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Helicobacter pylori infection and its relationship to plasma magnesium in hemodialysis patients

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Abstract

Dyspeptic symptoms are quite common in chronic hemodialysis patients, and Helicobacter pylori (cagA$^+$) is thought to play an important role in the pathogenesis of the active gastritis and other upper gastrointestinal mucosal lesions in these patients. The aim of this study was to evaluate a probable association between plasma magnesium (Mg^{2+}) and Helicobacter pylori infection in maintenance patients. Helicobacter pylori specific IgG antibody levels and plasma magnesium were measured in patients. Totally 44 patients consisted from 34 non diabetic hemodialysed patients and 10 diabetic hemodialysis patients. In this study, a significant positive correlation between anti-Helicobacter IgG antibody and plasma magnesium was found in all patients (r=0.29, p=0.050) (adjusted for dialysis sessions). The results of this study suggest the association of serum magnesium with the infection of Helicobacter pylori. Mg^{2+} acquisition by CorA is essential for Helicobacter pylori in vitro. We concluded that high serum magnesium level and probably its higher concentration in gastric mucosa might facilitate the colonization of Helicobacter pylori in the stomach of hemodialysis patients, although more studies are needed to prove the clinical relevance of this finding *(Tab. 1, Fig. 1, Ref. 23)*. Full Text (Free, PDF) *www.bmj.sk*.

Key words: chronic renal failure, hemodialysis, magnesium, Helicobacter pylori IgG antibodies.

Helicobacter pylori (strains cagA$^+$) has been shown to play an important role in the development of gastritis and gastric ulcer (1). Patients with chronic renal failure often have dyspeptic symptoms and may develop peptic disease or digestive disorders leading to severe gastrointestinal complications (2). Studies on the relationship between high plasma urea nitrogen, creatinine and Helicobacter pylori infection in hemodialysis patients presented contradictory results (3). While the background of the gastroduodenal disorder remains unclear in these patients, the link between Helicobacter pylori, chronic gastritis and peptic ulcer disease has grown stronger (4–6). It has been reported that patients with chronic renal failure have an increased incidence of peptic ulcer, however, it is unclear whether the increased incidence is due to altered gastric acidity, hypersecretin of gastrin, or increased colonization of Helicobacter pylori (7–8). Only few reports are available regarding the promoting factors of Helicobacter pylori infection in hemodialysis patients. Regarding this, lack of significant relationship between PTH abnormalities, which is frequently seen in hemodialysis patients, and H. pylori infection was noted previously (9) and high pepsinogen II plasma levels (an interacting factor for H. pylori infection in dialysis patients) were proposed in another study (10). It was found that renal excretion is the major route of magnesium elimination from the body and that a positive magnesium balance would be expected in renal insufficiency (11). In chronic renal failure, the limited ability of the kidney to excrete an increased magnesium load may result in toxic plasma concentrations (11–12). Following the chronic hemodialysis treatment, the main determinant of magnesium balance is the concentration of magnesium in the dialysate. Thus in end-stage renal failure, magnesium levels are increased in plasma and red blood cells (12–13) and magnesium retention could be a problem in patients on maintenance hemodialysis (13). Magnesium seems to be an important factor for

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Tab. 1. Mean±SD of patients' data.

Total patients n=44	Minimum m	Maximum m	Mean±SD	Median
Age years	11	80	43±17.6	40.5
DH* months	2	156	29±34	17.5
Dialysis dose sessions	18	1584	300±367	121
Mg mg/dl	1.6	3.5	2.5±0.41	2.4
AntiHp IgG U/ml	0.5	34	7.7±10.	3 2
Non diabetics n=34	Minimum	Maximum	Mean±SD	Median
Age years	11	80	40.6±17	40
DH* months	2	156	33±37.4	20
Dialysis dose sessions	18	1584	300±408	135
Mg mg/dl	1.6	3.3	2.45±0.41	2.4
AntiHp IgG U/ml	0.5	34	7.6±10	2
Diabetics n=10	Minimum	Maximum	Mean±SD	Median
Age years	27	79	52±16.6	55
DH* months	6	24	14.4±6.7	12
Dialysis dose sessions	54	216	120.5±57	99
Mg mg/dl	2	3.5	2.46±0.48	2.3
AntiHp IgG U/ml	0.5	33	8.2±11.7	1.5

