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Community periodontal index of treatment needs and pain control beliefs in relation to calcium-phosphate parameters and iron metabolism among hemodialysis patients

Abstract

Introduction. According to scientific reports, lack of oral hygiene, as well as disturbances in the calcium-phosphate and iron metabolism disorders are the main causes of periodontitis. The analysis of factors influencing the development and treatment of periodontitis should be conducted parallel in the medical and psychological domain.

Aim. The aim of this study was to determine the dependency between the community periodontal index of treatment needs (CPITN) and the beliefs about pain control and biochemical parameters of the iron, calcium and phosphate metabolism.

Material and methods. The study was conducted on a group of 124 hemodialysis patients with chronic renal failure aged from 24 to 90 (M=65.47; SD=15.65). The urea reduction rate (URR) was 71.24% and an average dose of dialysis (Kt/V) was 1.35. In the research time the indicators such as the values of serum levels of calcium and phosphorus, transferrin, ferritin, and iron were under control. Patients were diagnosed using the periodontal index of treatment needs (CPITN) and beliefs about pain control questionnaire (BPCQ) in Polish adaptation done by Z. Juczyński. In order to evaluate intergroup differences, the Kruskal-Wallis H test was used.

Results. The hemodialysis patients with stage 2 or stage 3 periodontitis (according to CPITN) had the highest levels of transferrin and the lowest levels of ferritin (Table 3.). In contrast, the patients with stage 4 CPITN had the lowest level of transferrin and the highest level of ferritin. No statistically significant differences were observed between the five stages according to the community periodontal index of treatment needs (CPITN) in relation to the three domains of the beliefs about pain control questionnaire (BPCQ).

Conclusions. The hemodialyzed patients with the most advanced periodontitis (stage 4 according to CPITN) had the lowest transferrin serum levels and the highest ferritin serum levels. They did not differ in pain control beliefs associated with the community periodontal index of treatment needs (CPITN).

Keywords: Community Periodontal Index of Treatment Needs (CPITN), pain control beliefs, end stage renal disease, iron metabolism, hemodialysis.

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INTRODUCTION

Periodontitis is one of the most common dental problems, which each year affects millions of people all over the world. It is a kind of chronic inflammatory disease that damages soft tissues and bones in the area surrounding teeth. Periodontitis, which is caused by polymicrobial plaque, can lead to tooth loss, heart attack, stroke and other health problems. The plaque, which remains on the teeth for more than 48 hours, becomes a site of bacterial accumulation and is difficult to remove. Initially, leaving tartar and plaque on teeth leads to gingivitis, however, in subsequent phases of periodontitis, it causes the penetration of microorganisms into deep layers of gingival tissue. This, in turn, may cause gingivitis, bone inflammation and even loss of teeth.

Although there were as many as 700 bacterial species identified in the human oral cavity, it is suggested that only ten of them (e.g. *Campylobacter rectus*) play an important role in the pathogenesis of periodontitis [1,2]. Darveau also investigated this pathogenesis and indicated that the “red-complex” bacteria (*Porphyromonas gingivalis*, *Treponema denticola*, *Tannerella forsythia*) use particular mechanisms to interfere with host defense reactions [3].

According to scientific reports, lack of oral hygiene, as well as disturbances in the calcium-phosphate metabolism and iron metabolism disorders are the main causes of periodontitis. According to Grenier and Tanabe, transferrin, which was found in periodontal sites, may be a source of iron for periodontal pathogens [4].

In patients with an end stage renal disease (ESRD) treated with hemodialysis, development of periodontitis is strongly

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associated with poor oral hygiene, as well as with calcium-phosphate and iron disorders [5]. In an epidemiological study, Chen et al. revealed that ESRD patients have high prevalence of periodontal inflammation and poor hygiene. According to them, 80.6% of hemodialysis patients have poor oral health status and periodontal diseases [6]. Hou et al. indicated that hemodialysis patients who brush their teeth twice a day had significantly less chance of developing periodontitis in comparison to those who brush their teeth only once a day [7].

The analysis of factors influencing the development and treatment of periodontitis should be conducted parallel in the medical and psychological domain. One of the most important psychological factors in the dentistry practice is a phenomenon of pain. Pain can affect the mood of the patient, modulate health behaviors and influence the therapeutic processes. [8]. Psychological factors, that contribute to preventing or overcoming pain, play a very important role in the dentist – patient relationship. It is essential to consider the patients' psychological determinants of pain responses when analyzing dental diseases among hemodialysis patients.

