

Radiographic findings of oral and dental aspects of chronic renal failure of Iraqi patients under hemodialysis therapy

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ABSTRACT

Background: Chronic renal failure can give rise to a wide spectrum of oral manifestations, affecting the hard or soft tissues of the mouth. The majority of affected individuals have disease that does not complicate oral health care. The main aim of this study is to assess the response to therapy and to determine the radiographic manifestations in teeth and jaws of individuals with chronic renal failure undergoing hemodialysis and to find possible preventive and therapeutic strategies.

Materials and methods: Thirty male patients with chronic renal failure who were continuously receiving therapy with ongoing hemodialysis were included in this study and were divided into two subgroups according to the period of therapy (those who had renal dialysis for less than a year, and 1 to 2 years). All patients were requested for panoramic (OPG) radiographs with standardized parameters according to user manual of the machine then quantify the frequency of abnormal dental and periodontal radiographic findings in both arches i.e. the alveolar bone resorption, presence of hypercementosis of the roots, lamina dura reduction or loss and dental condition, then the data were analyzed statistically by comparison with control normal subjects.

Results: It has been established that the duration with the increase the abnormality in dental and periodontal radiographic findings as alveolar bone resorption, presence of hypercementosis of the roots, lamina dura reduction or loss, as well as other dental diseases.

Conclusion: Panoramic radiographic view used in this study considers as a good monitor for jaw and dental changes associated with patients affected with chronic renal failure treated with hemodialysis, and the results showed strong correlation between duration of hemodialysis and all studied variables. Clinicians should use oral health assessment tools to determine individual treatment and approaches to promote the oral health of patients undergoing hemodialysis and improve their quality of life.

Key words: Panoramic radiograph, chronic renal failure. (J Bagh Coll Dentistry 2012; 24(4):52-57).

INTRODUCTION

Chronic kidney disease is a worldwide public health problem. Its prognosis is for deterioration of condition and may vary from a decrease in kidney function to the development of renal failure and/or death for cardiovascular disease (a population –based). Chronic renal failure is defined as kidney damage or glomerular filtration rate (GFR) below 60ml/min per 1.73m² for 3 months or more irrespective of the cause. ⁽¹⁾ Patients with chronic renal failure are affected by many systemic diseases due to their lack of ability to control water and electrolyte balance and filtrate waste products⁽²⁾ in order to prolong life, hemodialysis as an artificial means of removing nitrogenous and other toxic products of metabolism from the blood, is the treatment of choice. ⁽³⁾

Patients with chronic renal failure have many oral and dental manifestations so they need early evaluation of oral health status that is essential to eliminate potential infection foci from the oral cavity. ⁽⁴⁾

Radiographic alterations in the maxilla and mandible - loss of lamina dura, radiolucent lesions and abnormal post-extraction bone healing, decrease or loss of cortical bone - are caused by loss of calcium from the bone tissues due to an increase of parathormone production. This results in the calcium, phosphate and vitamin D metabolism disorders. ^(3, 5-7) It is important to point out that bone demineralization can lead to rapid bone destruction and periodontitis. ⁽⁸⁾ The updated guidelines expanded use of panoramic examination as an alternate baseline dental radiographic examination which is used in the routine of all the types of patients where initial panoramic radiographic findings suggested widespread disease significant enough to affect the quality of life and longevity of the patient. ⁽⁹⁾

Panoramic radiography produces an image that includes both the maxillary and mandibular dental arches and the such surrounding structures Although, dentists might concentrate only on the teeth and their supporting tissues when the examining panoramic radiographs, they should also be able to identify all other structures that appear in the image. ⁽¹⁰⁻¹²⁾ Early detection can lead to appropriate treatment and alleviation of untoward side effects. This is an area where the

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dentist may well save a life, valuing its performance as professional of health, understanding the patient as a whole.⁽⁹⁾

MATERIALS AND METHODS

This prospective study was carried out on patients with chronic renal failure receiving hemodialysis treatment at Nephrology & Renal transplantation Center/ Medical City in Baghdad.

