



Clinical predictor of postoperative hyperkalemia after parathyroidectomy in patients with hemodialysis



Sijia Li^a, Shuangxin Liu^{a,1}, Qiuhan Chen^{c,1}, Pingjiang Ge^{b,*}, Jie Jiang^b, Xiaoli Sheng^b, Shaohua Chen^{b,**}

^a Department of Nephrology, Guangdong General Hospital and Guangdong Academy of Medical Sciences, Guangzhou City, PR China

^b Department of Otolaryngology, Guangdong General Hospital and Guangdong Academy of Medical Sciences, Guangzhou City, PR China

^c Department of Otolaryngology, Zhaoqing Gaoyao People's Hospital, Zhaoqing City, PR China

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ABSTRACT

Objective: Hyperkalaemia is one of the most common reasons for patients requiring emergency treatment. This study is to investigate the risk factors of postoperative hyperkalemia in renal failure patients undergoing parathyroidectomy with autotransplantation (PTXa).

Methods: One hundred and eight patients [54 men and 54 women; age, 45.1 ± 11.1 years (mean \pm SD)] with secondary hyperparathyroidism undergoing parathyroidectomy with autotransplantation were involved in this study. Laboratory chemistries (hemoglobin, fasting blood glucose, serum calcium level, alkaline phosphatase, phosphorus, parathyroid hormone) were measured before surgery. Serum potassium level was obtained before surgery and at 0 h after surgery.

Results: Serum potassium level increased in 108 patients after surgery ($P < 0.05$). Sixteen patients (14.8%) potassium levels rose more than 6.0 mmol/L after parathyroidectomy with autotransplantation. Age and preoperative serum potassium level were significantly negative correlated with postoperative serum potassium level. Correlation analysis and receiver operating characteristic curve method confirmed that use of the preoperative serum potassium level was the primary predictor of postoperative hyperkalemia. The cutoff point for preoperative serum potassium level was 4.40 mmol/L, according to the Youden index of the receiver operating characteristic curve.

Conclusions: Preoperative serum potassium increased after parathyroidectomy with autotransplantation in patients with secondary hyperparathyroidism. The preoperative serum potassium level could help the surgeon to predict postoperative hyperkalemia in case of emergency dialysis following surgery.

1. Introduction

Hyperkalemia is a severe medical condition requiring early recognition and treatment. Symptoms of hyperkalemia are non-specific, including muscle weakness, malaise, and palpitations. As potassium rises to 5.50–6.50 mmol/L, peaked T-waves and a prolonged PR segment may be seen, advancing with higher levels of potassium to a progressive widening of the QRS complex, fascicular and bundle branch blocks, cardiac arrest [1–4]. Hyperkalaemia is one of the most common reasons for patients requiring emergency dialysis. It is at least 3–5% of deaths in dialysis patients due to hyperkalemia [5]. Parathyroidectomy is an effective treatment for bone and mineral metabolism disorder due

to secondary hyperparathyroidism, but then postoperative hyperkalemia has been reported previously in the patient after parathyroidectomy (PTX) [6,7]. Bajaj Y reported a young patient dying from hyperkalemia undergoing parathyroidectomy [8]. On the contrary, the patients might encounter higher economic burden if they routinely received hemodialysis following PTX.

The aim of this study was to estimate the risk of postoperative hyperkalemia using the clinical risk factors and to prevent emergency dialysis following surgery.

* Corresponding author. Department of Otolaryngology, Guangdong General Hospital and Guangdong Academy of Medical Sciences, Southern Medical University, 106, Zhongshan 2 Ave, Guangzhou City 510080, China.

** Corresponding author.

E-mail address: gepingjiang@aliyun.com (P. Ge).

¹ These authors contributed equally to Dr. Li.

Table 1
Demographics and clinical characteristics of the study population.

Characteristic	Value
Age (yr) (n = 108)	45.1 ± 11.2
Male:Female	54:57
Dialysis duration (yr) (n = 108)	7.6 ± 5.0
Total volume of parathyroid glands (cm ³) (n = 108)	3.8 ± 2.2
Preoperative laboratory data(n=108)	
Hemoglobin (g/dL)	106.0 ± 19.0
FBG (mmol/L)	5.0 ± 1.5
Phosphorus (mmol/L)	2.2 ± 0.7
Serum ALP(U/L)	242.7 [146.1496.0] ^b
Serum PTH(pg/mL)	1817.3 ± 870.5
Serum calcium (mmol/L)	2.5 ± 0.3
Serum potassium (mmol/L) (3.50–5.30 ^a)	4.13 ± 0.61
Postoperative laboratory data(n=108)	
Serum potassium immediate after PTXa (mmol/L)	4.85 ± 1.06
Postoperative serum PTH (pg/mL)	44.1 ± 33.1

Values are presented as mean ± SD.

^a Normal range.

^b Interquartile range, FBG = fasting blood glucose, ALP = alkaline phosphatase, PTH = parathyroid hormone.

2. Materials and methods

Approval was obtained from the XXX General Hospital research ethics committee review board prior to conducting this study. Written consent for the procedure was obtained from each patient before the operation. The work has been reported in line with the STROCSS criteria [11].

