Dental Management of Chronic Kidney Disease patients
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CHRONIC KIDNEY DISEASE

Good morning friends in this lecture series on medically compromised patients. Today we will be discussing about the Dental Management of Chronic Kidney Disease patients or Chronic Renal failure patients or CKD patients.

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Now, at the end of this discussion, we should be able to talk about the functions of kidney, manifestations of CKD, stages, and dental considerations in CKD patients.

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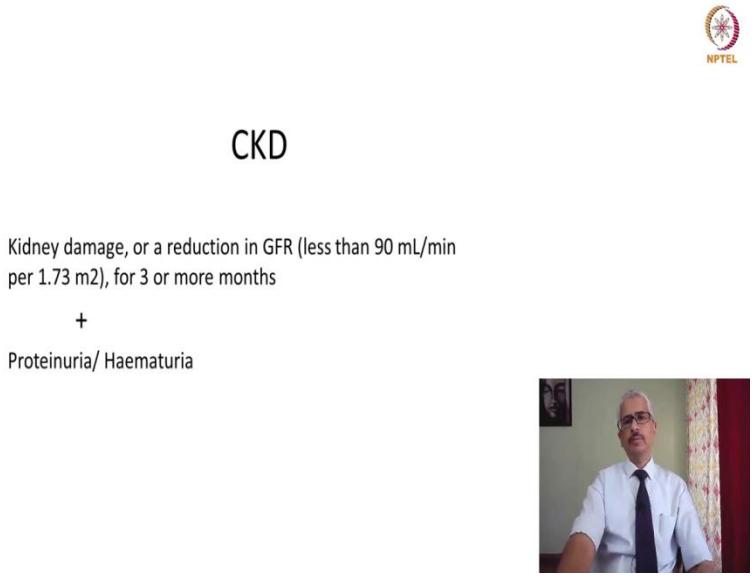

Now, chronic kidney disease is basically a progressive disease of the kidney which is characterized by reduction progressive reduction in the function of the kidneys over a period of months or years. Now, this reduction in the function is due to reduction in the number of nephrons. Nephrons are the functional unit of kidneys. Now, as there is a reduction in the function of the kidneys due to reduction in the count of nephrons, we see a reduction in GFR or GFR or the Glomerular Filtration Rate is a very sensitive indicator of the function of the kidneys.

So, that GFR or glomerular filtration rate is the rate at which the ultra filtrate is created in the glomerulus. So, the normal values of GFR is 130 per ml, 130 ml per minute per 1.73 meter square. Now, the definition of the CKD is also based on the GFR. So, the CKD has been defined as kidney damage or reduction in GFR is less than 90 ml per minute per 1.73 meter square for 3 or more months, this is a along with the presence of Proteinuria or Hematuria.

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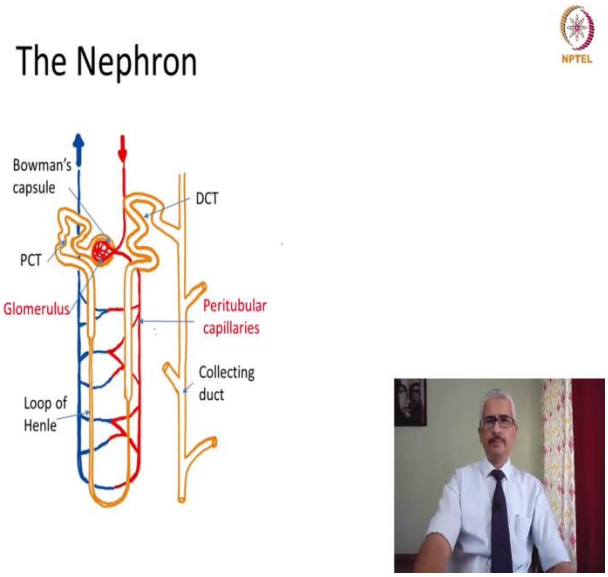

Now, we said that the nephron is the functional unit of kidney. So, let us look at little in a little bit more detail about the structure of nephron. So, the nephron consists of the Bowman's capsule, Proximal Convoluted Tubule, Loop of Henle, Distal Convoluted Tubule, finally draining into the collecting ducts.

Now, the vascular system, which is lying in close proximity to the nephron consists of an afferent arteriole which forms a high pressure capillary bed called as glomerulus. Now, this glomerulus is characterized by a capillary bed which is having high pressure and thin walls so, thin wall and high pressure is conducive for formation of the ultra filtrate here, the efferent vessel is also an arterial which goes on to create the next set of capillaries called peritubular capillaries.

Now, these peritubular capillaries basically lie in close proximity to the tubular cells and thereby it facilitates exchange of water, electrolytes and other substances between the ultrafiltrate and the blood vessels.

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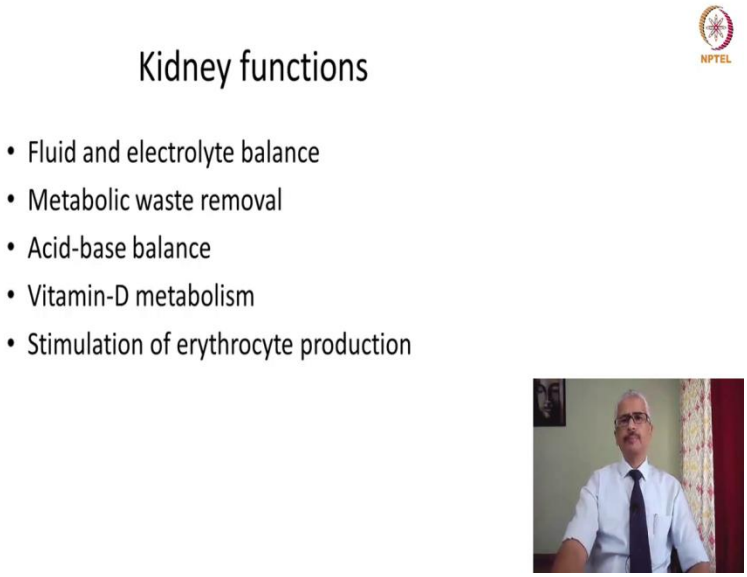

Now, kidney has many important functions, it has a role in fluid and electrolyte balance, it plays a role in metabolic waste removal, acid base balance, vitamin D metabolism and stimulation of erythrocyte production. So, let us look at some of these functions in detail.

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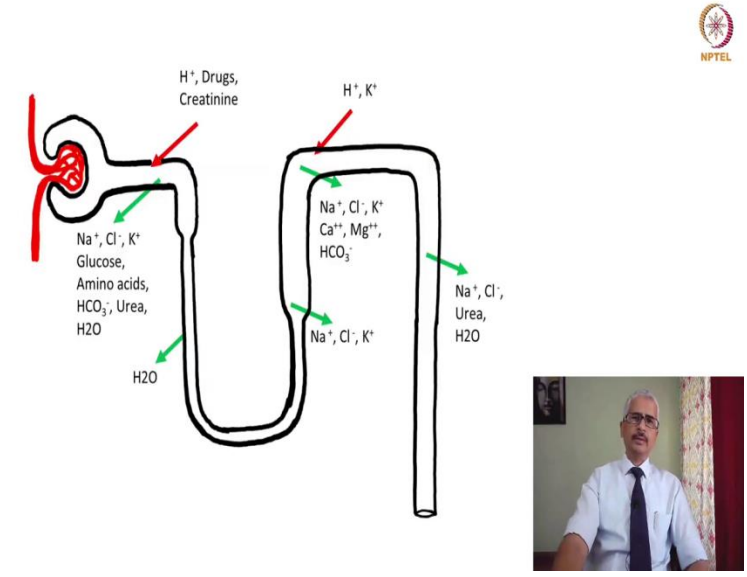

Now, kidney is one of the most important sites where the regulation of water and electrolyte takes place. So, different areas of the nephron either it secretes certain electrolytes and other areas reabsorbed the electrolyte, so, in the proximal convoluted tubule we have secretion of hydrogen

ions, drugs, creatinine, and there is reabsorption of sodium ions, chloride, potassium ions, glucose, amino acids, bicarbonate ions, urea and water.

In the descending limb of the Loop of Henle, we have reabsorption of water and in the thick ascending limb of the Loop of Henle we have reabsorption of sodium chloride and potassium ions.

Now, in the distal convoluted tubule there is a primary site for secretion of hydrogen ions and potassium ions whereas at the same site, reabsorption of sodium ions, chloride ions potassium, calcium, magnesium and bicarbonate ions take place. In the collecting duct there is net reabsorption of sodium chloride ions urea and water.