*Duration of hemodialysis treatment

both gastric acid secretion regulation (together with Ca^{2+}) and for Helicobacter pylori survival and virulence (14). Therefore it can be useful to evaluate if Helicobacter pylori infection is accompanied by changes in plasma Mg availability in patients with regular hemodialysis. According to the data on the status of plasma magnesium in maintenance hemodialysis patients, we aimed to conduct a study to evaluate the probable association of plasma magnesium with Helicobacter pylori infection in end-stage renal failure patients undergoing regular hemodialysis treatment.

Patients and methods

A cross-sectional study was conducted in patients with end-stage renal disease, undergoing maintenance hemodialysis treatment with an acetate basis dialysate and polysulfone membranes. Exclusion criteria for patients were following: taking H2 proton pomp inhibitors and antibiotics, and active or chronic infection. All patients had various upper gastrointestinal complaints consisting of epigastric pain, epigastric burning, postprandial fullness, early satiety, bloating and belching. In all patients, plasma magnesium (Mg) was measured. Helicobacter pylori specific IgG antibody level was measured by enzyme-linked immunosorbent assay (ELISA) using a standard kit. A titer >10 U/ml was interpreted as positive according to the manufacturer's instructions. Duration and sessions of hemodialysis treatment were calculated from patients' records. The duration of each hemodialysis session was four hours. For the statistical analysis, descriptive data were expressed as mean±SD. A comparison between groups was performed using the Student's t-test. The partial correlation test was used for correlations. All statistical analysis was performed using the SPSS (version 11.5.00). Statistical significance was interpreted as $p<0.05$.

Results

Totally, 44 patients were including (F=27, M=17), consisting of 34 non-diabetic hemodialysis patients (F=21 M=13) and 10 diabetic hemodialysis patients (F=4 M=6). Table 1 shows patients' data. The mean age was 43 years (SD±17.6). The length of the hemodialysis time was 29 months (+34) (median: 17.5 months). The plasma magnesium of all patients was 2.5 (±0.41) mg/dl, the plasma level of Helicobacter pylori specific IgG antibody of all patients was 7.7 (±10.3) U/ml (median: 2 U/ml). In this study, non-significant difference in age, plasma Helicobacter IgG antibody and plasma magnesium between males and female patients was observed. Non-significant difference in plasma magnesium and Helicobacter IgG antibody between diabetics and non-diabetics patients was observed and no significant difference in Helicobacter IgG antibody level between males and females was seen (p=NS). In all patients, neither a significant correlation between plasma Helicobacter IgG antibody levels and age, nor a significant correlation between plasma Helicobacter IgG antibody levels and duration and sessions of hemodialysis was found (p=NS). In all patients, not a significant correlation between plasma magnesium and age, duration of hemodialysis

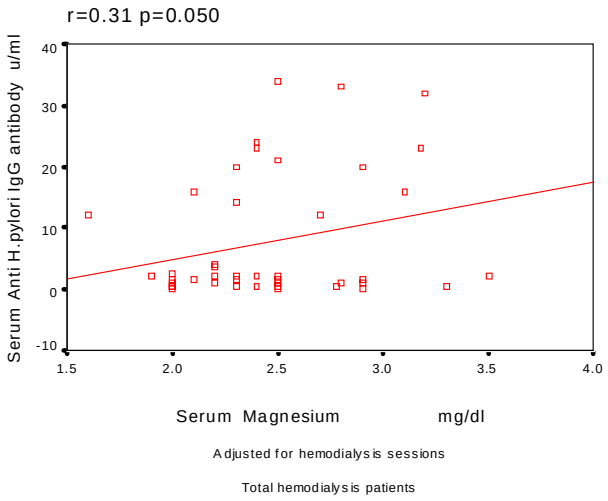

Fig. 1. A significant positive correlation between Helicobacter IgG antibody and plasma magnesium in all patients.

treatment and hemodialysis doses was found (p=NS). In this study, a significant positive correlation between Helicobacter IgG antibody and plasma magnesium (r=0.31 p=0.050; figure1) was seen in all patients (adjusted for dialysis sessions) (Tab. 1, Fig. 1).