Thirty male patients with chronic renal failure who were continuously receiving therapy with ongoing hemodialysis were included in this study and were assessed for personal and medical information. After careful history taken from each patient about the duration of therapy they were divided into two subgroups: (those who had renal dialysis for less than a year; and 1 to 2 years). Another thirty patients without any history of renal problems were studied also for comparison purposes. All patients were requested for panoramic (OPG) radiographs using Planmeca Proline CC Panoramic x-ray machine with standardized parameters according to user manual of the machine then quantify the frequency of abnormal dental and periodontal radiographic findings in both arches and the information was recorded in a questionnaire containing the following variables: { loss of lamina dura, focal osteosclerosis adjacent to the roots, narrowed dental pulp chamber, hypercementosis of the roots, pockets of any two recorded areas extend apically to the CEJ from 3-6 mm, pockets of any two recorded areas extend apically to the CEJ more than 6 mm, and number of teeth loss}, then the data were analyzed statistically.

RESULTS

Total of 30 patients with ongoing hemodialysis were subdivided according to duration of therapy as (18) patients were <1 year on hemodialysis, and (12) patients were One-two years hemodialysis then compared to 30 apparently healthy control subjects. Chi-square for trend showed that duration of hemodialysis is strongly correlated with the variable evaluated in this study. In addition, there was ordered increase in the percentage of no pockets scores among apparently healthy controls, <1 year hemodialysis, and One-two years hemodialysis patients respectively. On the other hand there is ordered decrease in the percentage of pockets >6 mm scores among One-two years hemodialysis, <1 year hemodialysis, and apparently healthy controls subjects respectively, P (Fisher's exact) when applied and although there was increased

severity for almost all variables but it did not reach the statistical significance (Table 1).

Lamina dura loss, as shown in table (2), the Chi-square for trend showed strong correlation with a significant increase on its incidence in comparison between <1 year hemodialysis and controls, and a non significant differences between One-two years hemodialysis and <1 year hemodialysis when Fisher's exact is used which is also seen for teeth with narrowed dental pulp chambers also (table 3).

Chi-square for trend when applied to study the correlation of teeth with focal osteosclerosis adjacent to the roots also appeared to be strong, but when Fisher's exact test was done there was a non significant difference when 1 year hemodialysis and controls was compared and significant when the comparison was between One-two years hemodialysis and controls and One-two years hemodialysis and <1 year hemodialysis (table 4).

There was a strong correlation between the study groups and teeth showing Hypercementosis with a significant difference between groups when the incidence in each was compared (table 5).

P (LSD) for difference in mean between hemodialysis groups and apparently healthy controls in showing percent teeth with hypercementosis was strongly correlated ($r = 0.86$, $P < 0.001$), while in showing percent teeth loss was ($r = 0.016$, $P = 0.39$) as in table (6).

ROC statistical analysis is used to show the most effected variables on hemodialysis in comparison to apparently healthy control, loss of lamina dura, narrowed dental pulp chamber and hypercementosis were on the head of the variables list (table 7) and when using ROC analysis for the most effected variables according to duration hypercementosis, focal osteosclerosis adjacent to the roots, and loss of lamina dura were the most effected respectively with p-value <0.001 as in table (8).

DISCUSSION

The prevalence of chronic renal failure (CRF) is increasing worldwide. Oral and systemic complications can occur as a result of CRF or its treatment.⁽¹³⁾ Changes in bone metabolism are common and caused mainly by secondary hyperparathyroidism, which, in turn, results from a high phosphorus serum level (due to decreased renal clearance) and low serum calcium and calcitriol levels (due to decreased hydroxylation of 25-hydroxyvitamin D3 in the kidneys).⁽¹⁴⁾ These alterations can occur concomitantly and lead to bone resorption and they might present either as generalized or localized periodontitis

with pocket formation.^(5,6,15) This study showed that older hemodialysis patients experienced severe periodontal diseases which was similar to Tollefsen study⁽¹⁶⁾ as shown in table (1), there was an obvious increasing of the periodontal severity with long duration but statistically failed to reach significance among apparently healthy controls, <1 year hemodialysis, and One-two years hemodialysis patients due to the shorter average duration in addition to hygiene status of control group this result was similar to Hamid et al, study.⁽¹⁷⁾

One of the systemic manifestations unchain alterations in the oral cavity associated with chronic renal failure patients under hemodialysis is loss of lamina dura which caused by calcium loss from the bone tissues due to an increase of parathormone production. Both primary and secondary hyperparathyroidism have been shown to cause loss of lamina dura. Nevertheless, although considered as a pathognomonic sign for hyperparathyroidism in the past, it is now recognized as non-specific⁽¹⁸⁾ in our study 66.7% at of patients <1 year duration of hemodialysis show At least one tooth showing loss of lamina dura compared to 91.7% One-two years duration of hemodialysis patients(table2).