AIM

The aim of this study was to determine the dependency between the community periodontal index of treatment needs (CPITN) and the beliefs about pain control and biochemical parameters of the iron, calcium and phosphate metabolism.

MATERIAL AND METHODS

The study was conducted on a group of 124 hemodialysis patients with chronic renal failure aged from 24 to 90 (M=65.47; SD=15.65), who consented to participate in this study. All participants have been treated for at least 6 months with hemodialysis. This group consisted of 59 men and 65 women. The urea reduction rate was (URR) 71.24% and an average dose of dialysis (Kt/V) was 1.35. In the research time, the indicators such as the values of serum levels of calcium and phosphorus, transferrin, ferritin, and iron were under control.

Dental examination was performed before hemodialysis. All patients were diagnosed using the periodontal index of treatment needs (CPITN). CPITN was determined according to the following scheme: Code 0 – normal state, Code 1 – bleeding after gentle probing, Code 2 – supragingival or subgingival calculus and/or defective margins are detected, Code 3 – indicating probing depth of no greater than 5 mm, Code 4 – colored area of probe completely disappears, indicating probing depth of greater than 5 mm.

The beliefs about pain control questionnaire (BPCQ) (Originally developed by S. Skevington [9]) was used in a Polish adaptation done by Z. Juczyński [10]. The questionnaire consists of 13 items (questions) assigned to three domains, which measure beliefs about personal (internal) control of pain (IS), beliefs that powerful others (e.g. doctors) can control pain (PD) and beliefs that pain is caused by chance events and there is no efficient way for controlling it (CH). Higher scores in these domains (IS, PD and CH) indicated stronger endorsements of the respective beliefs.

RESULTS

Statistical analyzes were performed using Statistica 12.0 PL. In order to evaluate intergroup differences, the Kruskal-Wallis H test was used. Statistically significant dependencies were identified using the nonparametric Spearman Rank Correlation test (ρ).

During the process of data evaluation based on the Kruskal-Wallis test, no statistically significant differences were identified between intergroups of community periodontal index of treatment needs (CPITN stage 0-4) in relation to the hemodialysis adequacy indicators (Table 1.).

No statistically significant differences were observed between the five stages according to the community periodontal index of treatment needs (CPITN) in relation to the three domains of the beliefs about pain control questionnaire (BPCQ) (Table 2.). It is worth mentioning that the patients in all stages of CPITN showed weaker beliefs about the internal control pain levels (IS levels) than about powerful doctors and chance happening controls pain (PD and CH) (Table 2.).

TABLE 1. Differences in the hemodialysis (HD) adequacy indicators conditioned by the Community Periodontal Index of Treatment Needs (CPITN).

	Community Periodontal Index of Treatment Needs (CPITN)										Kruskal-Wallis H Test	
	CPITN 0 N=27		CPITN 1 N=29		CPITN 2 N=25		CPITN 3 N=22		CPITN 4 N=21			
	M	SD	M	SD	M	SD	M	SD	M	SD	H	p
KT/V	1.22	0.21	1.32	0.20	1.30	0.44	1.27	0.29	1.31	0.16	2.54	0.771
URR [%]	69.26	7.04	72.65	5.32	69.77	13.24	70.18	8.94	72.24	4.06	3.18	0.672
Urea before HD [mg/dL]	134.24	30.00	131.04	21.39	125.02	41.89	110.38	23.71	113.60	43.07	7.08	0.215
Urea after HD [mg/dL]	41.37	13.15	36.03	9.84	41.11	30.60	33.45	13.61	31.88	14.46	4.52	0.477

TABLE 2. Differences in the BPCQ factors (IS, PD, CH) conditioned by stages of Community Periodontal Index of Treatment Needs (CPITN).

Factors of BPCQ	Community Periodontal Index of Treatment Needs (CPITN)										Kruskal-Wallis H Test	
	CPITN 0 N=27		CPITN 1 N=29		CPITN 2 N=25		CPITN 3 N=22		CPITN 4 N=21			
	M	SD	M	SD	M	SD	M	SD	M	SD	H	p
Internal control pain (IS)	11.41	5.53	12.32	6.62	11.76	5.38	12.24	5.23	10.20	3.77	6.35	0.184
Powerful doctors control pain (PD)	14.53	5.10	16.16	5.08	15.28	4.27	16.29	4.69	16.20	4.82	6.62	0.251
Chance happening control pain (CH)	15.12	3.64	15.63	2.99	15.32	2.48	16.41	3.28	16.60	4.16	5.34	0.376

TABLE 3. Differences in biochemical indicators of calcium-phosphate and iron metabolism conditioned by stages of Community Periodontal Index of Treatment Needs (CPITN).