Discussion

The findings of our study were following: not a significant difference in the Helicobacter IgG antibody level between diabetic and non-diabetic hemodialysis patients and not a significant difference in Helicobacter IgG antibody levels between males and females. Also, not a significant difference in plasma magnesium between diabetic and non-diabetic hemodialysis patients and between males and females was found. A significant positive correlation between Helicobacter IgG antibody and plasma magnesium was found in all patients. The cation metabolism of the gastric pathogen Helicobacter pylori (15) is substantially important for the survival in the hostile and changing environment of the gastric mucosa (16–17). Mechanisms involved in maintaining the cation homeostasis were required for the effective gastric colonization in animal models (18). Although the essential biological functions of Mg^{2+} point towards the relevance of Mg^{2+} acquisition in the adaptation to the gastric environment, proteins involved in H. pylori Mg^{2+} uptake and metabolism have not been studied in detail (19). A complete growth deficiency in media without Mg^{2+} supplementation and a drastic Mg^{2+} requirement of 20 mM manifested by corA mutants demonstrates that H. pylori CorA is essential for Mg^{2+} acquisition, required for the survival in low-Mg^{2+} environment (19). These findings underline the role of H. pylori cation metabolism in maintaining metabolic functions and highlight a substantial importance of Mg^{2+} acquisition in gastric adaptation (19). A role of CorA-mediated Mg^{2+} uptake in H. pylori colonization and/or survival in the gastric mucosa is supported by the Mg^{2+} concentration in human gastric juice, which is at 0.7 mM (20) far below the values required for the growth of corA mutants. Thus, it seems very unlikely that H. pylori corA mutants can persist in the gastric mucosa for an extended time periods. The observations indicate that Mg^{2+} is the dominant CorA substrate (19). Our findings suggest the association of plasma magnesium with the infection of Helicobacter pylori. As mentioned, Mg^{2+} acquisition by CorA is essential for Helicobacter pylori in vitro and because corA mutants had not grown in media without Mg^{2+} supplementation (15, 19) and magnesium Mg^{2+} is a cofactor for many enzymes involved in central biochemical pathways, thus pathogenic bacteria express specific Mg^{2+} uptake systems, which are essential for bacterial viability (21–22). Hemodialysis patients are more prone to have a high magnesium level, which is noted in this and also our previous study (13). Magnesium also seems to be an important factor for both gastric acid secretion regulation (together with Ca^{2+}) and for Helicobacter pylori survival and virulence (14). Regarding this, in a study whether magnesium ion in water could influence the colonization of Helicobacter pylori in 2-weeks old miniature pigs, Koga found that magnesium ion in drinking water is essential for the colonization of H. pylori in the pig stomach (23). It is believed that H. pylori CorA transports nickel and cobalt in addition to Mg^{2+} and Mg^{2+} is the dominant CorA substrate, as the corA mutation affected neither cobalt and nickel resistance nor nickel induction of urease in H. pylori (14, 19). We concluded that high plasma magnesium level and probably its higher concentration in gastric mucosa might facilitate the colonization of H. pylori in the stomach of hemodialysis patients, although more studies are needed to define the clinical relevance of this finding.

References

1. Nakajima F, Sakaguchi M, Oka H, Kawase Y, Shibahara N, Inoue T, Ueda H, Katsuoka Y. Prevalence of Helicobacter pylori antibodies in long-term dialysis patients. Nephrology 2004; 9 (2): 73—76.

2. Nardone G, Rocco A, Fiorillo M, Del Pezzo M, Autiero G, Cuomo R, Sarnelli G, Lambiase A, Budillon G, Cianciaruso B. Gastroduodenal lesions and Helicobacter pylori infection in dyspeptic patients with and without chronic renal failur. Helicobacter 2005; 10 (1): 53—58.

3. Tsukada K, Miyazaki T, Katoh H, Yoshikawa M, Masuda N, Ojima H et al. Helicobacter pylori infection in hemodialysis patients. Hepatogastroenterology 2003; 50 (54): 2255—2258.