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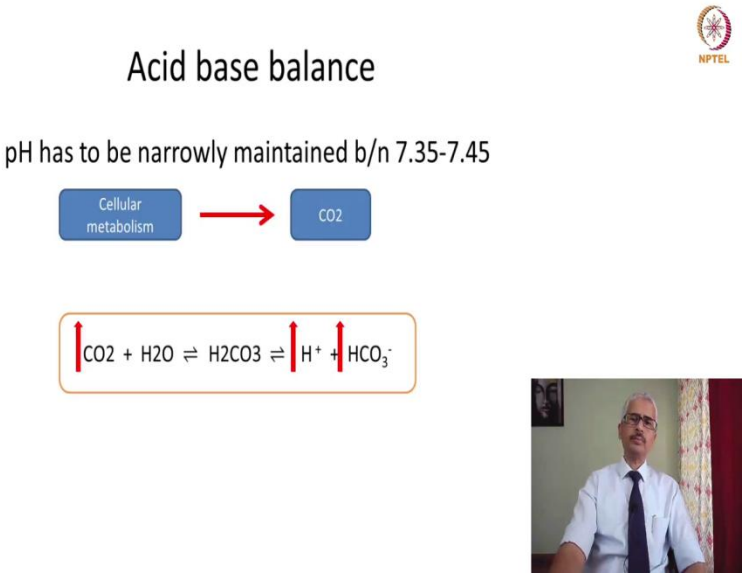

Now, one of the most important functions of kidney is maintenance of acid base balance. Now, body's pH has to be narrowly maintained between 7.35 and 7.45. Now, this very narrow range of pH is essential for many or most of the biochemical reactions that are going on in body. This is also essential for the respiration cellular respiration that takes place. Now, at a cellular level, aerobic cellular respiration is the basic requirement for life. One of the end products of this cellular respiration aerobic cellular respiration is carbon dioxide.

Now, this carbon dioxide is an important element which plays a big role in the acid base balance. Now, carbon dioxide combines with water to form carbonic acid. Now, this carbonic acid dissociates into hydrogen ions and bicarbonate ions now, this reaction is in equilibrium what is it

mean? It means that whenever there is increase in the carbon dioxide level, there is going to be an increase in the hydrogen ions and whenever there is a decrease in the carbon dioxide, there is going to be a decrease in hydrogen ions.

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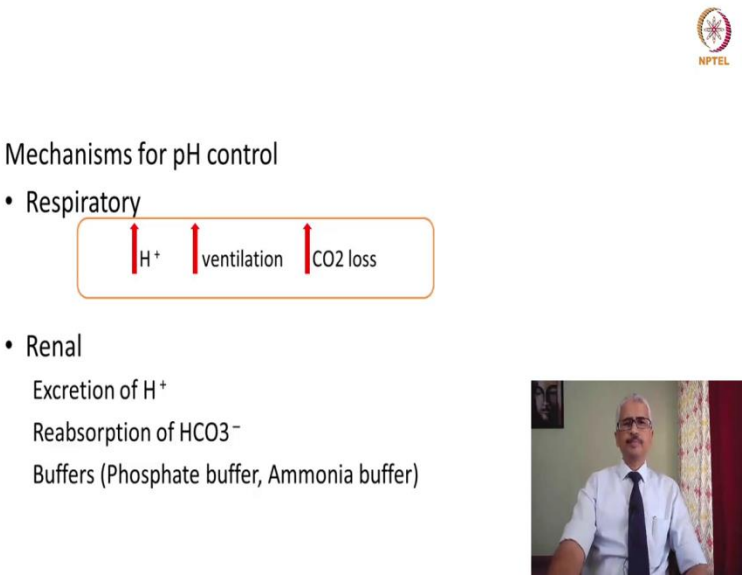

Now, the mechanism of pH control in body is basically by either respiratory mechanism or by renal mechanism. The respiratory mechanism controls the pH by controlling the carbon dioxide loss. So, whenever there is a need to increase the hydrogen ions in the body, there is increased whenever there is an increase in hydrogen ion of the body there is increased ventilation and there is increased carbon dioxide loss. So, we have seen the equilibrium reaction earlier that wherever there is increase in the carbon dioxide loss, there is going to be decrease in the hydrogen ions in the body.

Now, the other mechanism is the renal mechanism in which there is excretion of hydrogen ions, and there is reabsorption of bicarbonate ions. Kidneys are also a site of phosphate and ammonia buffer system. So, let us look at this renal mechanism of maintenance of the pH in little bit more detail.

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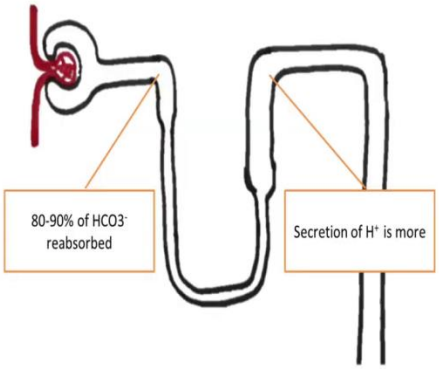

So, most of this action of the regulation of the pH is happening at either proximal convoluted tubule or at the distal convoluted tubules. So, at the proximal convoluted tubule 80 to 90 percent of the secreted, bicarbonate is reabsorbed, whereas in the distal convoluted tubule hydrogen ion is secreted in the tubules.

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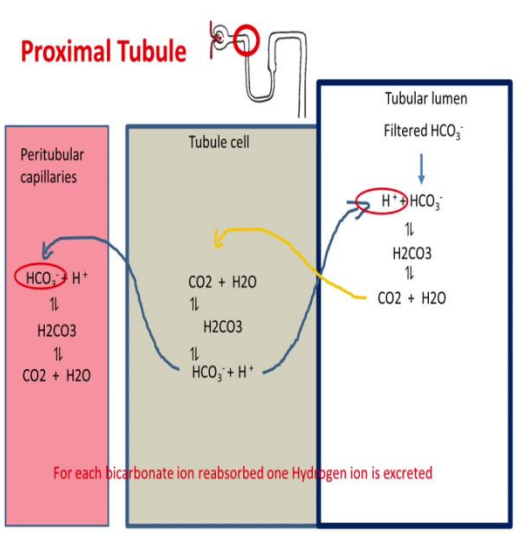

Now, let us look at in greater detail of what exactly is happening in the proximal convoluted tubules. The filtered bicarbonate combines with the hydrogen ions secreted by the brush borders of the tubule cells. Now, this hydrogen ion combining with the bicarbonate ion, form the carbonic acid. Now, this carbonic acid then dissociates into carbon dioxide and water. Now, this carbon

dioxide and water then dissociates back into tubule cells, where they combine and form carbonic acid and which dissociates into bicarbonate ion and hydrogen ion, the bicarbonate is then transported back to peritubular capillary.

So, we can see here that for each bicarbonate ion reabsorb, there is one hydrogen ion excreted. So, there is a net excretion of hydrogen ion there. So, this is a very important mechanism of pH control happening at the proximal tubule level.

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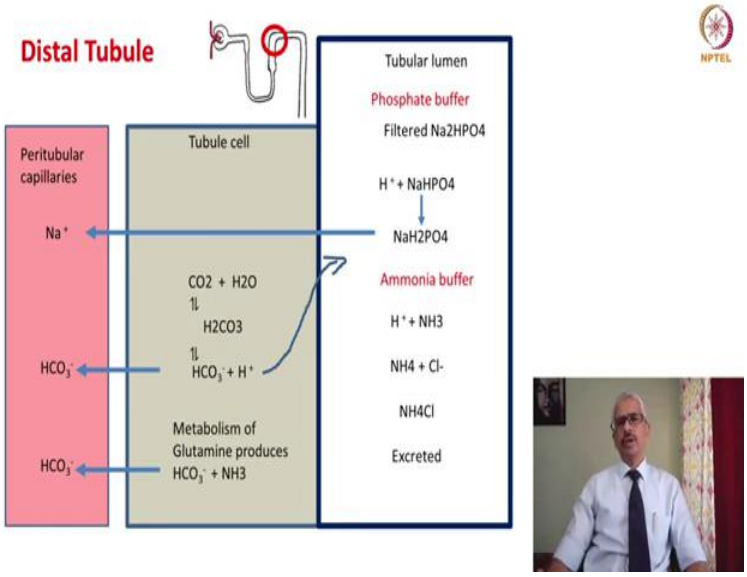

Now, the distal convoluted tubule is a site where the phosphate buffer and the ammonia buffer primarily act. Now, these both buffer systems basically the function like ion trap on hydrogen ion traps. So, here the filtered sodium mono hydrogen phosphate combines with the hydrogen ions secreted by the first waters of the tubule cells and it is excreted. So this traps the hydrogen ion and takes it out of body. Similarly, the ammonia buffer system works where the ammonia combines with the hydrogen ion and it is excreted with during.

