

Abnormalities of serum magnesium levels in dialysis patients undergoing parathyroidectomy

Shih-Ping Cheng; Chi-Yu Kuo; Jie-Jen Lee; Chung-Hsin Tsai

Department of Surgery, MacKay Memorial Hospital and MacKay Medical College, Taipei, Taiwan

Introduction

Hypomagnesemia has been associated with hypocalcemia after total thyroidectomy and with hungry bone syndrome after parathyroidectomy for primary hyperparathyroidism. The magnesium dynamic and its significance have not been well studied in patients undergoing parathyroidectomy for secondary hyperparathyroidism. In this study, we analyzed perioperative serum magnesium levels and their associations with clinical parameters.

Materials and methods

A total of 268 patients on renal replacement therapy who underwent surgery for secondary hyperparathyroidism from 2013 to 2022 were included in this study.

Results

The median of baseline magnesium levels was 2.3 mg/dL (interquartile range, 2.1–2.5). Given the reference range of 1.8 to 2.5 mg/dL in our hospital, 214 (80%) patients had normomagnesemia.

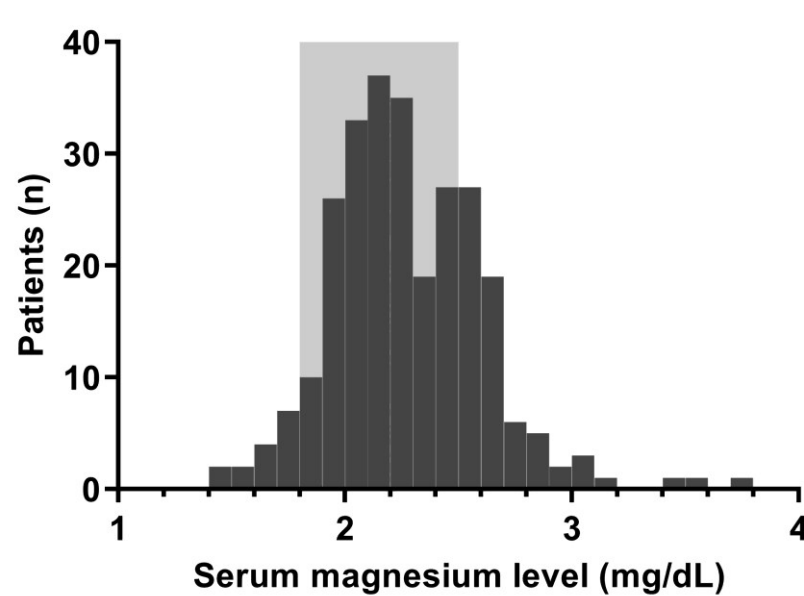


Figure: Distribution of baseline serum magnesium levels in the study cohort. The shaded area represents the reference range.

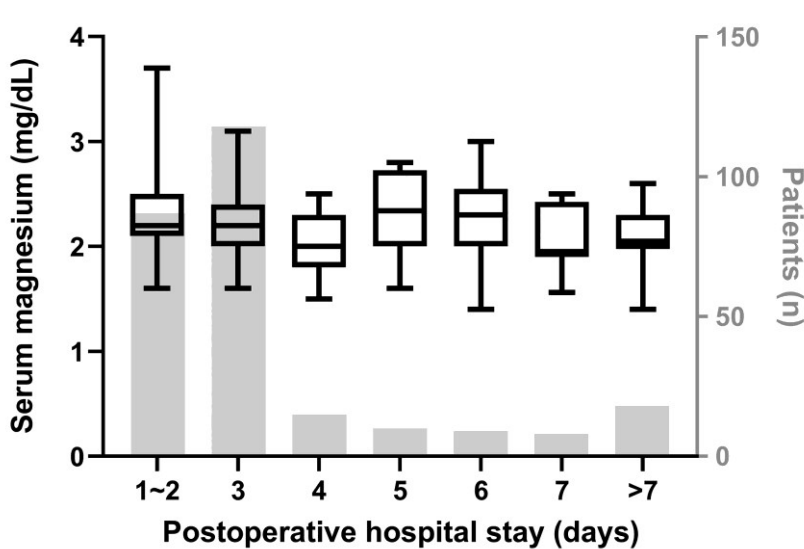


Figure: Association of serum magnesium levels and length of postoperative hospital stay after parathyroidectomy. Magnesium levels are shown as boxplots.

Table: Patient characteristics stratified by serum magnesium levels

	Hypomagnesemia (Mg ²⁺ < 1.8 mg/dL) n=15	Normomagnesemia (Mg ²⁺ = 1.8–2.5 mg/dL) n=214	Hypermagnesemia (Mg ²⁺ > 2.5 mg/dL) n=39	P-value
Female, n (%)	11 (73%)	113 (53%)	23 (59%)	0.275
Patient age, years	47 (33, 56)	55 (48, 62)	56 (52, 60)	0.031 ^{ab}
Body mass index, kg/m ²	20.7 (19.6, 22.9)	22.8 (20.7, 25.7)	24.2 (21.3, 26.7)	0.113
Hemodialysis, n (%)	2 (13%)	187 (87%)	29 (74%)	<0.001
Dialysis duration, years	8.0 (4.0, 12.0)	9.0 (5.5, 13.0)	7.0 (5.0, 10.0)	0.196
Corrected calcium, mg/dL	10.2 (9.4, 10.6)	10.5 (10.0, 11.1)	10.8 (9.9, 11.5)	0.030 ^{ab}
Phosphorus, mg/dL	6.1 (5.3, 7.7)	5.9 (5.0, 6.9)	6.5 (5.4, 7.4)	0.057
Calcium-phosphorus product, mg ² /dL ²	65.1 (55.1, 76.1)	61.8 (54.1, 71.8)	67.9 (59.2, 83.6)	0.037 ^c
Alkaline phosphatase, U/L	312 (120, 697)	199 (129, 358)	194 (146, 290)	0.583
Parathyroid hormone, pg/mL	1691 (1231, 1800)	1450 (1156, 1667)	1300 (974, 1500)	0.021 ^{bc}
Osteocalcin, ng/mL	285 (249, 1399)	281 (213, 949)	269 (203, 673)	0.413
Bone mineral density, T-score	− 1.7 (− 2.8, − 0.7)	− 1.7 (− 2.8, − 0.6)	− 2.0 (− 2.7, − 1.3)	0.787
Bone mineral density, Z-score	− 0.9 (− 1.9, 0.0)	− 0.6 (− 1.5, 0.1)	− 0.6 (− 1.2, − 0.1)	0.762
Postoperative stay, days	4 (3, 7)	3 (2, 3)	3 (2, 3)	0.019 ^{ab}

