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Dental Concern of Children with Renal Diseases - A Narrative Review

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ABSTRACT

Renal failure leads to a drop in glomerular infiltration rate which results in progressive hypertension, fluid retention and build-up of metabolites that are not excreted normally.

Disorders of the kidneys can be classified into the following diseases or stages: disorders of hydrogen ion concentration (pH) and electrolytes, acute renal failure (ARF), chronic renal.

Failure (CRF) and end-stage renal failure to uremic syndrome. Burning sensation of the lips and tongue. Children usually exhibit growth retardation, bleeding tendency due to capillary fragility and thrombocytopenia is positive, pale and anaemic. Caries rate is lower in children with end stage renal disease, possibly caused by ammonia being released in saliva. Teeth calcifying during renal failure will exhibit chronological hypoplasia or hypomineralisation and teeth may be brown or green due to incorporation of blood products such as biliverdin. Pale oral mucosa, uremic stomatitis, enamel hypoplasia and dry mouth due to decreased salivary secretion. Drugs to be avoided are paracetamol, pencillin, tetracycline and chloramphenicol. Bleeding is a prime concern. Appropriate precautions should be taken, including aggressive local hemostatic measures. Extractions, placement of orthodontic brackets, removal of calculus, periodontal treatment, endodontic procedures, implants, periapical surgery, reimplantation procedures done under antibiotic prophylaxis. Avoid aspirin and NSAIDs. Other analgesics should be prescribed. This article discuss about aetiology, clinical features and management of children with renal diseases.

INTRODUCTION

Kidneys are vital organs for maintaining a stable internal environment (homeostasis). The kidneys have many functions, including regulating the acid-base and acid~elcctrolyte equilibria of the body by filtering blood, selectively reabsorbing water and electrolytes and excreting urine. In addition, the kidneys excrete metabolic waste products, including urea, creatinine and uric acid, as well as foreign chemicals. Apart from these regulatory and excretory functions, the kidneys have a vital endocrine function, secreting renin, the lively form of vitamin D and erythropoietin. These

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hormones are important in maintaining blood pressure, calcium metabolism, and the synthesis of erythrocytes respectively [1,2].

Prevalence of Chronic Renal disease is increasing worldwide. Information is limited on the epidemiology of renal diseases in children due to asymptomatic in early stages as well as under diagnosed and under reported [3]. It was reported that the prevalence of CRD to be 6-16% in Australia, Europe and Japan whereas in Asia it is 12-16%. Disorders of the kidneys can be classified into the following diseases or stages: disorders of hydrogen ion concentration (pH) and electrolytes, acute renal failure (ARF), chronic renal failure (CRF) and end-stage renal failure (ESRF) or uremic syndrome [4,5].

Renal Failure

When nephrons get destroyed to an unrepairable extent and beyond repair, kidneys go back into compensatory mechanism through the hypertrophy of remaining nephrons in order to maintain normal kidney function. There are two forms of renal failure. 1. Acute renal failure 2. Chronic renal failure

Acute renal failure: It is rapidly progressive loss of renal function characterized by sudden decrease in glomerular filtration rate (GFR) lasts for hour's upto days. The loss is characterized by decreased urine production that is qualified less than 400 ML/day for adults and 6.5 Ml/kg/hour for children and 1 mb/kg/hour in infants. Other manifestations are electrolyte disturbances and body fluid derangements. The underlying causes have been given (**Table 1**). Removal or treatment of underlying cause should revert the condition [6-8].

Table 1. Etiology of acute renal failure.

Prerenal	Intrinsic renal failure	Postrenal
Excessive perspiration	Severe cortical necrosis	Urethral obstruction in case of single kidney
Bleeding	Vasculitis	Bladder rupture
Burns	Accelerated scleroderma	Bladder obstruction
Renal loser	Allergic interstitial nephritis	
GI loser	Vasomotor nephropathy	
Liver failure	Severe acute glomerulonephritis	
Cardiovascular failure		

Chronic renal failure: It is also known as chronic kidney disease as it develops slowly, with few initial symptoms and is a long term result of irreversible acute disease or untreated disease progression. CRF is characterized by gradual reduction in the number of functional nephrons sufficient to produce alterations in the well-being and hampering the organ function. GRF rate falls less than 60 ML/min. Failure of kidney failure depend upon the degree of intoxication [9,10].

Etiology: Glomerulonephritis, pylonephritis, interstitial nephritis, diabetes, antihypertensive drugs (eg. Acetamimphen rarely), calculi, pylocystitic kidney, systemic lupus erythematosus [9].