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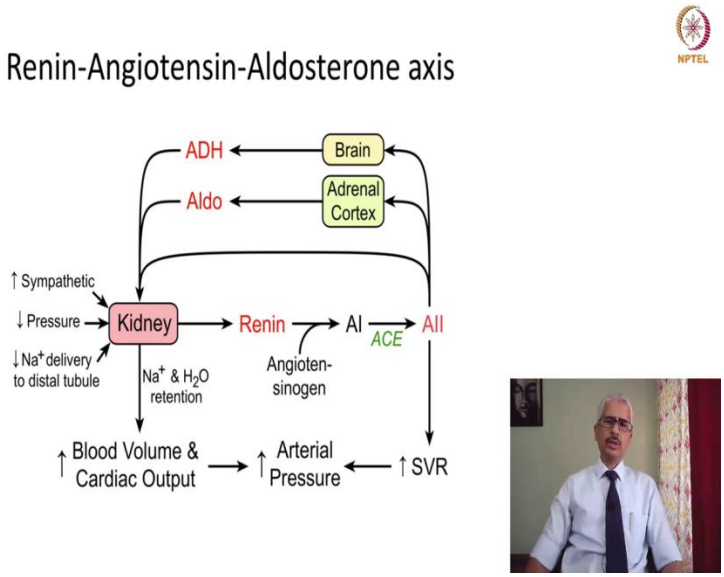

Now, another important mechanism by which the kidneys control water balance is by the Renin Angiotensin Aldosterone axis. So, as you can see in the name, there are three important components to this axis Renin, Angiotensin and Aldosterone. Now, this Renin is stored and secreted by the juxtaglomerular cells of that kidney.

Now, this is released, whenever there is increased sympathetic tone, whenever there is decreased blood pressure and whenever there is decreased sodium delivery to the distal convoluted tubules. So, under these triggers, the renin is secreted by the juxtaglomerular cells of Kidney. Now, this renin converts the angiotensinogen to angiotensin one. Now, this angiotensin one is then carried to runs through the blood where the presence of angiotensin converting enzyme in the endothelial cells convert says angiotensin one to angiotensin two.

Now, this angiotensin two has various effects. So, the angiotensin two works on the adrenal cortex to release Aldosterone and it stimulates the brain to release antidiuretic hormone. Now, both antidiuretic hormone and Aldosterone then act on the kidneys to cause sodium and water retention. So, because of this sodium and water retention, there is increased blood volume and there is increased cardiac output, this leads to increased arterial pressure. Now, angiotensin two also has a direct effect of causing increased systemic vascular resistance. So, all this mechanism basically maintains the blood pressure and maintains the water balance of body.

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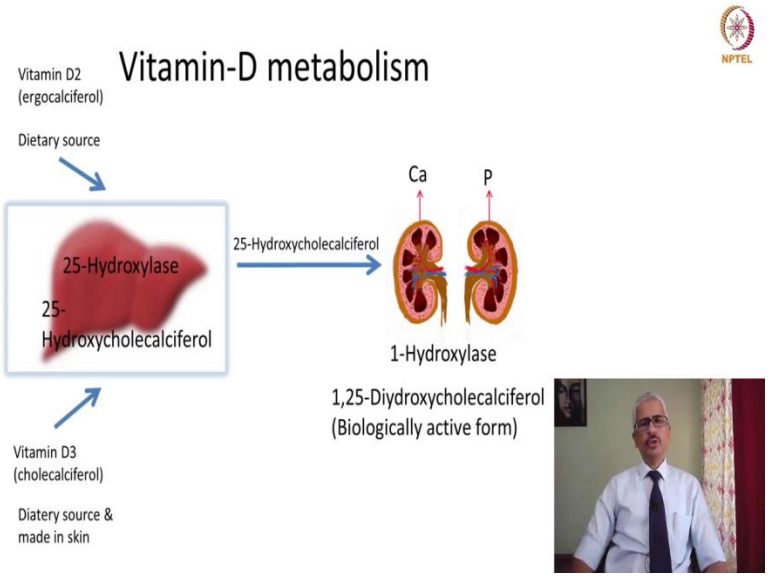

We have seen earlier that one of the functions of kidneys is regulation of vitamin D metabolism. So, here the dietary source of vitamin D is ergocalciferol under the presence of the enzyme 25 hydroxylase in the liver is converted first to 25 hydroxycholecalciferol. Now, this 25 hydroxycholecalciferol is then carried to kidneys.. Where in the presence of enzyme one hydroxylase it is converted to, so the here under the presence of one hydroxylase is 25 hydroxycholecalciferol gets converted to 125 dihydroxycholecalciferol, which is the biologically active form of vitamin D.

Now, this vitamin D is having effects on the bone on the intestine and it also affects it has direct effects on the kidney where it causes reabsorption of calcium and phosphorus. So, there is an important site for vitamin D metabolism.

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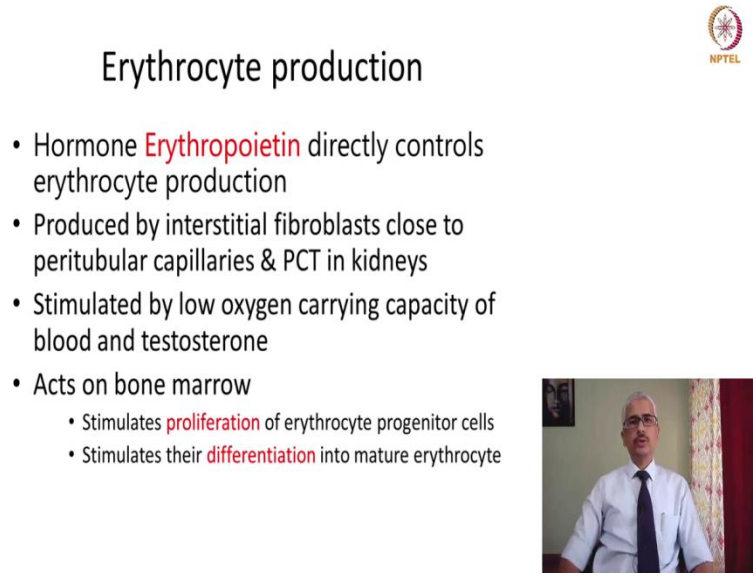

Now, kidneys also regulate the erythrocyte production by the release of hormone erythropoietin, hormone erythropoietin directly controls the erythrocyte production. Erythropoietin is produced by the interstitial fibroblasts, close to the peritubular capillaries and proximal convoluted tubule in the kidneys. Now, this release of erythropoietin is stimulated by low oxygen carrying capacity of blood and testosterone. Now, this erythropoietin once released, it acts on the bone marrow in two ways, it stimulates the proliferation of erythrocyte progenitor cells, and it stimulates their differentiation into mature erythrocytes.

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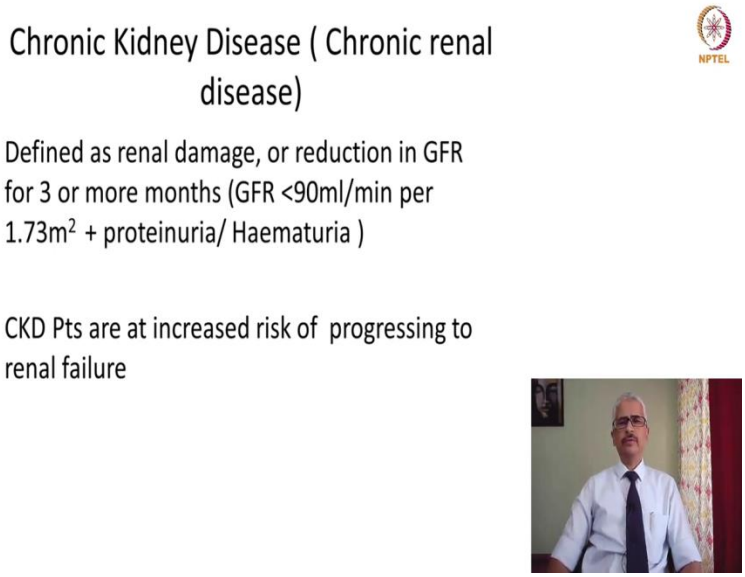

Now, coming back to the CKD. Let us revise the definition of CKD. So, CKD was defined as a renal damage or reduction in GFR for 3 or more months, where the GFR reduction is less than 90 ml per minute per 1.73 meter square along with presence of proteinuria or haematuria. Now, CKD patients they must remember are at increased risk of progressing to renal failure.