Narrowing or calcification of the pulp chamber of teeth of adults with chronic renal disease can occur.^(19, 20, 21) The exact cause of this dental change is not known, may be the total plasma steroid clearance is low the amount of drug received and its pharmacokinetics seemed to be an essential factor in the initiation of narrowing of the dental pulp chamber.^(13, 22) Our result revealed that all the 18 patient who were <1 year duration of hemodialysis show At least one tooth with narrowed dental pulp chamber(100%), while those who were One-two years duration of hemodialysis represent (91.7%) with P (Chi-square for trend) < 0.001 as in(table 3) this agreed with Galili et al, 2007 study⁽¹⁹⁾ in which A comparison of relative dental pulp size in chronic renal disease patients with dental pulp size in healthy controls revealed a significant pulp narrowing with A strong correlation between the chronicity of the renal disease and the pulp narrowing in the premolar and molar teeth of the tested group.

The radiographic interpretation of the OPG films show well localized radiopacities lying below the species of vital molars represents focal osteosclerosis (FIG. 1). This opacity generally lacks the radiolucent halo, yet is well demarcated with respect to the surrounding bone.⁽²³⁾

this study show significant value for difference between<1 year duration of hemodialysis and

One-two years duration of hemodialysis with strong correlation between focal osteosclerosis and duration of hemodialysis ($r=0.782$, $p<0.001$) Scutellari et al, 1996⁽²⁴⁾ also found that focal osteosclerosis adjacent to the roots one of the radiographic manifestations of teeth and jaws in chronic renal disease patients under hemodialysis. Other finding of OPG interpretation is the hypercementosis of teeth roots which is present as thickening of the cementum layer as well as blunting or rounding of the root tip, Therefore the radiographic diagnosis of it is established by the shape or outline of the root rather than by any differences in radiodensity of the root structure.^(25, 26) In table 5 both hemodialysis groups show significant difference between them and controls by using (Fisher's exact) difference with high statistically significant effect of hemodialysis duration as an important factor.

Due to bad oral hygiene with sever pedriodontitis most of the hemodialysis patients loss their teeth, but statistically there is non-significant level when compared to apparently healthy controls (table 6) it seems that they do not pay much attention to their oral hygiene, which suggests the need for appropriate instructions and more education in this regard. This is may be related to loss of motivation, low socioeconomic status, and high cost of dental care services.⁽²⁷⁾

There was a strong correlation between duration of hemodialysis and all evaluated variables also its severity when compared with healthy subjects. Panoramic radiography is useful in monitoring the oral abnormality associated with patients suffering from chronic renal failure and especially to assess the response to therapy.

Clinical implications

Clinicians should use oral health assessment tools to determine individual treatment and approaches to promote the oral health of patients undergoing hemodialysis and improve their quality of life. This is done by frequent recall examinations as preventive measures in order to minimize the need for extensive dental treatment. Close consultation between the dentist and the physician is essential for safe dental management of these patients. Both hemodialysis and renal transplant patients must be protected against infection. This is achieved through early, dental treatment.



Figure 1: OPG image shows Focal osteosclerosis adjacent to the roots



Figure 2: OPG image shows narrowed dental pulp chamber with hypercementosis of the roots.

Table 1: Score of Pockets for two recorded areas extend apically from the CEJ

Study group	No pockets		Pockets from 3-6 mm		Pockets >6 mm		Total	
	N	%	N	%	N	%	N	%
Apparently healthy controls	14	46.7	3	10.0	13	43.3	30	100.0
<1 year hemodialysis	3	16.7	3	16.7	12	66.7	18	100.0
One-two years hemodialysis	1	8.3	2	16.7	9	75.0	12	100.0

P (trend) = 0.01, P (Fisher's exact) for difference between <1 year hemodialysis and controls = 0.14[NS]

One-two years hemodialysis and controls = 0.09[NS]

One-two years hemodialysis and <1 year hemodialysis = 0.7[NS]

Table 2: score of lamina dura loss

Study group	Total	At least one tooth showing loss of lamina dura	
	N	N	%
Apparently healthy controls	30	0	0.0
<1 year hemodialysis	18	12	66.7
One-two years hemodialysis	12	11	91.7

P (Chi-square for trend) < 0.001, P (Fisher's exact) for difference between <1 year hemodialysis and controls < 0.001

One-two years hemodialysis and controls < 0.001

One-two years hemodialysis and <1 year hemodialysis = 0.19[NS]

