

Dental Management of Patients with Renal Failure

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Classification of Renal Failure

- The kidney compensates for the loss of a nephron through hypertrophy of the remaining nephrons. Thus, kidney function is maintained until roughly 50% of functional nephrons have been lost. Symptoms of renal impairment begin to emerge once this point is reached.
- Acute renal failure (ARF) is characterized by a sudden, significant reduction in glomerular filtration rate (GFR). ARF may be a result of pre-renal, intrinsically renal or post-renal causes. Patients with ARF are typically not suitable for elective dental care.
- Chronic renal failure (CRF) is characterized by a progressive loss of functional nephrons and reduction in GFR. The natural end-point of CRF is end-stage renal failure (ESRF), which can only be managed with dialysis and/or kidney transplantation.

Table 1

Acute renal failure			Chronic renal failure
Pre-renal	Intrinsic renal causes	Post-renal	
gastrointestinal losses	acute tubular necrosis	ureteral obstruction	chronic immune
excessive perspiration	(vasomotor nephropathy)	bladder obstruction	glomerulopathy
bleeding	severe cortical necrosis	bladder rupture	HTN nephrosclerosis
burns w/ fluid sequestration	severe acute	urethral obstruction	chronic tubulointerstitial
renal losses	glomerulonephritis		diseases
cardiovascular failure	vasculitis		metabolic disease
liver failure	malignant HTN		congenital/hereditary renal
	accelerated scleroderma		processes
	allergic interstitial nephritis		

Chronic Renal Failure

- CRF is diagnosed on the findings of GFR <60 mL/min, renal damage (albuminuria), hematuria and radiologic anomalies during a period greater than three months.

Epidemiology

- CRF typically increase with age, affects men more than women, shows higher incidence in Asians and Native Americans and is frequently secondary to diabetes mellitus (40-60%), arterial hypertension (15-30%), and glomerulonephritis (10%).

Diagnosis

- Renal function is inferred by assessing changes in GFR using the following methods:
 - insulin clearance (not widely used in practice)
 - creatinine clearance (common method but overestimates GFR)
 - precise 24-hour urine samples (laborious)
 - formula using serum creatinine levels (factoring in age, sex, race)

- Table 2 shows how GFR may be estimated based on plasma creatinine and clinical context

Table 2

Glomerular function % filtrate	Creatinine clearance	Blood creatinine	Clinical condition
100%	90-120 mL/min	0.5-1.3 mg/dL	Normal
>50%	>45-60 mL/min	<1.3 mg/dl	Renal compensation
25-50%	20-60 mL/min	1.3-2.5 mg/dl	Onset of clinical features of renal failure (hematuria, fatigue)
10-25%	10-25 mL/min	2.5-10 mg/dl	Established clinical disease
<10%	<10 mL/min	> 10 mg/dl	Dialysis

- Early vs Late CRF
 - GFR is a useful late stage marker of kidney disease. Early stage CRF may exhibit normal or only slightly reduced GFR and thus may mask the disease
 - As such a more useful early marker of CRF is proteinuria. Albumin (predominant protein excreted by kidneys) can be detected by reactive strip test or by other precise means

Clinical Manifestations

General

	clinical features depend on underlying systemic or renal issue and rate of renal function impairment
Arterial hypertension	common complication, resulting from retention of sodium and water, and activation of RAAS (renin-angiotensin-aldosterone system)
Uremia	presents as generalized paleness (secondary to anemia), brown hyper-pigmented nails and skin (secondary to retention of dietary pigments) and intense itching (secondary to build-up of calcium and phosphate microcrystals)
Anemia	secondary to impaired erythropoiesis
Hemostatic impairment	altered due to platelet dysfunction and anti-coagulant use in dialysis
Platelet dysfunction	increased risk of bleeding due to: <ul style="list-style-type: none"> □ diminished platelet count due to mechanical trauma from dialysis □ reduced platelet adhesion due to increased prostacyclin activity, decreased platelet factor, and decreased capillary strength
Immunosuppression	uremia results in decreased cellular immune function and impaired chemotaxis
Renal osteodystrophy	impaired mineral metabolism, increasing risk of fractures, bone defects, pain and calcifications

Endocrine dysfunction increased risk of hypoparathyroidism, delayed growth, infertility (women) and erectile dysfunction

Oral

approximately 90% of CRF patients experience oral manifestations

Uremia bad odor, metallic taste

Xerostomia due to reduced fluid intake, polypharmacy, salivary gland dysfunction and sleep apnea.