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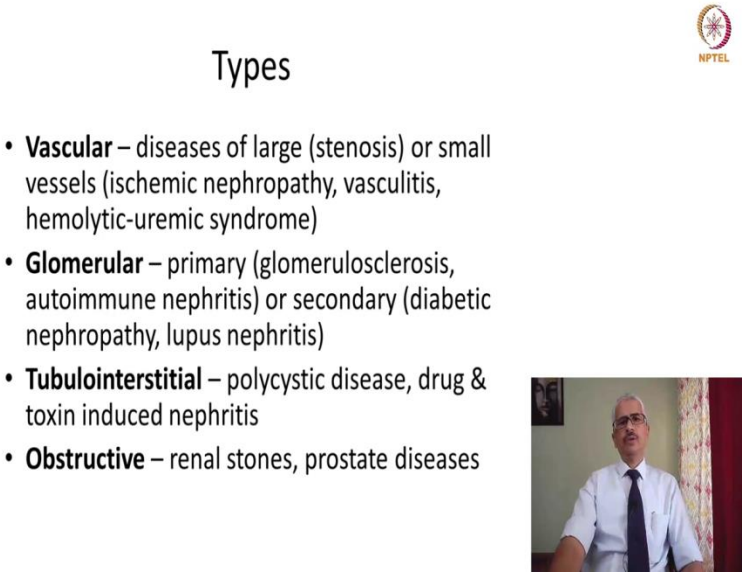

Now, the different types of CKD or Vascular, glomerular, tubulointerstitial and obstructive, based on basically the etiology of this renal damage. So, in case of vascular it is due to diseases of large or small vessels. The disease of large vessels like stenosis causes the nephron damage and the

diseases of small vessels like ischemic nephropathy, vasculitis hemolytic uremic syndrome is the reason for the kidney damage.

The Glomerular cause is due to primary or secondary reasons the primary glomerular cause is glomerulosclerosis and autoimmune nephritis. Whereas, the secondary causes are diabetic nephropathy and lupus nephritis. The other reason for the CKD is tubulointerstitial which is due to polycystic disease, drugs, and toxin induced nephritis. One of the most common causes of CKD is obstructive due to renal stones and prostate diseases.

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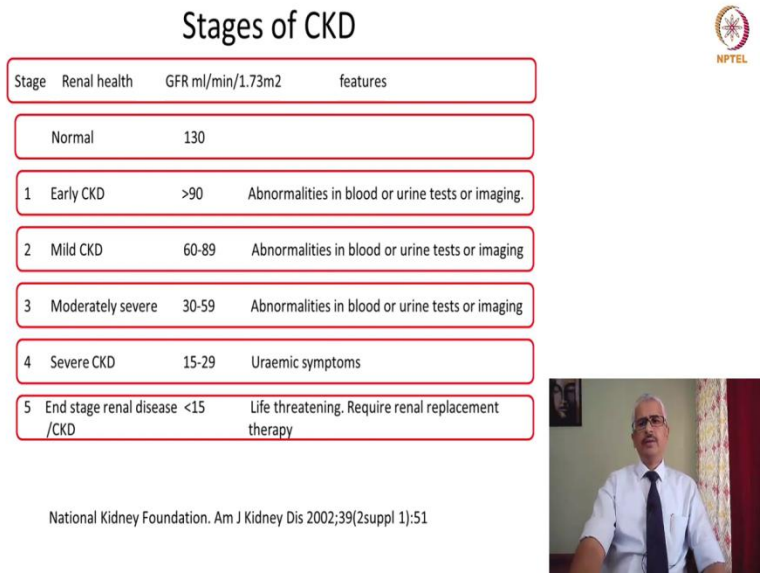

Now, we have seen that the basis of defining CKD is GFR. And similarly, the staging of the severity of the CKD is also based on the GFR. So, the normal GFR we have seen is should be above 130 ml per minute per 1.7 meter square. Early CKD is defined as a GFR of more than 90 and less than 130 ml and mild CKD is defined as a GFR of 60 to 89 per minute. And moderately severe CKD is defined as a GFR between 30 to 59 per minute, and severe CKD defined as GFR between 15 to 29 per minute. And finally, the end stage renal disease where the GFR is less than 15 per minute per 1.73 meter square.

Now, this early CKD, mild CKD and moderately severe CKD, they present as abnormalities in blood or urine tests or imaging, whereas the severe CKD presents with urinary symptoms. The end stage renal disease is life threatening and it requires renal replacement therapy, there is renal transplant.

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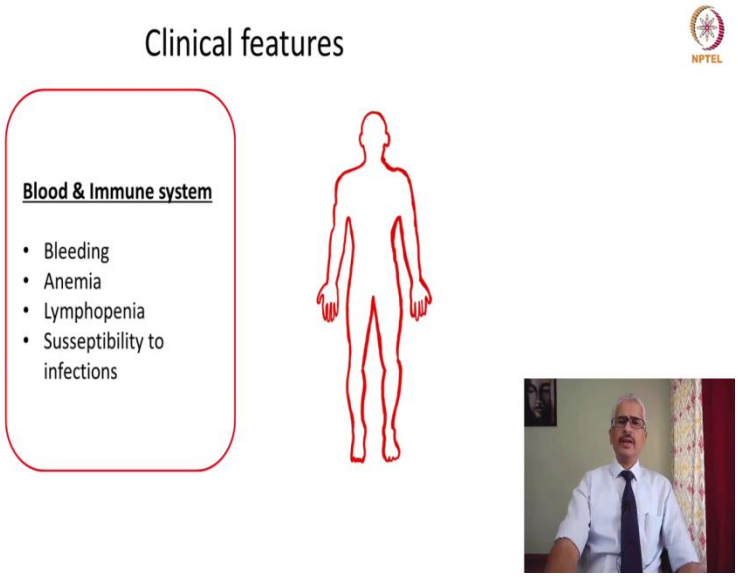

The CKD or the chronic kidney disease affects virtually the whole body. And thereby we have clinical symptoms affect based on the different, different systems that are affected by this disease. So, the effects of this disease on blood and immune system manifests as bleeding, anemia, lymphopenia and susceptibility to infections.

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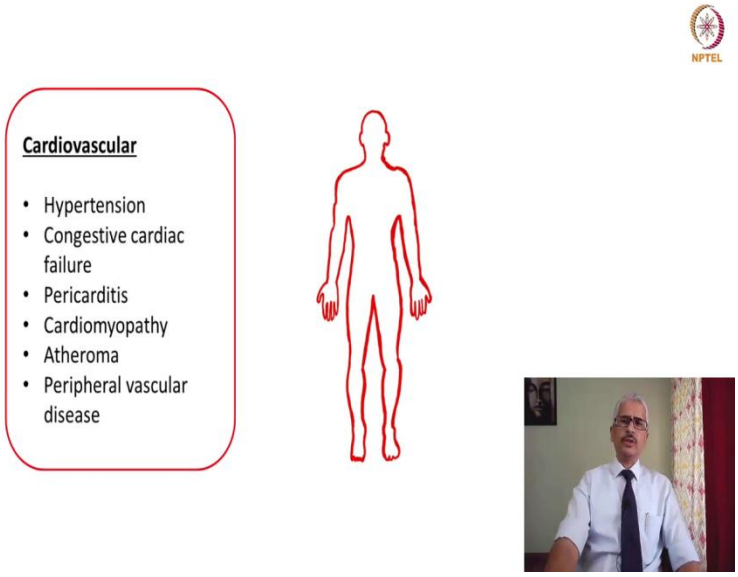

The cardiovascular effects are hypertension, congestive cardiac failure, pericarditis, Cardiomyopathy, Atheroma and peripheral vascular disease.

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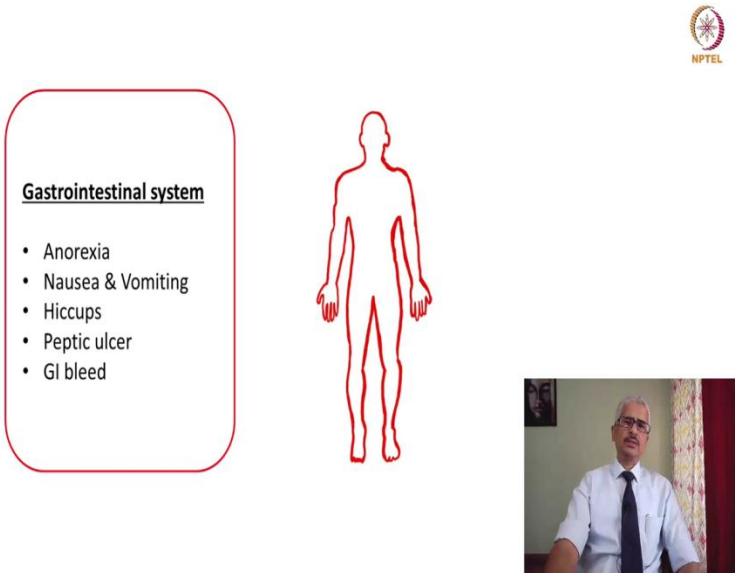

The gastrointestinal system effects are anorexia, nausea and vomiting, hiccups, peptic ulcer and GI bleed.