	Community Periodontal Index of Treatment Needs (CPITN)										Kruskal-Wallis H Test	Post-hoc (NIR)	
	CPITN 0 N=27		CPITN 1 N=29		CPITN 2 N=25		CPITN 3 N=22		CPITN 4 N=21				
	M	SD	M	SD	M	SD	M	SD	M	SD			
Calcium before HD [mg/dL]	8.62	0.76	9.37	1.26	9.29	1.04	9.47	0.92	8.96	1.17	6.11	0.295	-
Calcium after HD [mg/dL]	9.38	0.56	9.46	0.84	9.47	0.80	9.43	0.79	9.48	0.73	1.56	0.907	-
Serum phosphorus before HD [mg/dL]	5.29	1.96	5.82	1.47	5.37	1.97	5.14	0.92	5.60	1.13	3.68	0.597	-
Serum phosphorus after HD [mg/dL]	2.65	0.84	2.51	0.47	2.48	0.39	2.75	0.59	2.58	0.65	2.76	0.737	-
Transferrin [mg/dL]	163.00	21.59	185.26	37.41	196.46	53.90	204.19	39.07	140.80	50.13	17.20	0.004	0<2 0<3 1>4 2>4 3>4
Ferritin [ng/ml]	477.31	384.43	657.78	402.88	319.50	272.87	409.00	422.18	836.80	818.70	12.67	0.027	1>2 2<4 3<4
Iron [ug/dL]	71.94	20.26	76.97	39.98	70.49	33.95	73.70	24.98	61.20	21.08	2.93	0.711	-

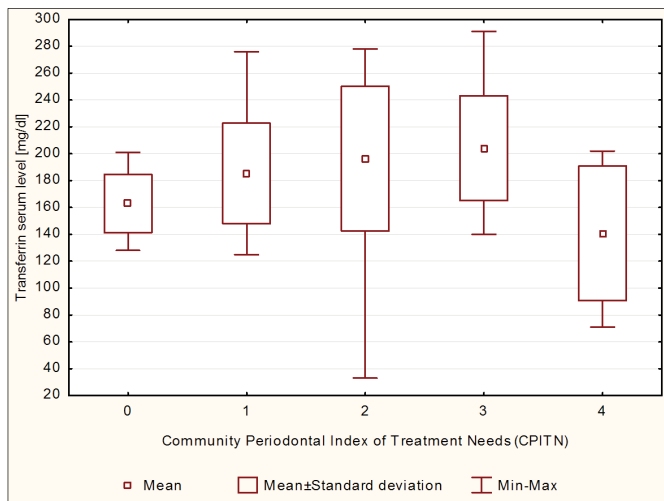


FIGURE 1. Differences in transferrin serum level conditioned by stages of Community Periodontal Index of Treatment Needs (CPITN).

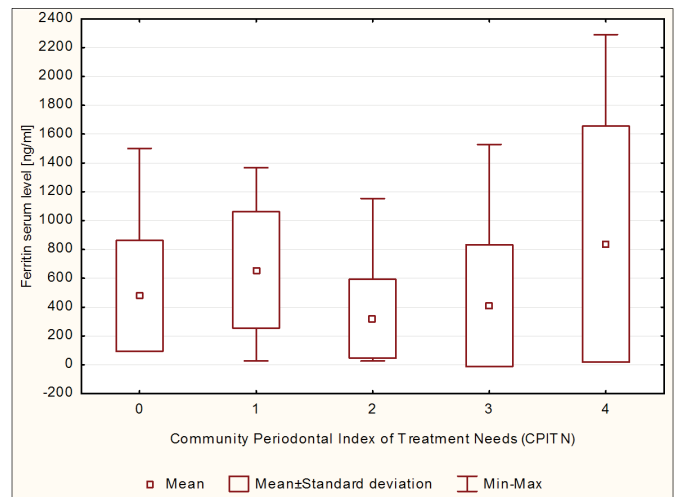


FIGURE 2. Differences in ferritin serum level conditioned by stages of Community Periodontal Index of Treatment Needs (CPITN).