Table 3: score of teeth with narrowed dental pulp chambers

Study group	Total	At least one tooth with a narrowed dental pulp chamber	
	N	N	%
Apparently healthy controls	30	6	20.0
<1 year hemodialysis	18	18	100.0
One-two years hemodialysis	12	11	91.7

P (Chi-square for trend) < 0.001, P (Fisher's exact) for difference between <1 year hemodialysis and controls < 0.001, One-two years hemodialysis and controls < 0.001

One-two years hemodialysis and <1 year hemodialysis = 0.4[NS]

Table 4: score of teeth with focal osteosclerosis adjacent to the roots

Study group	Total At least one tooth showing focal osteosclerosis adjacent to the roots		
	N	N	%
Apparently healthy controls	30	3	10.0
<1 year hemodialysis	18	5	27.8
One-two years hemodialysis	12	12	100.0

P (Chi-square for trend) < 0.001

P (Fisher's exact) for difference between

<1 year hemodialysis and controls = 0.13[NS]

One-two years hemodialysis and controls<0.001

One-two years hemodialysis and <1 year hemodialysis<0.001

Table 5: score of teeth showing Hypercementosis

Study group	Total At least one tooth with Hypercementosis		
	N	N	%
Apparently healthy controls	30	0	0.0
<1 year hemodialysis	18	10	55.6
One-two years hemodialysis	12	12	100.0

P (Chi-square for trend) < 0.001

P (Fisher's exact) for difference between

<1 year hemodialysis and controls<0.001

One-two years hemodialysis and controls<0.001

One-two years hemodialysis and <1 year hemodialysis = 0.01

Table 6: Percent teeth with hypercementosis& percent teeth loss

	Apparently healthy controls	<1 year hemodialysis	One-two years hemodialysis	P (ANOVA)
Percent teeth showing hypercementosis				<0.001
Range	(0 to 0)	(0 to 25)	(20.7 to 48.1)	
Mean	0.0	4.8	30.2	
SD	0.0	7.0	8.4	
SE	0.00	1.65	2.44	
N	30	18	12	
Percent teeth loss				<0.001
Range	(0 to 33.3)	(0 to 39.1)	(0 to 45.5)	
Mean	5.9	14.4	16.4	
SD	7.9	13.8	12.3	
SE	1.44	3.24	3.55	
N	30	18	12	

P (LSD) for difference in mean between: Apparently healthy controls x <1 year hemodialysis for hypercementosis = 0.004

Apparently healthy controls x One-two years hemodialysis < 0.001

<1 year hemodialysis x One-two years hemodialysis < 0.001 R=0.86, p<0.001 (LSD)

for difference in mean between Apparently healthy controls x <1 year:

Apparently healthy controls x One-two years hemodialysis = 0.006

<1 year hemodialysis x One-two years hemodialysis = 0.62[NS]

R=0.016, p=0.39

Table 7: More effected variable on hemodialysis in comparison to control

Case-control comparison	ROC area	P
At least one tooth showing loss of lamina dura	0.883	<0.001
At least one tooth with a narrowed dental pulp chamber	0.883	<0.001
Percent teeth roots showing hypercementosis	0.867	<0.001
At least one tooth with Hypercementosis	0.867	<0.001
At least one tooth showing focal osteosclerosis adjacent to the roots	0.733	0.002
Percent teeth loss	0.732	0.002
Score of Pockets for two recorded areas extend apically to the CEJ +3 mm	0.666	0.028

Table 8: More effected variable on heamo according to duration

Longer duration of hemodialysis (1-2 years) compared to <1 year duration	ROC area	P
Percent teeth showing hypercementosis	0.981	<0.001
At least one tooth showing focal osteosclerosis adjacent to the roots	0.861	0.001
At least one tooth with Hypercementosis	0.722	0.042
At least one tooth showing loss of lamina dura	0.625	0.25[NS]
Percent teeth loss	0.563	0.57[NS]
Score of Pockets for two recorded areas extend apically from the CEJ +3 mm	0.549	0.66[NS]
At least one tooth with a narrowed dental pulp chamber	0.458	0.70[NS]