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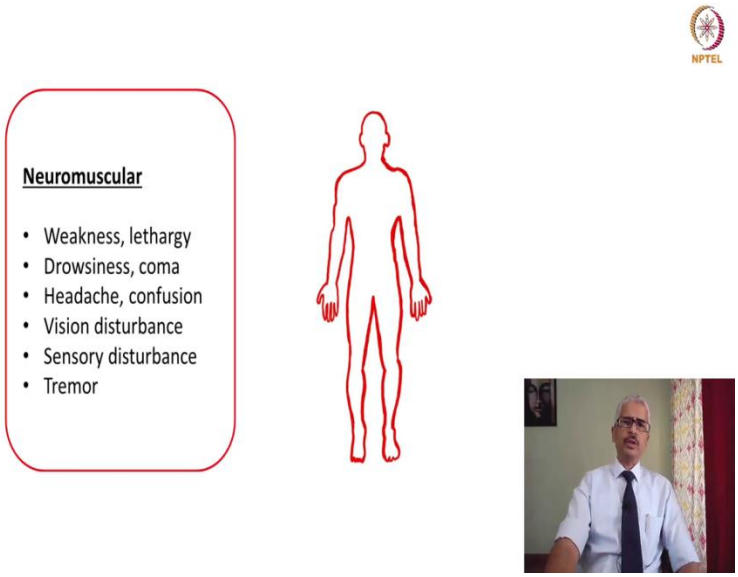

The neuromuscular effects the neuromuscular symptoms are weakness, lethargy, drowsiness, coma, headache, confusion, vision disturbance, sensory disturbance and tremor.

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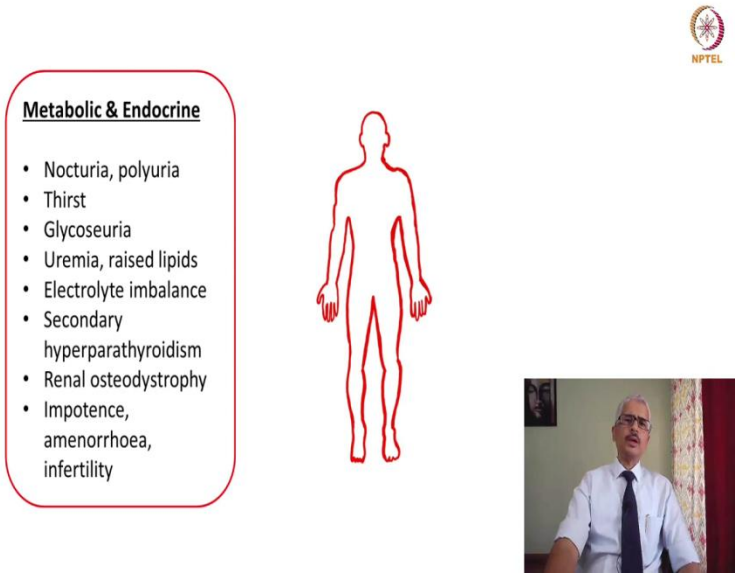

The metabolic and endocrine effects result in nocturia, polyurea, thirst, glycoseuria, uremia, raised lipids, electrolyte imbalance, secondary hyperparathyroidism, renal osteodystrophy, impotence, amenorrhoea and infertility.

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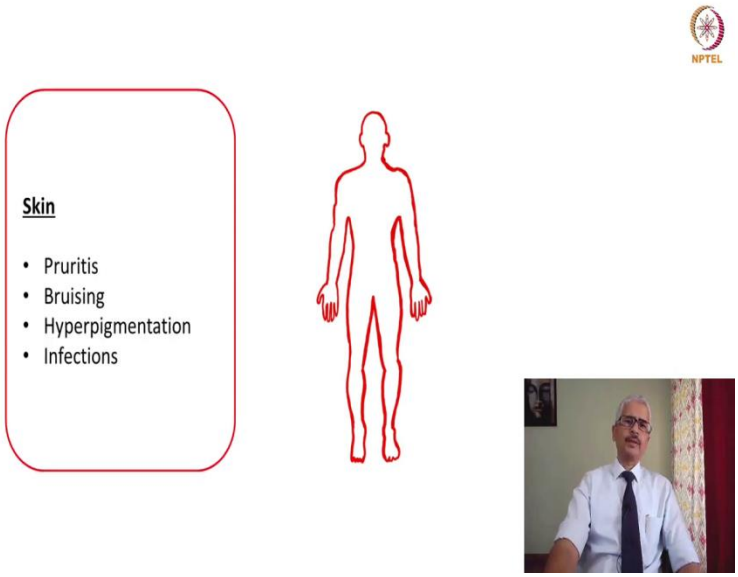

The effects on the skin are pruritis, bruising, hyperpigmentation and infection. So, we have seen that this disease affects almost a whole body and all the systems.

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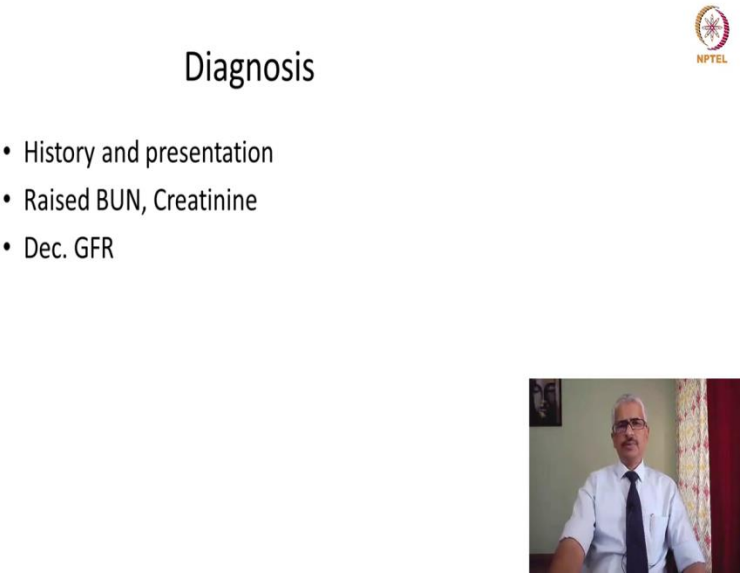

Now, the diagnosis is primarily based on history and presentation and lab values like raised blood urea nitrogen, raised, raised Creatinine and decrease GFR.

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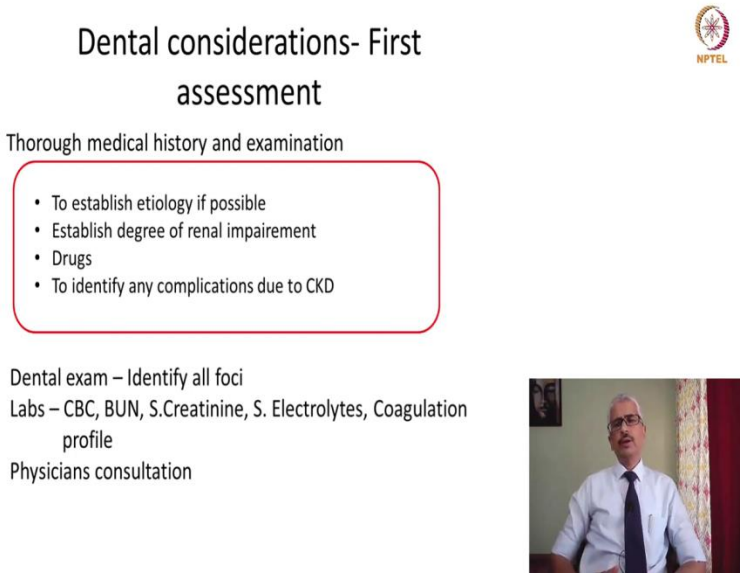

Now, once we have diagnosed this, let us look at what are the important dental considerations when the patient first visits. Now, at the first visit, the first assessment consists of a thorough medical history and examination. Now, this thorough medical history and examination is done to establish the etiology if possible, we need to find out what exactly was the cause of this CKD. We also want to take this history and examination to establish a degree of renal impairment, because

this is going to affect our treatment decisions. If the disease is mild, hopefully we will be able to do something. And if the disease is severe, probably we will have to defer our treatment.

