	50%	N
Glucocorticoids	H	N	N	N	*

GFR = Glomerular Filtration Rate, R = Renal, HD = Hemodialysis

PD = Peritoneal Dialysis, H = Hepatic, N = None

% = Percentage of Normal Dose, A = Should be avoided

* = Serum Level should be used to determine exact dosing.

CONCLUSION

Selective dental procedures can best be performed the day after dialysis, with stabilization of medical condition and under antibiotic prophylaxis to prevent infective endocarditis. It is recommended that immediate preoperative administration of dDAVP may provide the safe and most effective control of hemorrhage in CRF patients about to undergo minor surgical procedures.

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