Classification of CRF according to severity of failure as determined by the GFR (**Tables 2-4**).

GFR (Glomerular Filtration Rate) is the volume of fluid filtered by the kidney per minute and is normally 20 ml/min. it is restrained by creatinine clearance.

Table 2. Classification of chronic renal failure.

Mild CFR	GFR 30-50 ml/min
Moderate CFR	GFR 10-29 ml/min
Severe CFR	GFR 5-9 ml/min
End-Stage Renal Failure (ESRF)	GFR <5 ml/min

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Table 3. Symptoms of chronic renal failure.

Increased level of urea in the blood may lead to	Nocturnal urination
	Frequent urination in smaller amounts
	Pale urine, Foamy for bubbly urine,
	Difficulty in urinating, Weight loss, Nausea, Vomiting, Blood in urine
Increased levels of phosphates may cause	Muscular cramps
	Itching, Bone damage
Accumulation of potassium may lead to	Hyperkalemia, Muscular paralysis, Disturbed heart rhythm
Increased production of erythropoietin ultimately resulting in anemia that causes	Weakness, Loss of memory, Dizziness, Hypotension, Difficulty in concentrating
Failure to remove excess fluids results in	Shortness of breaths due to overload on lungs, oedema of face, eyelids, ankle and feet
Other symptoms include	Metallic taste in the mouth, loss of appetite due to altered taste, hyperpigmentation of skin, difficulty in sleeping

Table 4. Clinical manifestations of CRF.

Neurological disorders	Fatigue, lethargy, sleep disturbances, headache, seizures, encephalopathy, peripheral neuropathy including restiess leg syndrome, paresthesia, motor weakness and paralysis
Hematologic disorders	Anemia, bleeding tendency-due in part to platelet dysfunction
Cardiovascular disorders	Pericarditis, hypertension, congestive heart failure, coronary artery disease and myocardiopathy
Pulmonary disorders	Pleuritis, uremic lung
Gastrointestinal disorders	Anorexia, nausea, vomiting gastroenteritis, gastrointestinal bleeding and peptic ulcer
Metabolic endocrine disorders	Glucose intolerance, hyperlipidemia, hyperuricemia, malnutrition, sexual dysfunction and infertility
Bone, calcium phosphorus disorders	Hyperphosphatemia, hypocalcemia, tetany, metastatic calcification, secondary hyperparathyroidism, 1,25-dihydroxy vitamin D deficiency, osteomalacia, osteoporosis and osteosclerosis
Skin disorders	Pruritus, pigmentation, easy bruising and uremic frost
Psychological disorders	Depression, anxiety, denial and psychosis
Fluid and electrolyte disorders	Hyponatremia, hyperkalemia, hypermagnesemia, metabolic acidosis, volume expansion or depletion

Oral Manifestations

Children with renal diseases show oral signs and symptoms in soft and hard tissues.

There is an increased level of urea in the blood which is mainly due to reduced function of kidney. This is also seen in most of the hemodialysed patients. Children are usually caries free, this could be due to increased salivary urea that splits into ammonia and CO_2 that raises the pH above the critical pH [11-13].

Halitosis is of uremic origin and generally followed by uremic stomatitis, in addition to this an unpleasant, metallic taste. Apart from urea, other factors feasibly inferred are the increase in the concentration of phosphates and proteins and changes in the pH of saliva [14].

The high levels of urea, the presence of dimethyl-and trimethyl-amines, or low zinc levels (due to the malabsorption derived from gastrointestinal disorders) gives rise to alteration in the taste especially sweet flavors [15].

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Enlarged tongue and burning sensation of the lips and tongue are interesting findings in these patients [4,16].

Salivary secretion is decreased due to the effects of medication, further leads to mouth breathing [17].

Due to the decrease in the synthesis of erythropoietin, gives raise to anemia as well as paleness in the mucosa [18].

Stomatitis can be described as thickened and reduced buccal mucosa with layer of pseudo membrane covering oral mucosa gingival, soft palate and pharynx. Vincent infection is common in cases with uremic stomatitis [14,19].

With respect to dental anomalies in these patients delayed eruption of the teeth has been reported children with CRD. There is alterations in calcium and phosphorus metabolism leads to enamel hypoplasia [20].