Then these patients are frequently taking drugs for hypertension and diabetes. So, we have to take, we have to actively ask the patients if they are taking any inference, then these patients we have seen that the whole body systems are affected. So, we have to identify any complications that need to cause due to CKD, because then in that case, our medical compromised and medical considerations will also includes those complications.

Now, in dental examination, we must remember that these patients are a high risk of infection. Now, we are not just talking about local dental infections, we are also we are talking about the dental infections as a cause for systemic infections. So, they work like foci and therefore, we have to aggressively and exhaustively do detailed into examination to identify all the foci of infections, because later on those foci of infection, may be the reason for significant morbidity and mortality in these patients.

So, some of the labs that we must perform the CBC, blood urea nitrogen, serum creatinine, serum electrolytes, and coagulation profile. And finally, we should always see physician consultation, if we are proceeding with if you take a decision to proceed with any treatment.

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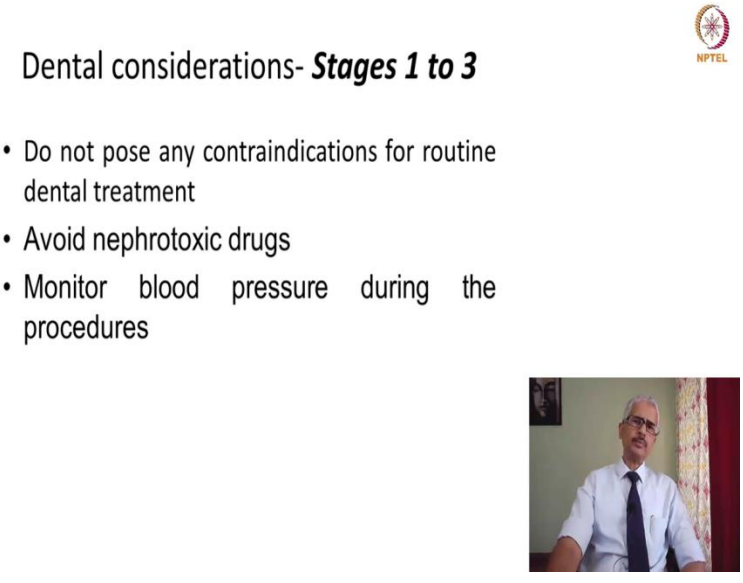

Now, as we have seen that the CKD is divided into different stages. First look at stage wise dental consideration. So, in stages 1 to 3, we can take up most of the dental treatment and it does not pose any contraindications for routine dental treatment. But we have to be careful about the nephrotoxic drugs. So, we have avoid all the nephrotoxic drugs.

And these patients are frequently hypertensive patients and they may or may not being on antihypertensive medications. So, we have to monitor blood pressure during the procedure.

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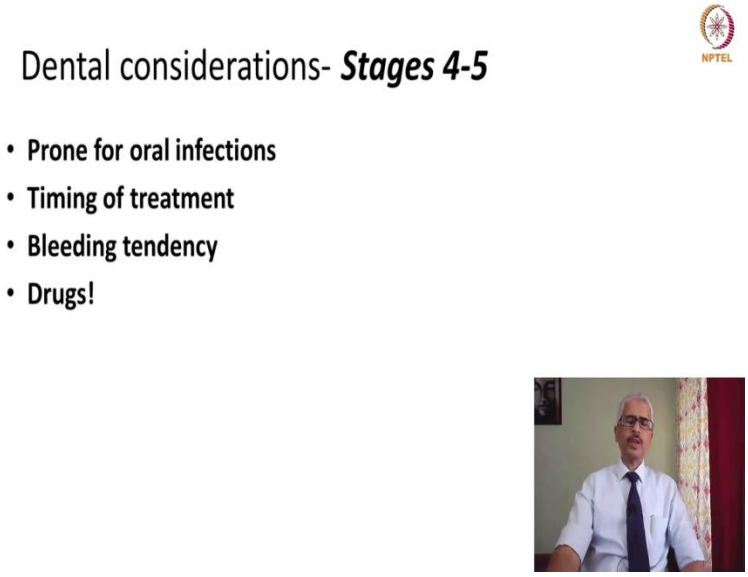

Now, the stages 4 to 5, this is where we have to be very careful. These patients are prone for oral infections, systemic infections, these patients may also be on dialysis. So, whenever the patient is on dialysis, we have to find the treatment carefully because before just before dialysis patients, the toxins are not clear from the body and the general system condition of the patient is not good. So, that is not a good time for doing any other treatment.

Whereas, on the day of dialysis, the same day of dialysis, there is an effect of the anticoagulants which are used for facilitating the dialysis. So, that is also not a good day of doing treatment. So, the best time for undertaking any (())(23:21) treatment is on the day after the day of dialysis, because by then, most of the toxins have been taken care off and the effects of the anticoagulants have also worn off.

So the best time for treating these patients are a day after dialysis. Now, we must also remember that these patients have a high bleeding tendency, and these patients have altered drug excretion. And that is why whichever drug we are planning to get, we need to pay more attention to the effects of. So, let us look into these aspects in a little bit more detail.

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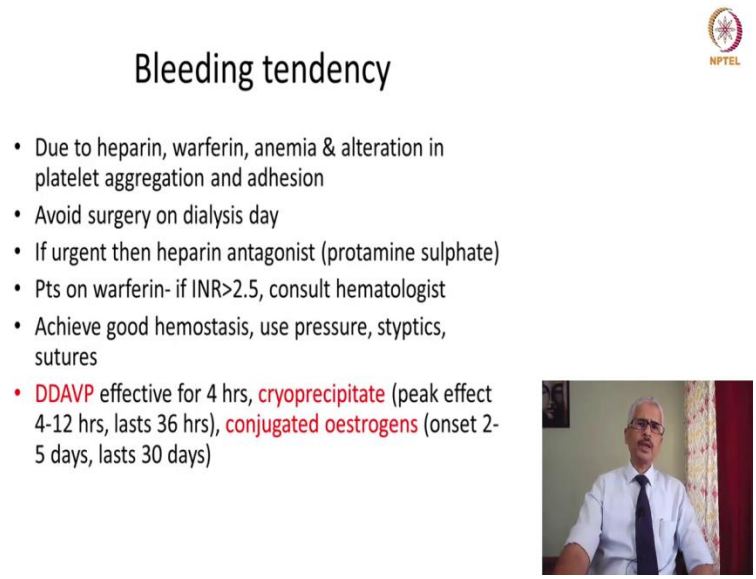

Bleeding tendency, so we have seen that these patients have a higher bleeding tendency, this could be due to the use of heparin and warferin for facilitating dialysis. And another reason for these patients having bleeding tendency is due to anemia and alteration in platelet aggregation and adhesion. And we have seen earlier that the surgery should be avoided on the dialysis day because of the effect of the heparin and warferin.

So, on the day of dialysis they have the highest chance of undergoing uncontrolled bleeding during or after the procedure. Now, sometimes we may have to take up urgent treatment. In that case, we can consider a heparin antagonist, that is protamine sulfate. Now, some of these patients are on warferin. Now, these patients we can take up till INR 3.5 however, if the INR is more than 2.5, then we should always consult a hematologist because later we may need to undertake medical treatment like the use of DDAVP, cryoprecipitate and conjugated oestrogens.

So, whenever we are doing any procedure that can cause bleeding, any invasive procedure are a must read to achieve good hemostasis, use pressure, use the peptics and sutures. Sometimes these

patients may require medical management with the deamino arginine vasopressin DDAVP or cryoprecipitate or conjugated oestrogen.

So DDAVP is effective for pourers, cryoprecipitate the peak effect comes in 4 to 12 hours at lasts for 36 hours then the conjugated oestrogens the onset is 2 to 5 days and it lasts for 30 days. So, depending on how long we want to have the effect of the how long we want the effect of hemostasis we can choose between DDAVP cryoprecipitate, conjugated oestrogens.