Pallor paleness of mucous membranes

Uremic stomatitis uncommon finding related to uremia
painful bleeding, hyperkeratotic ventral tongue, buccal mucosa



Bleeding gingival bleeding, petechiae, ecchymosis resulting from platelet dysfunction

Gingival hyperplasia secondary to use of cyclosporine, calcium channel blockers

Erosion erosion of lingual surfaces due to frequent vomiting and nausea

Periodontal disease

Pulp obliteration, enamel hypoplasia related to altered calcium and phosphate metabolism

Delayed dental eruption

Altered bone composition renal osteodystrophy resulting in decreased trabeculation, loss of cortication, giant cell radiolucencies and soft tissue calcifications
increased fracture risk during extractions

Caries decreased due to bacteriostatic effect of urea

Infections candidiasis, cytomegalovirus following transplantation

Mucosal lesions lichenoid lesions, oral hairy leukoplakia secondary to immunosuppression

Malignization potential increase risk of epithelial dysplasia and carcinoma following renal transplantation. Immunosuppression predisposes mucosa to viral tumors such as Kaposi's sarcoma or non-Hodgkin lymphoma.

Treatment & Prognosis

- Conservative management aims to: prevent or correct metabolic changes and preserve remaining renal function. Treatment options include a high carbohydrate, low protein diet (consensus lacking), body weight control, antihypertensive medication, lipid lowering agents, vitamin D, erythropoietin therapy

- Surgical management is only considered once conservative management fails. Management includes renal transplant or dialysis.
- Dialysis is the mechanical removal of excess water and metabolites from the blood in the context of kidney failure. Peritoneal dialysis involves placement of a catheter into peritoneum of abdomen. Filtration takes place via osmotic flow. Hemodialysis (HD) involves a dialyzer, which carries blood through a semipermeable membrane and filters out toxins and metabolites. Usually performed three days a week, which requires a permanent vascular access in the form of a catheter or arteriovenous fistula. HD patients receive anticoagulants such as heparin to ensure a permeable vascular access and constant blood flow through the dialyzer.
- Renal transplantation is indicated in patients with irreversible renal failure. Patients receive immunosuppressive therapy before and after surgery to prevent rejection. This persists for life unless the organ was donated by an identical twin.
- Infections remain the second leading cause of mortality in CRF. Vaccinations and careful monitoring are critical to prevent establishment of infection
- Life expectancy of dialysis patients are 1/3 of the general population. Commonest cause of death related to ESRF include cardiovascular issues, infections, and malignization.

Dental Management of Renal Failure Patients

- General modifications:
 - Multidisciplinary approach to health care involving creation of dental plan in context of patients overall medical status
 - Consultation with patient's nephrologist to determine the state of the disease, treatment being received, ideal timing for dental treatment, and possible medical complications that may arise. Proposed changes to patients' medications or treatment timing must discussed with the nephrologist.
 - Prior to invasive dental treatment must obtained complete blood count and/or coagulation tests to identify any alterations
 - Prompt elimination of sources of infection or oral trauma
 - Consideration for antibiotic prophylaxis when treatment involves bleeding or risk of septicemia (extractions, periodontal therapy, endodontics, periapical surgery, orthodontic braces, implant surgery, reimplantation).
 - Continuous cardiac monitoring in combination to stress reduction methods (sedation)
 - Dose adjustment of drugs whose pharmacokinetics are altered in context of renal failure
- Pharmacologic modifications (Table 3)
 - Avoid aminoglycosides, tetracycline's due to nephrotoxicity
 - Usual doses of penicillin, clindamycin, cephalosporin's may be administered *but* at a prolonged dosing interval
 - Acetaminophen remains analgesic of choice. Due to the prolonged antiplatelet activity, aspirin should be avoided in patients with uremia. NSAIDs require dose reduction or complete avoidance in advanced renal failure as they impart a hypertensive effect
 - Benzodiazepines do not require dose adjustments, however excessive sedation may occur
 - Medications primarily metabolized by the liver, including narcotics (codeine, morphine, fentanyl) do not require dose adjustment

