



Original Contribution

Young age, male sex, and end-stage renal disease with secondary hyperparathyroidism as risk factors for intraoperative hyperkalemia during parathyroidectomy



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(SHPT)

Abstract

Study Objective: The aim of this study was to investigate the risk factors of intraoperative hyperkalemia in end-stage renal disease patients undergoing parathyroidectomy (PTx) with autotransplantation (AT).
Design: Prospective observational study.

Setting: Operating room of a tertiary care medical center.

Patients: Thirty-two adult, American Society of Anesthesiologists physical status 2 and 3 patients with secondary hyperparathyroidism aged between 31 and 72 years scheduled for PTx with AT.

Measurements: Laboratory chemistries (intact parathyroid hormone, Na, K, Ca, P, arterial blood gas) were obtained before surgery and at 2 time points during surgery. The first chemistry levels during surgery were checked after the first 2 parathyroid glands had been removed, and the second levels were checked after wound closure. Statistical analysis was performed using *t* test, Fisher exact test, the receiver operating characteristic curve method, as appropriate.

Main Results: Eight patients (25%) developed hyperkalemia during surgery. The hyperkalemia patients had younger age (42 ± 11.44 years vs 52.58 ± 11.83 years, $P = .044$) and a male dominance (odds ratio, 11.4; $P = .01$; 95% confidence interval, 1.74–74.65). The cutoff for age was 40.5 years, according to the highest value for sensitivity plus specificity of the receiver operating characteristic curve. There was a higher incidence of intraoperative hyperkalemia in younger patients than in older patients (odds

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ratio, 8.33; $P = .023$; 95% confidence interval, 1.39–49.87) as well as a significant increase in potassium level during surgery in younger male patients ($P = .005$ and $.002$, respectively).

Conclusions: The anesthesiologist should be aware of the complications of intraoperative hyperkalemia during PTx with AT, especially in male end-stage renal disease patients younger than 40 years.

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1. Introduction

Secondary hyperparathyroidism (SHPT) is a common abnormality of mineral metabolism in patients with end-stage renal disease (ESRD) [1,2]. Long-term, uncontrolled SHPT may result in bone metabolism disturbances and higher cardiovascular morbidity and mortality [2–7]. Parathyroidectomy (PTx) for SHPT was first performed in 1965, and approximately 29% of patients with ESRD refractory to medication undergo the procedure to control their metabolic status [8,9]. Parathyroidectomy with auto-transplantation (AT) of parathyroid glands into the subcutaneous layer of the forearm or thigh is a treatment of symptomatic hyperparathyroidism [10,11].

After PTx, hypocalcemia is the most frequent complication requiring aggressive calcium administration [12,13]. Although the mechanism is not understood, hyperkalemia is not uncommon in dialysis patients after PTx, occurring in 80% of patients in one series [8,14]. Bajaj et al [15] reported that potassium levels increased beyond the normal limit (5.3 mmol/L) in 16 of 29 ESRD patients who received PTx. The intraoperative potassium levels in 17 (58%) of 29 patients increased by more than 0.5 mmol/L when compared with the postinduction levels [15]. Therefore, this prospective study investigated the risk factors of intraoperative hyperkalemia in ESRD patients undergoing PTx with AT.

2. Materials and methods

Thirty-two ESRD and American Society of Anesthesiologists (ASA) physical status grade II to III patients aged between 31 and 72 years and with symptomatic SHPT from Kaohsiung Chang Gung Memorial Hospital were enrolled into the study since April 2012 to April 2013. The institutional review board of Chang Gung Memorial Hospital approved this study. All patients provided written informed consent and were included in the study (Table 1), and no patients were excluded. One surgeon performed all the procedures. After standard monitoring devices were used in the operating room, anesthesia was induced with propofol and fentanyl without any premedication. Cisatracurium was administered intravenously for neuromuscular block. After endotracheal tube placement, anesthesia was maintained with an oxygen and sevoflurane or desflurane mixture according to the practice of different anesthesiologists, and no nitrous oxide was used. Intravenous morphine or fentanyl

was administered postoperatively for further analgesia, and neostigmine with atropine was used to reverse the muscle relaxant effect after the operation had been completed.

All demographic data (including age, sex, and body mass index [BMI]), clinical variables (dialysis duration and status, operation time), thallium scan, and past medical diseases were recorded. Laboratory chemistries (intact parathyroid hormone [iPTH], Na, K, Ca, P, arterial blood gas) and electrocardiography were obtained before surgery and at 2 time points during surgery. The first chemistry levels during surgery were checked after the first 2 parathyroid glands had been removed, and the second levels were checked after wound closure. If the potassium level > 5.3 mmol/L, glucose and insulin (20 mL 50% glucose + 10 U insulin) intravenous push, or calcium gluconate was administered according to the anesthesiologist's decision for treating hyperkalemia. Potassium levels were rechecked using an arterial blood sample in a blood gas machine after 15 minutes, and the surgeon arranged emergency hemodialysis for further management of hyperkalemia if necessary.

2.1. Patient population and indication of surgery

The objective biochemistry data of the ESRD patients with SHPT included for PTx were the serum iPTH level > 800 pg/mL, associated with calcium level > 10 mg/dL, or blood phosphorus level > 4.5 mg/dL [16].

2.2. Parathyroid AT

A low collar incision approximately 5 to 6 cm in length was made during general anesthesia. The smallest parathyroid gland without nodular hyperplasia was immersed in isotonic sodium chloride solution at 4 °C, and 60 to 90 mg chopped tissue was placed in 3 to 4 pockets in the subcutaneous tissue of the forearm or thigh.

2.3. Statistical analysis

All values in the figures and tables are expressed as mean \pm SD. Student t test (unpaired, 2-tailed) was used for comparison between groups. Changes in the data before and after treatment were tested by the paired-sample t test. Fisher exact test was performed to compare the proportions of patients. The receiver operating characteristic (ROC) curve method was used in the differentiation between age and intraoperative hyperkalemia; the sensitivity and specificity

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