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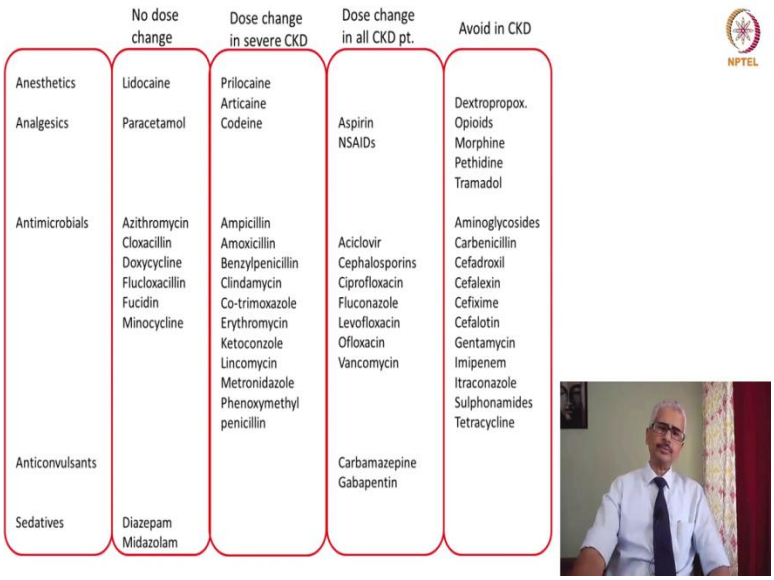

Now, we have seen that the drug elimination is affected in kidney disease. So, we have to categorize the drug into different types of drugs like the drugs which do not require any change and the drugs which will require dose change only in severe CKD patients and then drugs which require a dose change in all the CKD patients and some drugs which we have to completely avoid in CKD patients.

So, the commonly used drug classes in dentistry are in Anesthetics, analgesics, antimicrobials, anticonvulsants and sedatives. So, these drugs do not require any dose change like lidocaine, paracetamol, azithromycin, cloxacillin, doxycycline, flucloxacillin, fucidin, minocycline, diazepam and midazolam. So, these drugs can be given safely to these patient.

Now, these drugs pilocaine, articaine, codeine, ampicillin, amoxicillin, benzylpenicillin, clindamycin, co-trimoxazole, erythromycin, ketacanzole, lincomycin, metronidazole, phynoxymethyl, penicillin, now all these drugs, the dose changes required only in severe CKD patients. So, in CKD, category 1 and 2, we can give these drugs without any dose chain, whereas a higher severe patients, we have to reduce the dose of these drugs.

Now, these are the drugs which needs those modification or dose reduction in all categories of CKD patients. So, these drugs are aspirin, all NSAIDs, Aciclovir, cephalosporins, Ciprofloxacin, fluconazole, levofloxacin, oflaxacin, vancomycin, carbamazepine and Gabapentin. So, all these drugs, we must reduce the dose in all categories for CKD patients. Now, these drugs have to be completely avoided in CKD patients.

So, these drugs are Dextrapropaxopine, opioids, morphine, pethidine Tramadol, aminoglycosides carbenicillin, cephradroxil, cephalexin, cefixime, cepfalotin, gentamycin, imipenem, itrcanazole, sulphonamides and tetracycline. So, we must always remember that whenever we are dealing with CKD patients, the management of the drug is one of the most important aspects, we certainly do not want to give drugs, those are nephrotoxic and we certainly do not want to give the drugs where because of reduced elimination, we are likely to see the toxic effects of that drug itself.

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Now, let us look at some of these specific dental considerations. Now, we have already seen that the management of oral hygiene represents one of the most important steps in renal failure patients of CKD. Patients, because these patients are at high risk infection patients. These in these patients systemic infections can be caused by the dental foci and therefore, the periodontal considerations most important periodontal consideration is good assessment of oral hygiene and maintenance of oral hygiene.

So, supra and subgingval scaling should be undertaken, but the surgical treatment should only be undertaken, if the prognosis can be if the prognosis is considered to be good. Otherwise, if there is a doubt, whether the patient will be able to maintain the hygiene or whether the surgical treatment may or may not succeed in that case, we should not undertake the surgical treatment. And again, when we are sending the patient back, we must emphasize maintenance of oral hygiene. So, the oral hygiene maintenance I stress again represents one of the cardinal steps in prolonging the life of these patients.

Now, from the conservative and endodontics point of view, the teeth with where we can give good prognosis, we have to restore and the teeth where the prognosis is doubtful or poor prognosis, we should extract these teeth because, again, we do not want a foci of infection in the oral cavity which can cause systemic infections.

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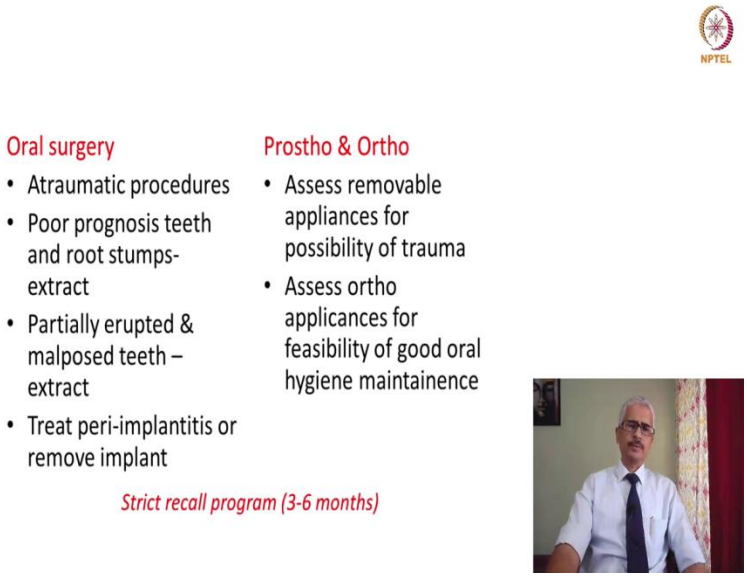

From the oral surgical point of view, whatever procedure we undertake, the procedure should be as Atraumatic as possible. Now, all the teeth with poor prognosis like decayed teeth, root stumps, we have to extract. The partially erupted and malposed teeth should also be extracted, because at any time, they may become a reason for all of this spread of infection.

Now, the implant treatment has become very common all over the world. And therefore, we are also seeing a lot of patients of Peri implantitis. Now, if we see a patient of Peri implantitis, we will have to take a decision whether we can really treat that Peri implantitis or not, if we are very confident that we will be able to deal with this peri implantitis, only then we should keep that implant otherwise, we must remove that implant, we must also remember that it is very difficult to treat Peri implantitis.

So, the level of confidence should be really good that we should be that we will be able to treat peri implantitis only then we should keep that implant otherwise we must get rid of that implant.

Now, from the prosthodontic and orthodontic point of view, the primary consideration is whether any prosthodontic or orthodontic appliance will cause any trauma to choose and become a source of infection. And whether oral hygiene will be affected by the use of this, of these appliances. So, we have to assess all the removable appliances for the possibility of them causing trauma to the issues. If there is if you see that, yes, there is a possibility of trauma being caused by those appliances, we either make a new appliance, or we do not use that appliance at all.

Now, from orthodontic point of view, the important consideration is after using that appliance or during the use of those appliances, whether we will be able to maintain good oral hygiene. If our assessment says that, yes, we will be able to maintain good oral hygiene. In that case, we can keep that appliance otherwise, we have to get rid of that appliance.

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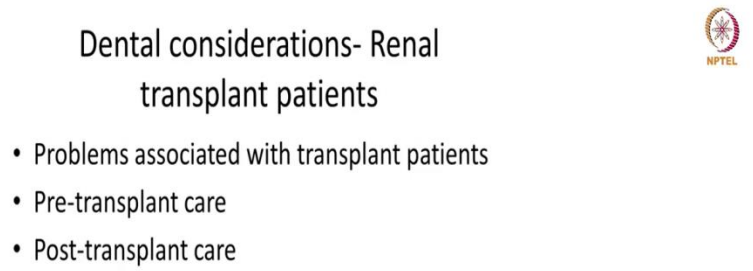

Now, the renal transplant is becoming more and more successful and the number of renal transplantation are also going up all over the world. And therefore, all over the world we see a trend that more and more of the patients are now visiting the clinic for taking care of their dental needs. Now, these patients we have to be, we have to see in a little bit different light. So let us look at this problem from three aspects. What are the problems associated with these transplantations and what constitutes pre transplant care and what constitutes the post transplant care?