REFERENCES

- Jurgen F, Richard J, John F. Comprehensive clinical nephrology. Vol. 2. 4th ed. Mosby; 2010. p: 907.
- Torkzaban P, Arabi R, Kadkhodazadeh M, Moradi J, Khoshhal M. Periodontal status in patients undergoing hemodialysis. DJH 2009; 1(1): 7-10.
- De Rossi Ss, Glik M. Dental cosidration fro the patient with renal disease receiving hemodialysis. Jam Dent Assoc 1996; 12: 211-9.
- Naugle K, Darby ML, Bauman DB, Lineberger LT, Powers R. The oral health status of individuals on renal dialysis. Ann Periodontol 1998; 3: 197-205.
- Ferguson CA, Whyman RA. Dental Management of People with Renal Disease and Renal Transplants. N Z Dent J 1998; 94: 125-30.
- Bottomley WK, Cioffi RF, Martin AJ. Dental management of the patient treated by renal transplantation: preoperative and postoperative considerations. J Am Dent Assoc 1972; 85: 1330-5.
- Gavaldá C, Bagán JV, Scully C, Silvestre FJ, Milián MA, Jiménez. Renal hemodialysis patients: oral, salivary, dental and periodontal findings in 105 adult cases. Oral Dis 1999; 5: 299-302.
- Wilson TG, Kornman KS. Fundamentals of periodontics. 2nd ed. Chicago: Quintessence Publishing Co.; 2003.
- Watanabe PCA, Farman A, Watanabe MGDC, Issa J PM. Radiographic signals detection of systemic disease. orthopantomographic radiography. Int J Morphol 2008; 26(4): 915-26.
- White SC, Taguchi A, Kao D, Wu S, Susan K S, Yoon D, Swei Y, Nakamoto T, Tanimoto K. Clinical and panoramic predictors of femur bone mineral density. International Osteoporosis Foundation; National osteoporosis Foundation, 2004.
- Farman AG, Nortje CJ, Wood RE. Oral and maxillofacial diagnostic imaging. St. Louis: Mosby -Year Book; 1993.
- Watanabe PCA, Arita ES, Monteiro SAC, Oliveira T M, Taguchi A. The relationship among three indicators of bone quality in the osteoporosis research on panoramic radiographic. Osteoporos Int 2004; 15(1): S67-255.
- Proctor R, Kumar N, Stein A, Moles D, Porter S. Oral and dental aspects of chronic renal failure J Dent Res 2005; 84: 199.
- Daugirdas JT, Blake PG, Ing TS. Handbook of dialysis. 3rd ed. Rio de Janeiro: Medsi; 2003.
- Naylor GD, Fredericks MR. Pharmacologic considerations in the dental management of the patient with disorders of the renal system. Dent Clin North Amer 1996; 40: 665-83.
- Tollefsen T. Periodontal status in patients before and after renal transplant. J Periodont Res 1985; 20: 227-36.
- Hamid M, Dummer C, Pinto L. Systemic conditions, oral findings and dental management of chronic renal failure patients: general considerations and case report. Braz Dent J 2006; 17(2): 166-70.
- Frankenthal S, Nakhoul F, Machtei EE, Green J, Ardekian L, Laufer D, Peled M. The effect of secondary hyperparathyroidism and hemodialysis therapy on alveolar bone and periodontium. J Clin Periodontol 2002; 29: 479-83.
- Galili D, Berger E, Kaufman E. Pulp narrowing in renal end stage and transplanted patients. J Endod 1991; 17: 442-3.
- Nasstrom K. Dentin formation after corticosteroid treatment. A clinical study and an experimental study on rats. Swed Dent J 1996; 115: 1-45.
- Ganibegovic M. Dental radiographic changes in chronic renal disease. Med Arch 2000; 54: 115-8.
- Näsström K, Forsberg B, Petersson A. Narrowing of the dental pulp chamber in patients with renal diseases. Oral Surg Oral Med Oral Path 1985; 59(3): 242-6.
- Eversole LR. Clinical outline of oral pathology: diagnosis and treatment. 4th ed. People's medical publishing house; 2011. P.480.
- Scutellari PN, Orzincolo C, Bedani PL, Romano C. Radiographic manifestations in teeth and jaws in chronic kidney insufficiency. Radiol Med. 1996; 92(4): 415-20.
- Saraf S. Text book of oral pathology. 1st ed. JAYPEE; 2006. P. 480
- Rajendran R, Sivapathasundharam B. Shafer's text book of oral pathology. 6th ed. Elsevier; 2009. P. 586
- Malekmakan L, Haghpanah S, Pakfetrat M, Ebrahimi Z, Hasanlic E. Oral health status in Iranian hemodialysis patients. Indian J Nephrology 2011; 21(4): 235-8