- Modifications for dialysis patients
 - Peritoneal dialysis patients require no special modifications beyond the general precautions listed above
 - Hemodialysis patients should receive dental care on non-dialysis days in order to prevent excess bleeding. Heparin which has a half-life of four hours, must be eliminated from circulation prior to treatment. Invasive treatment should be preceded by complete blood count and coagulation tests. Local hemostatic measures must be available, including mechanical compression, sutures, topical thrombin, microfibrillar collagen and oxidized cellulose. Additional hemostatic measures may include desmopressin for severe bleeding renal failure patients, conjugated estrogens, and tranexamic acid rinse or oral tablet (10-15 mg/kg/day).
 - Antibiotic prophylaxis remains controversial for these patients. In general, patients with central lines may receive antibiotics one hour prior to dental treatment to prevent bacterial endocarditis.
- Transplant patients
 - Elective dental care should be avoided within the first 6 months after transplantation
 - All sources of infection and hopeless teeth must be extraction prior to transplantation
 - Risk of oral infection after transplantation is very high due to concurrent immunosuppressive therapy. Antibiotic prophylaxis is a necessity before invasive dental care.
 - Stress dosing may be required for patients receiving prolonged corticosteroids

Table 3

Drug	Elimination	Adjustment	Adjustment according to GFR (mL/min)		
			>50	10-50	<10
Antimicrobials					
amoxicillin	R(H)	↑ interval	8 hr	8-12 hr	12-18 hr
ampicillin	R(H)	↑ interval	6 hr	6-9 hr	9-12 hr
clindamycin	H	no changes	--	--	--
metronidazole	H (R)	↓ dosage	100%	100%	50%
erythromycin	H	↓ dosage	100%	100%	50-75%
tetracycline	R(H)	↑ interval	6-8 hr	12-24 hr	avoid
doxycycline	H (R)	no changes	--	--	--
acyclovir	R	↑ interval	8 hr	12-24 hr	48 hr
ketoconazole	H	no changes	--	--	--
Analgesics					
ASA	H (R)	↑ interval	4 hr	4-6 hr	avoid
acetaminophen	H (R)	↑ interval	4 hr	6-8 hr	8-12 hr
ibuprofen	H (R)	↓ dosage	100%	100%	avoid
diclofenac	H	↓ dosage	100%	100%	avoid
naproxen	H	↓ dosage	100%	100%	avoid
Sedatives					
codeine	H (R)	no changes	--	--	--
diazepam	H	no changes	--	--	--
alprazolam	H (R)	no changes	--	--	--

Anesthetics

lidocaine	H	no changes	--	--	--
mepivacaine	H	no changes	--	--	--

Others

prednisone	H	no changes	--	--	--
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R = mainly renal elimination; H = liver metabolism. Parenthesis represents 2ndry elimination route.

D = dose reduction as % of usual dose; I = prolongation of dosing interval in hours.

Summary

- Approximately 90% of patients with chronic renal failure present with oral manifestations
- Treatment of CRF ranges from conservative management such as life-style changes to invasive procedures such as dialysis or kidney transplantation
- Dental management requires prior consultation with patient's nephrologist to determine status of the disease, timing for dental care, as well as procedural and pharmacologic modifications
- Modification include timing dental care on non-dialysis days, obtaining CBC prior to invasive treatment and considering antibiotic prophylaxis for patients with central lines.
- Drug modifications include avoidance of tetracycline and aminoglycosides, and dosing interval of penicillin, clindamycin and cephalosporin
- Multidisciplinary approach to patient's health care is critical to ensure patients safety and prevent complications in the dental chair

References

Cerveró, A. Jover, et al. "Dental management in renal failure: patients on dialysis." *Med Oral Patol Oral Cir Bucal* 13.7 (2008): E419-26.