CRF or its treatment involve both the soft and hard tissues and include:

Pallor of the oral mucosa, uremic Stomatitis, gingival bleeding, petechiae and echymoses; Gingival inflammation; Gingival overgrowth; Periodontal disease; Enamel hypoplasia; Pulp obliteration; Osseous changes of the jaws; Reduced prevalence of dental caries [21].

Gingival inflammation: Decreased salivary secretion and accumulation of plaque leads to poor oral hygiene which further leads to gingival inflammation.

Gingival inflammation has been reported, due to plaque accumulation and poor oral hygiene habits. Oral hygiene has the potential to reduce the inflammatory component of gingival disease in patients with renal failure. Gingival bleeding, easy bruising. Petechiae and ecchymosis occur due to platelet dysfunction and heparin therapy/blood thinner (dialysis patients). Low incidence of gingival inflammation but may respond varyingly in response to plaque accumulation. Gingival hyperplasia secondary to medications used in renal transplant such as cyclosporine or calcium channel blockers in dialyzed patients. Hyperplasia mainly affects the labial surface of interdental papilla; gingival margins of lingual or palatal surface may get affected as well [8].

Gingival overgrowth (GO): Drug induced gingival over growth is common especially cyclosporine which alters the fibroblast metabolism. Other problems associated with this are delayed eruption of the teeth, speech is impaired, unpleasant appearance, interfere with normal function and ultimately difficult to maintain oral hygiene.

Gingival overgrowth (GO) is believed to be related to the following: As an alteration of the fibroblast metabolism by cyclosporine and or its metabolites: increasing protein synthesis; collagen; extra-cellular matrix formation [22-24].

Laser surgery's potential advantages include: Decreased bleeding and postoperative trauma; No need for sutures; Faster healing; Reduced infection risk and; Shorter procedure and recovery times [22-24].

Cytomegalovirus infections are common post-transplant Candidiasis and herpes virus infection are common due to prolonged immunosuppression [22,25].

Lichenoid reactions are medicine associated; drug induced oral hairy leukoplakia (OHL). Epstein-Barr virus can be seen in primary infection of oropharynx where the virus gets latent in epithelium and gets reactivated upon immunosuppressant manifesting itself as OHL/tongue lesions [7].

Increased risk of virus related malignization such as Kaposi sarcoma or non-Hodgkin's lymphoma. Xerostorma is generally due to fluid restriction and medium induced along with salivary gland dysfunction. Pale mucosa] membrane can be due to anaemia resulting from reduced erythropoietin production.

Delayed eruption of tooth as well as discoloration also reported.

Severe erosions have been seen on the lingual surface of the teeth due to frequent vomiting induced by uremia, regurgitations and dialysis associated nausea and medications.

Enamelhypoplasia: Enamel hypoplasia is mainly due to disturbed calcium and phosphorous metabolism which correlate with age. Treatment varies from composite restorations to full crown coverage based on the severity and extent of the defect [7,9].

Pulp obliteration: Pulp obliteration is important finding which is should be diagnosed as early as possible [9].

Renal osteodystrophy: Secondary to renal osteodystrophy, changes in jaw trabeculation cortical loss, demineralised bone (ground glass appearance), and calcified extraction site brown tumors manifested as localized radiolucent brown tumours [26].

Osseous changes of the jaws: Classically, the triad of loss of laminadura, demineralized bone (“ground-glass”), radiolucent jaw lesions which are localized and apparent. In addition to this bony fractures and bone tumors from secondary hyperparathyroidism may take place (**Figure 1**) [27-30].

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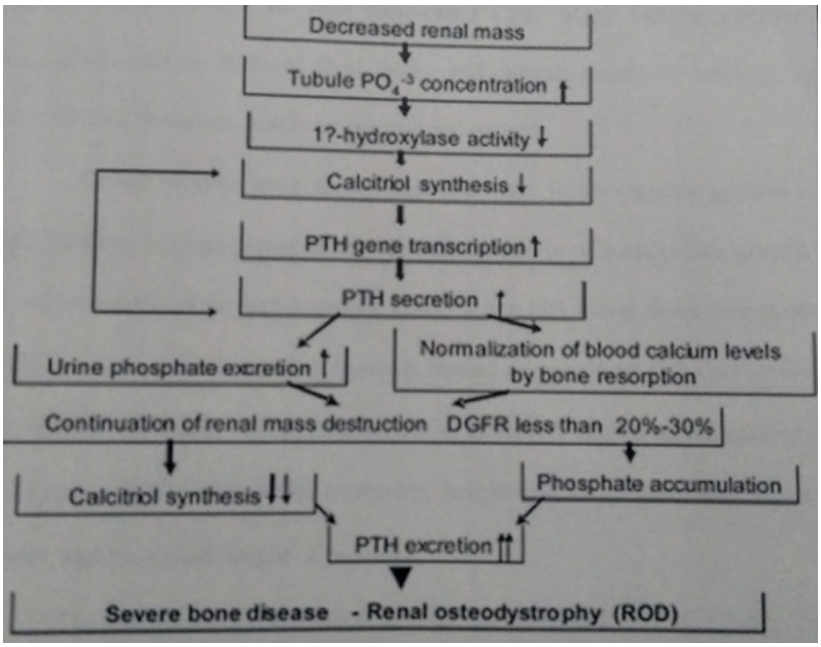