* Data are expressed as frequency (percentage) or median (interquartile range)

* Kruskal–Wallis test with post hoc Dunn test $P < 0.05$: ^a hypomagnesemia vs normomagnesemia; ^b hypomagnesemia vs hypermagnesemia; ^c normomagnesemia vs hypermagnesemia

Table: Logistic regression analysis of predictors for prolonged hospital stay after parathyroidectomy

	Univariate analysis			Multivariate analysis		
	OR	95% CI	P-value	OR	95% CI	P-value
Sex (male vs female)	1.179	0.663–2.097	0.574			
Patient age (years)	0.920	0.893–0.949	<0.001	0.925	0.892–0.960	<0.001
Body mass index, kg/m ²	1.001	0.929–1.078	0.980			
Dialysis type (peritoneal dialysis vs hemodialysis)	1.278	0.629–2.599	0.498			
Dialysis duration (years)	0.991	0.939–1.046	0.751			
Corrected calcium (mg/dL)	0.715	0.499–1.025	0.068			
Phosphorus (mg/dL)	1.172	0.968–1.419	0.104			
Calcium-phosphorus product (mg ² /dL ²)	1.009	0.991–1.028	0.304			
Alkaline phosphatase (U/L)	1.003	1.002–1.005	<0.001	1.003	1.002–1.005	<0.001
Parathyroid hormone (pg/mL)	1.001	1.000–1.001	<0.001	1.000	0.999–1.001	0.972
Osteocalcin (ng/mL)	1.001	1.000–1.001	0.001	1.001	1.000–1.001	0.001
Magnesium (mg/dL)	0.328	0.128–0.843	0.021	1.110	0.356–3.461	0.857
Bone mineral density (T-score)	0.982	0.804–1.199	0.859			
Bone mineral density (Z-score)	0.663	0.508–0.864	0.002	0.837	0.604–1.161	0.287
Operation type (total parathyroidectomy and autotransplantation vs subtotal parathyroidectomy)	1.541	0.727–3.264	0.259			
Parathyroid weight (mg)	1.000	1.000–1.000	0.117			

Discussion

Expression of calcium-sensing receptors (CaSRs), vitamin D receptors, and the FGFR-Klotho receptor system in parathyroid cells is regulated by magnesium. At moderately low calcium concentrations, magnesium shifts parathyroid hormone (PTH)-calcium curves and reduces PTH secretion. Paradoxically, magnesium deficiency mimics CaSR activation and thus causes inhibition of PTH secretion independent of calcium levels.

We observed a modest drop in magnesium levels after parathyroidectomy. The reduction in serum magnesium may result from movement of magnesium out of the extracellular space into the cells or into the bone where it is deposited. However, neither the baseline magnesium level nor the magnitude of magnesium drop was associated with the length of postoperative stay.

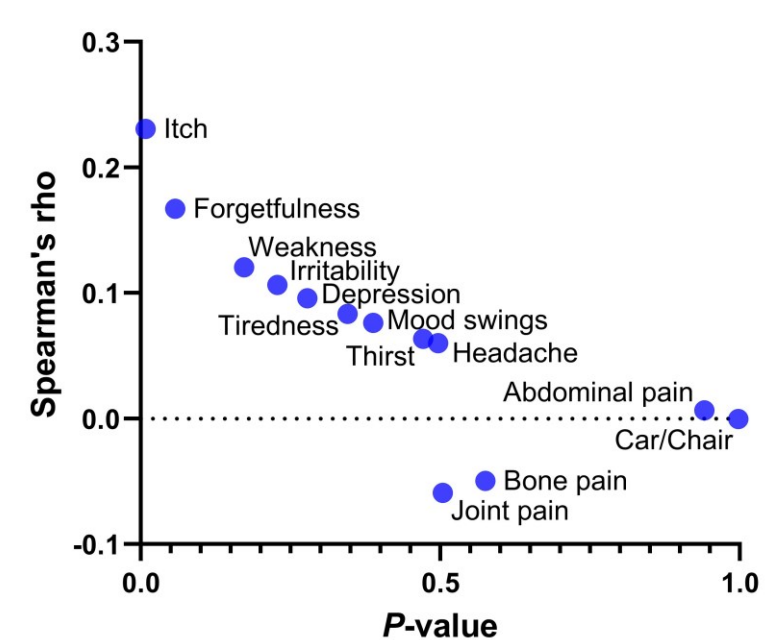


Figure: Correlation of serum magnesium levels and symptom scores of the Parathyroidectomy Assessment of Symptoms (PAS).

Conclusion

Magnesium abnormalities play a minor role in hungry bone syndrome after parathyroidectomy for secondary hyperparathyroidism. Patients with higher serum magnesium levels are likely to have more severe pruritus.