Using the Kruskal-Wallis test, few statistically significant differences were identified between the five stages of community periodontal index of treatment needs (CPITN). It was noticed that patients with stage 2 or stage 3 periodontitis (according to CPITN) have the highest levels of transferrin (Figure 1, Table 3) and the lowest levels of ferritin (Figure 2, Table 3). In contrast, patients with stage 4 CPITN have the lowest level of transferrin and the highest level of ferritin (Figure 1 and 2, Table 3).

By analyzing the correlation matrix obtained between the three domains of the beliefs about pain control questionnaire (BPCQ) and biochemical indicators of calcium-phosphate and iron metabolism, only one statistically significant negative correlation was identified. It was noticed that patients who were characterized by stronger beliefs about chance happening control pain have significantly lower levels of iron in serum (Table 4.).

DISCUSSION

Previous reports suggested a relationship between periodontitis and calcium-phosphate metabolism. Rodrigues et al. showed that periodontitis is associated with lower phosphorus

TABLE 4. Spearman’s rank correlation coefficient (ρ) between three domains of the BPCQ (IS, PD, CH) and the indicators of calcium, phosphate and iron metabolism.

	Factors of BPCQ		
	Internal control pain (IS)	Powerful doctors control pain (PD)	Chance happening control pain (CH)
Calcium before HD [mg/dL]	0.12	0.01	0.01
Calcium after HD [mg/dL]	-0.03	-0.27	-0.14
Serum phosphorus before HD [mg/dL]	0.05	-0.11	-0.10
Serum phosphorus after HD [mg/dL]	0.03	0.05	0.16
Transferrin [mg/dL]	0.03	0.01	0.08
Ferritin [ng/ml]	0.07	0.11	0.02
Iron [ug/dL]	-0.17	-0.17	-0.22*

*p<0.05

serum levels in hemodialysis patients [11]. In our study this observation was not confirmed during analyzing serum phosphorus in relation to community periodontal index of treatment needs (CPITN).

It is worth mentioning that a few previous studies claimed a relationship between transferrin and iron metabolism and the advancement of periodontitis. Shirmohamadi et al. noticed that lower transferrin serum levels were detected in patients with chronic periodontitis. They suggested that the transferrin serum levels after non-surgical periodontal treatment showed an upward tendency [12]. In our study hemodialyzed patients with the most advanced periodontitis (stage 4 according to CPITN) have the lowest transferrin serum level.

Some authors suggest a relationship between periodontal disease and iron metabolism. Medikeri et al. suggested that *Campylobacter rectus* requires iron as a significant source of nutrition for its survival and growth from its hosts in deeper subgingival sites [13]. A very interesting observation was made in this context by Su et al. who indicated that periodontal disease is associated with increased oxidative modification of proteins, lipids and salivary DNA. They stated that salivary amylase and transferrin are particularly prone to enhanced oxidation in periodontitis [14]. In the view of these findings, our observations about the lowest level of ferritin in patients with the most advanced periodontitis, i.e. hemodialyzed patients with stage 4 CPITN also prove important. It should be noted that the psychological mechanisms of rationalization of pain may have some effect on compliance in physician – patient relationship. What is more, patients who strongly disbelieve in the ability to control their pain may experience resignation attitudes towards medical advice, including advice on oral supplementation of iron.

The undertaken innovative problem of the dependency between community periodontal index of treatment needs (CPITN) and the beliefs about pain control was an attempt to identify psychological factors that may affect oral hygiene. Although no statistically significant relationship between factors of BPCQ and stages of CPITN was noted, the importance of individual psychological pain management schemes should not be underestimated in the patient – medical personnel cooperation. It was revealed that patients who were characterized by stronger beliefs about chance happenings controlling pain have significant lower levels of iron in serum. This observation may indicate that people who perceive pain through the prism of a coincidence are less likely to cooperate with medical staff regarding recommendations on oral iron supplementation.

CONCLUSIONS

1. The hemodialyzed patients with the most advanced periodontitis (stage 4 according to CPITN) have the lowest transferrin serum level.
2. The hemodialyzed patients with the most advanced periodontitis (stage 4 according to CPITN) have the highest ferritin serum level.
3. There is no difference in pain control beliefs among hemodialyzed patients.

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