Figure 1. Flow chart of severe bone diseases and renal osteodystrophy.

Dental management: Patient with renal failure requires special attention as being an end-organ disease, it does not only involve manifestations from multiple systems, but it can also have multiple side effects from me Wat rendered to the patient [31-33].

In any situation consultation with nephrologist is mandatory at all the time. Any modification required for prescribed medication should be done without consulting a nephrologist.

Working in close conjunction with physician/treating nephrologist will work on the best interest of patient (**Table 5**).

Table 5. Procedure indicated under antibiotic prophylaxis.

Extractions
Placement of orthodontic Bracket
Periodontal treatment, Calculus removal
Endodontic procedure
Periapical surgery
Reimplantation
Implants

As these patients are likely to have hematologic alterations, CBC and coagulation test should be doing: Before attempting any invasive procedures. Prophylactic antibiotic therapy as these patients a very prone to infection. Penicillin, clindamycin and cephalosporin are usually indicated. History should be taken regarding the allergies of penicillin. Avoid nephrotoxic drugs such as tetracycline or streptomycin. Due to poor GI resorption antibiotic should administer by IM route.

Local anaesthesia used should be of amide typo: such as lidocaine xylocaine because of their resorption potential of the liver. As per analgesics, paracetamol la the drug of choice, non-steroidal anti-inflammatory drugs should be adjusted or avoided in case of advance renal failure. Benzodiazepines of narcotic analgesic are metabolized via liver so does not require dose adjustments. Administration of relative analgesia to reduce anxiety.

For dialysis patients: Provide treatment on no dialysis days; Consult nephrologist for heparin dose adjustment

For dialysis patients:

1. At each visit, patient medical history and medication list should be checked.

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2. Carry out dental treatment of haemodialysis patients on non-dialysis days to ensure absence of circulating heparin.
3. Prefer use of local anaesthetics with reduced epinephrine in all dialysis patients
4. Withhold anticoagulants for a period of time agreed upon with the nephrologist.
5. Be aware that meticulous local haemostatics measures, including mechanical pressure, packing, suturing and topical thrombin, may be required, given the platelet dysfunction that often occurs in patients with renal failure [10,13,16,22].
6. Desmopressin controls severe bleedings.
7. Conjugated oestrogen achieves longer haemostasis.
8. Tranexamic acid for oral rinse
9. Lidocaine, narcotics (except meperidine) and diazepam can be used safely in patients with renal failure. Dose adjustment is needed for aminoglycosides and cephalosporin. Tetracycline is generally not recommended in patients with end-stage renal failure. Most of the nephrologists agree to the use of non-steroidal anti-inflammatory drugs, as dialysis patients usually have little salvageable renal function.
10. See the patient for dental check-ups as regularly as would be the case if they were not undergoing dialysis.
11. Complete all necessary dental care before the surgery. For patients being considered for transplantation.
12. Use antibiotic prophylaxis, if recommended by the patient's nephrologist, before extractions, periodontal procedures, placement of dental implants, re-implantation of avulsed teeth, endodontic instrumentation or surgery (beyond the apex only), sub-gingival placement of antibiotic fibres or strips, initial placement of orthodontic bands and intra-ligamentary injections of local anaesthetic. Advise the patient about the need for the antibiotic, such that it can be prescribed and taken just before the dental visit.
13. Advise patients to avoid chewing on ice; instead, recommend that they suck on the ice or chew sugar-free gum.
14. Alcohol-free mouthwashes are used to reduce oral dryness. Alternatively, recommend a saliva substitute.
15. Follow universal precautions. Dialysed patients due to numerous transfusion are at risk of developing hepatitis B, C, HIV and tuberculosis.