4. Kang JY. The gastrointestinal tract in uremia. Dig Dis Sci 1993; 38: 257—268.

5. Dooley CP, Cohen H, Fitzgibbons PL et al. Prevalence of Helicobacter pylori infection and histologic gastritis in asymptomatic persons. New Engl J Med 1989; 321: 1562—1566.

6. Peterson WL. Helicobacter pylori and peptic ulcer disease. New Engl J Med 1991; 324: 1043—1048.

7. Kim DH, Jung HY, Yang SK, Hong WS, Min YI. Prevalence of Helicobacter pylori in Patients with End Stage Renal Disease. Korean J Gastrointest Endosc 2000; 20 (2): 97—102.

8. Nardone G, Rocco A, Fiorillo M, Del Pezzo M, Autiero G, Cuomo R, Sarnelli G, Lambiase A, Budillon G, Cianciaruso B. Gastroduode-

nal lesions and Helicobacter pylori infection in dyspeptic patients with and without chronic renal failure. Helicobacter 2005; 10 (1): 53—58.

9. Bednarek-Skublewska A, Schabowski J, Majdan M, Baranowicz-Gaszczyk I, Ksiazek A. Relationships between hyperparathyroidism and Helicobacter pylori infection in long-term hemodialysis patients. Pol Arch Med Wewn 2001; 105 (3): 191—196.

10. Araki H, Miyazaki R, Matsuda T, Gejyo F, Koni I. Significance of serum pepsinogens and their relationship to Helicobacter pylori infection and histological gastritis in dialysis patients. Nephrol Dial Transplant 1999; 14 (11): 2669—2675.

11. Mountokalakis TD. Magnesium metabolism in chronic renal failure. Magnes Res 1990; 3 (2): 121—127.

12. Lindeman RD. Chronic renal failure and magnesium metabolism. Magnesium 1986; 5 (5—6): 293—300.

13. Nasri H, Baradaran A. Correlation of serum magnesium with dyslipidemia in maintenance hemodialysis patients. Acta Medica (Hradec Kralove) 2004; 47 (4): 263—265.

14. Abbasciano V, Sartori S, Trevisani L, Girometti R, Ranzini M, Nielsen I, Mazzotta D, Vecchiatti G, Bononi A, Guglielmini C. Comparison of magnesium concentration in serum, erythrocytes and gastric tissue in two groups of patients affected by chronic gastritis, Helicobacter pylori negative and positive. Magnes Res 2003; 16 (4): 281—286.

15. Dunn BE, Cohen H, Blaser MJ. Helicobacter pylori. Clin Microbiol Rev 1997; 10: 720—741.

16. McGee DJ, Mobley HL. Mechanisms of Helicobacter pylori infection: bacterial factors. Curr Top Microbiol Immunol 1999; 241: 155—180.

17. Nolan KJ, McGee DJ, Mitchell HM, Kolesnikow T, Harro JM, O'Rourke J, Wilson JE, Danon SJ, Moss ND, Mobley HL, Lee A. In vivo behavior of a Helicobacter pylori SS1 nixA mutant with reduced urease activity. Infect Immun 2002; 70: 685—691.

18. van Vliet AHM, Bereswill S, Kusters JG. Ion metabolism and transport. 193—206. In: Mobley HL, Mendz GL, Hazell SL (Eds). Helicobacter pylori: physiology and genetics. Washington, D.C., ASM Press 2001.

19. Pfeiffer J, Guhl J, Waidner B, Kist M, Bereswill S. Magnesium uptake by CorA is essential for viability of the gastric pathogen Helicobacter pylori. Infect Immun 2002; 70 (7): 3930—3934.

20. Greger R, Windhorst U (Ed). Comprehensive human physiology. New York, N.Y., Springer 1996, 2432 pp.

21. Moncrief MB, Maguire ME. Magnesium transport in prokaryotes. J Biol Inorg Chem 1999; 4: 523—527.

22. Smith RL, Maguire ME. Microbial magnesium transport: unusual transporters searching for identity. Mol Microbiol 1998; 28: 217—226.

23. Koga T, Sato K, Shimada Y, Takahashi K, Kikuchi I, Okazaki Y, Katsuta M, Iwata M. Essential role of magnesium ion in water for colonization of Helicobacter pylori in 2-week-old miniature pigs. Microbiol Res 2003; 158 (1): 69—75.

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