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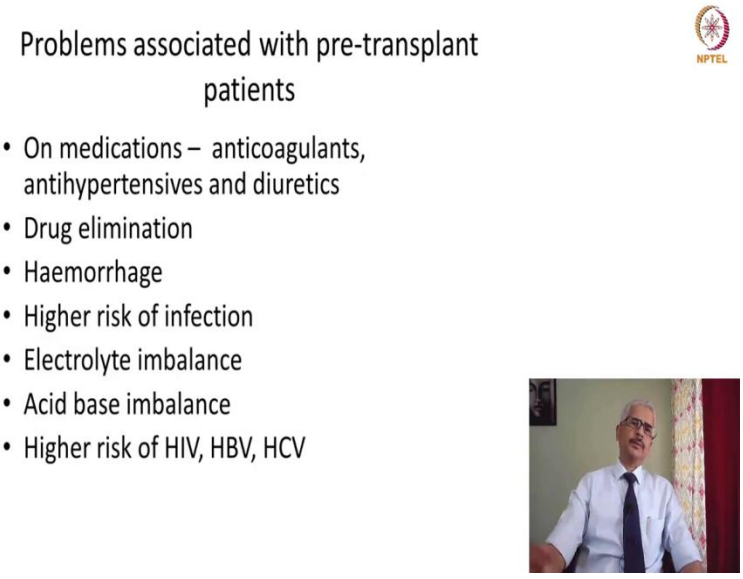

Now, these pre transplantations are basically a patients who are in advanced stages of CKD. Now, these patients are usually on medications like anticoagulants, antihypertensives and diuretics. Now, these patients we have seen earlier, these patients have altered drug elimination, so we need to think about the toxic effects of any drug which he may give. And then these patients have increased tendency of haemorrhage. They have a high risk of infection. They have electrolyte imbalance, they usually also have acid base imbalance and they are at higher risk of HIV, HBV and HCV because of the dialysis repeated dialysis they have to undertake.

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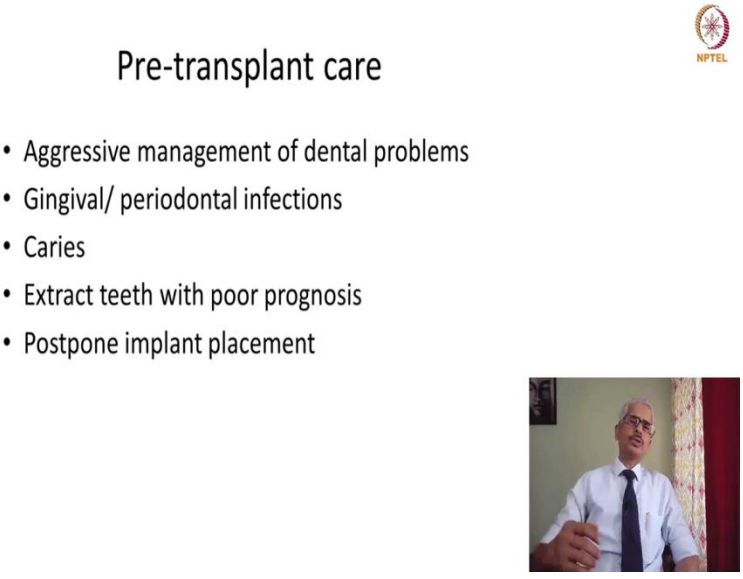

So, the pre transplant care when we see such patient being referred to us, what do we have to do? Again, the primary issue is management of the old conditions to prevent infection. So, we have to see, we have to aggressively manage all the dental problems from this aspect, we have to eliminate any cause of infection early on, so, that after transplantation, there is minimal chance of the dental foci becoming a cause of infection because these patients are high risk infection patients, because of their immunosuppresants they are on immunosuppresants drugs after transplant. So, we have to take care of the gingival and periodontal infections we feed them aggressively.

Caring should be taken care of, if we can confidently eliminate caries and if we can save the teeth, then we have to do we have to undertake conservative and (())(36:21) treatment, otherwise we have to extract the teeth whichever teeth has poor prognosis.

Further implant placement should be postponed because many a times the implant placement is a treatment that requires a long duration. And during this duration patient may undergo transplantation and this is not considered to be an emergency treatment. So, we have to postpone the placement of implants.

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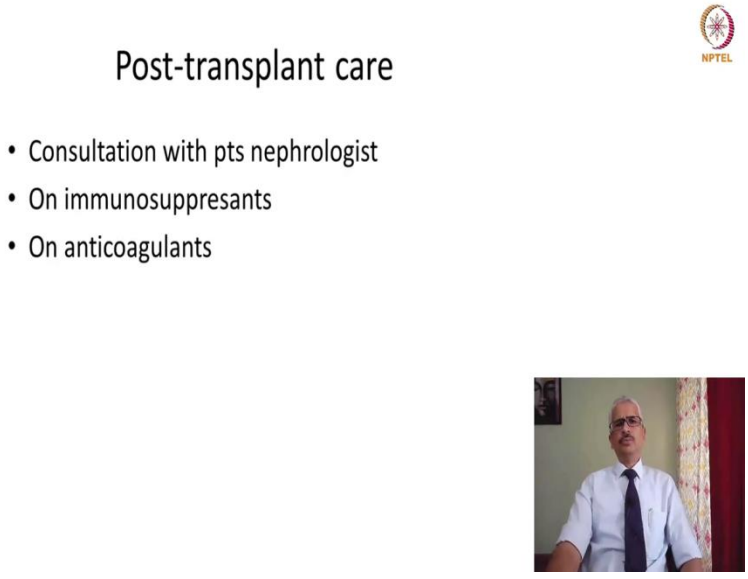

Now, when a patient comes to us, after transplant, we must always consult the nephrologist. The nephrologist will be the doctor who would know the actual condition of the patient and the condition of the transplant. These patients are usually on immunosuppresants and on anti coagulant. So, the aspects of management will depend on these two important factors.

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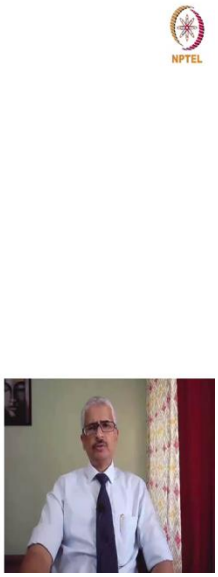

So, when we see a patient during the first 6 months of transplantation, we have to avoid all procedures except emergency. So, in the first 6 months, the amount of immunosuppression is maximum, these patients are on higher dose of immunosuppressant. So, they are at highest risk of infection during the first 6 months. So we have to avoid all procedures except emergencies. So, the dental treatment is only palliative and preventive.

Again, I stress that oral hygiene must be stressed upon. So, oral hygiene instructions must be given use of soft toothbrush, fluoride tooth brush, fluoride tooth paste, Antiseptic mouthwash like chlorhexidine should be advised to the patients. Now, the dentures and orthodontic appliances should not be used or placed, because of the possibility of them causing tissue trauma, because again, these patients are at very high risk of infection.

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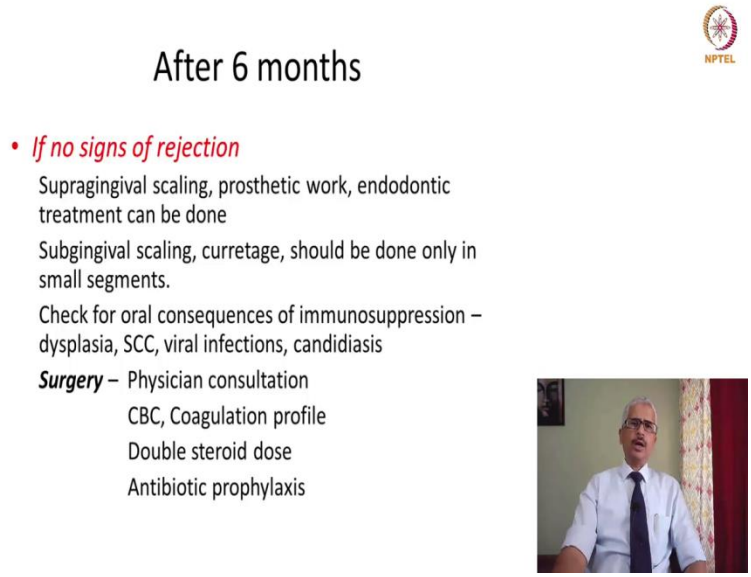

Now after 6 months, we may see a patient with no signs of rejection or we may see a patient of some signs of rejection. So, if we see a patient who has no signs of rejection, in that case, we can undertake most of the routine then treatment like supragingival scaling, prosthetic work, and endodontic work. Subgingval scaling curettage, should be done only in small segments. Now, we have to also check for the oral consequences of immunosuppression because this immunesuppression is going on for a long time. And these patients have a risk of dysplasia with common squamous cell carcinoma, viral infections and candidiasis.

Now, if we are to undertake surgery, then we must see physician consultation and we must advise CBC, coagulation profile because these patients are also on anticoagulants. So, they have a high risk of bleeding. Now, these patients are also we have seen earlier that they are also on steroid as one of the anti, as one of the immunosuppressants.