For patients of renal transplant:

1. Evaluate and eliminate the foci of infection before transplant.
2. All the elective dental procedures should be avoided first 6 months post renal transplant.
3. Prophylactic antibiotic therapy is mandatory.
4. A recommended dose of 25 mg of hydrocortlume via IV route before the procedure.
5. Uremic stomatitis can be treated with 10% hydrogen peroxide gargles (1:1 in water) 4 times a day.
6. Immunosuppressive therapy is given lifelong.
7. For candida infection, systemic anti- fungal agents are used.
8. Gingivectomy is indicated for gingival overgrowth to improve functional discomfort and aesthetic alteration [22,34-37].

These patients are at increased risk of developing oral infections are poorly controlled by the patient with CRF. They may giving rise to septicemia, and also accelerate tissue catabolism causing clinical deterioration (**Tables 6-8**).

These patients are at increased risk of developing oral infections are poorly controlled by the patient with CRF. They may giving rise to septicemia, and also accelerate tissue catabolism causing clinical deterioration (**Tables 9 and 10**).

Table 6. Stress-reduction guidelines.

1. Patients physician should be consulted, to accurate the requirement for supplementary steroids.
2. Patient should get proper rest in the night prior to the treatment.

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3. Dialysis patients should be scheduled in the morning the day after dialysis therapy, when the patient's health is best suited for dental treatment.
4. Prefer short period appointments.
5. Barbiturates, benzodiazepines, meperidine and chloral hydrate can usually be used in normal amounts.
6. Nitrous oxide oxygen therapy is an excellent anxiolytic regimen accepted well by patients with renal disease.

Table 7. Chair position.

1. Sit the patient in the semi reclined position or in a position that is most comfortable.
2. Provide breaks during treatment, as needed.
3. Local anesthesia can be used safely.
4. Administer immoral anesthetics slowly, with aspiration.

Table 8. Antibiotitic guidelines.

Culture and sensitivity testing is recommended whenever oral infection is present.
Provide antibiotic prophylaxis for dialysis patients to protect against endocarditis.
Consultation with the physician to determine dosage and frequency of administration is advised.
As long as patients are not hypersensitive to the drug oral penicillin can be used without any problem.
Tetracycline should be avoided. Doxycycline or minocycline should be substituted and nephrotoxic like Aminoglycosides (gentamycin, streptomycin, tobramycin) and should be eluded.
Cephalosporins may be nephrotoxic and should be used with caution.

Table 9. Infection control.

1. Antibiotic prophylaxis and oral antimicrobial rinses should be deliberated
2. Oral infection should be created early to minimize complications.
3. Gloves, masks, and eye protection is mandatory
4. Aseptic protocol must be followed.
5. Contact with blood, saliva, and aerosols should be minimized by using a rubber dam and high velocity evacuation, while limiting the use.
6. Cross-contamination is reduced by wrapping objects subject to touch and providing for all instruments required in a single sterile package.
7. Before sterilization, all the contaminated instruments should be free of all bodily fluids.
8. Contaminated disposable supplies should be discarded in labeled biohazardous bags.
9. Instruments should be sterilized by autoclaving, dry heat, or ethylene oxide gas.

Table 10. Hemorrhagic dental procedures.

1. Avoid hemorrhagic procedures with in the first 8 hours after hemodialysis.
2. Provide orophylactic antibiotic to prevent infection
3. Obtain preoperative complete blood count (RBC), differential, bleeding time, PT, and AP
4. Give attention to good surgical technique and closure.
5. To prevent bleeding after minor surgery, use microfibrillar collagen, topical thrombin.

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6. Consider desmopressin or cryoprecipitate for major surgical procedures.
7. Avoid “needle sticks”, but if they occur, the patient should be screened for HBAg’s and HIV

Dental Emergencies

Palliative emergency treatment should be administered: Bleeding is a prime concern. Appropriate precautions should be taken, including aggressive local hemostatic measures. Avoid aspirin and NSAIDs. Other analgesics should be prescribed. Aspirin containing analgesics and other NSAID should be avoided in the patient with renal failure, which may induce nephrotoxicity. These agents also increase bleeding tendencies. As an alternative acetaminophen. Barbiturates, or narcotics can be used [38-41].

CONCLUSION

The management proposed for a patient with renal disease depends on his/her current clinical status. Patients with decreased renal reserve, but without clinical signals and symptoms, can be treated conservatively as long as drugs with renal metabolism are not prescribed. Because drugs that are metabolized in kidneys can cause toxicity and aggravate the patient's condition, even if administered in usual doses.

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