2.1. Patients

One hundred and eight patients [54 men and 54 women; age, 45.1 ± 11.1 years (mean ± SD)], with the diagnosis of secondary hyperparathyroidism to renal failure, were enrolled into this study. All patients who had secondary hyperparathyroidism with high parathyroid hormone (PTH) serum levels (1817.3 ± 870.5 pg/mL; reference range, 15–69 pg/mL) were treated with parathyroidectomy with autotransplantation (PTXa) in Otolaryngology Head and Neck Surgery department in XXX General Hospital between February 2013 and July 2015 (Table 1).

2.2. Surgical procedure

All patients had dialysis within 24 h before PTXa. One experienced surgeon performed operations of all patients. Anesthesia was induced with propofol and midazolam. Cisatracurium was administered intravenously to block neuromuscular. Anesthesia was maintained with propofol and sevoflurane. Several factors contributing to the development of the hyperkalemia or hypokalemia were not applied during operation and anesthesia, such as calcium, succinylcholine, blood product [9,10]. Parathyroidectomy with autotransplantation (PTXa) was performed following general anesthesia in secondary hyperparathyroidism patients. A low collar incision 6–7 cm in length was operated. After the location of recurrent laryngeal nerve, all inferior and superior parathyroids were removed. The last one hyperplastic parathyroid gland was selected and cut into particles (60–100 mg) which were transplanted into the surface of brachioradialis muscle of the arm for autotransplantation. All specimens were examined by a pathologist to confirm the diagnosis.

2.3. Laboratory chemistry measurement

Laboratory chemistries (hemoglobin, fasting blood glucose, serum calcium level, alkaline phosphatase, phosphorus, parathyroid hormone, thyroid hormone) were measured before surgery. Serum potassium

levels (SPL) were checked at 4 h before surgery and immediate after surgery. If preoperative SPL were more than 5.0 mmol/L, the operation would be postponed until SPL less than 5.0 mmol/L. Postoperative serum potassium levels also were checked following surgery. All the operations were performed in the morning or noon. If postoperative serum potassium levels were more than 5.9 mmol/L, patients would be treated with insulin and glucose (40 mL 50% glucose + 5U insulin) intravenous injection or emergency dialysis. Serum PTH was checked at 24 h before surgery and at 18hr after surgery.

2.4. Statistical analysis

Data are presented as mean ± SD (range) or interquartile range. Pearson or Spearman correlation coefficients were used to examine associations between serum potassium levels (SPL) and variables. To evaluate changes in biochemical parameters, One Way ANOVA analysis was performed. Predicting parameters value for hyperkalemia were calculated from the ROC curves. P < 0.050 was considered statistically significant. Chi-square test was conducted to compare the proportions of patients. We processed all data using SPSS version 19.0 for Windows (SPSS, Chicago Illinois, USA) [11].

3. Results

Parathyroid hormone (PTH) levels decreased significantly after surgery, (1817.3 ± 870.5 pg/mL) preoperatively to (44.1 ± 33.1 pg/mL) within 18hs after surgery in 108patients (P < 0.05) (Table 1).

The postoperative serum potassium levels were significantly higher compared with preoperative potassium levels in all patients (P < 0.05). The potassium levels immediately rose above the normal limit (5.30 mmol/L in our hospital) in 28 of the 108 patients (25.9%), and above the critical limit (6.00 mmol/L) in 16 of the 108 patients (14.8%) after PTXa. Twenty-eight patients were treated with insulin injection or dialysis for profound hyperkalemia (> 5.90 mmol/L) or water retention.

In correlation analysis, where the dialysis duration, hemoglobin, fasting blood glucose, serum calcium level, alkaline phosphatase, phosphorus, PTH were independent variables, no correlations could be found between any of them and change in serum potassium level. But preoperative serum potassium level appeared to be the main correlation variable of hyperkalemia at 0hr after PTXa (P < 0.05). Other than the age was significantly correlated with immediate postoperative SPL (P < 0.05) (Table 2). The male patients undergoing PTXa are more prone to postoperative hyperkalemia (X² = 53.48, P < 0.05). In the

Table 2
Univariate analysis of postoperative serum potassium and parameters by correlation analysis.

Parameters	Serum potassium immediate after PTXa	
	R	P value
Age (yr)	−0.251	0.009 ^a
Dialysis duration (yr)	−0.03	0.979
Total volume of parathyroid glands (cm ³)	−0.001	0.994
Preoperative laboratory data(n=108)		
Hemoglobin (g/dL)	0.063	0.517
FBG (mmol/L)	−0.111	0.270
Phosphorus (mmol/L)	0.121	0.216
Serum ALP(U/L)	0.011	0.909
Serum PTH(pg/mL)	0.064	0.541
Serum calcium (mmol/L)	−0.156	0.124
Serum potassium (mmol/L) (3.50–5.30 ^b)	0.719	0.000 ^a

^a p < 0.05.

^b Normal range, FBG = fasting blood-glucose, ALP = alkaline phosphatase, PTH = parathyroid hormone.

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