Arterial and Venous Parathyroid Hormone Levels in Minimally Invasive Surgery

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Objective: To establish if venous and arterial parathyroid hormone (PTH) levels are similar during minimal access parathyroid surgery.

Design: Prospective study.

Setting: Marshfield Clinic, a large multispecialty tertiary care referral center in central Wisconsin.

Patients: All patients who underwent minimally invasive parathyroid surgery over a 10-month period.

Results: Fifteen consecutive patients were evaluated. There were 11 women and 4 men, with an average age of 65 years. All patients underwent a preoperative technetium Tc 99m sestamibi scan, with 11 localizing to the site of a probable adenoma. Mean ionized calcium levels were 5.95 mg/dL (1.49 mmol/L) preoperatively and 4.84 mg/dL (1.21 mmol/L) postoperatively. Of 13 patients undergoing both arterial and venous sampling, mean baseline venous PTH level was 221 pg/mL and 37 pg/mL at 10 minutes after excision of suspected adenoma (83% decline). Mean baseline arterial PTH level was 247 pg/mL and 38 pg/mL at 10 minutes after excision (84% decline). Using the Wilcoxon signed rank test, there was no significant difference in the arterial vs venous levels at baseline (P = .70) or 10 minutes (P = .48).

Conclusions: Intraoperative PTH levels during minimal access parathyroid surgery are similar for venous and arterial samples. Blood samples for PTH level monitoring can be obtained using a temporary indwelling arterial line.


Recent advances in parathyroid surgery have resulted in a move toward minimal access approaches with removal of the specific abnormal gland, thereby avoiding the need for a full 4-gland exploration. This has resulted in decreased operating time with less morbidity and hospitalization. Further advances have included technetium Tc 99m sestamibi scanning and radio-guided probes for parathyroid localisation. Up to 15% of primary hyperparathyroidism may be due to multiglandular disease, either parathyroid hyperplasia or, more rarely, double adenomas. Thus, there is a chance of persistent postoperative hypercalcemia requiring further exploration.

Intraoperative parathyroid hormone (PTH) determination is a recent advance that can give rapid confirmation of complete resection of a suspected adenoma. It is an excellent predictor of postoperative normocalcemia while the patient is still on the operating table. Persistently elevated PTH levels imply inadequate removal of parathyroid tissue with the need for further exploration. The rapid intraoperative intact PTH assay (ImmunoLine turbo intact PTH assay; Diagnostic Products Corporation, Los Angeles, Calif) is approved for venous sampling. This usually requires obtaining at least 2 blood samples during surgery. Access to fresh venous blood during the procedure can be difficult and may require multiple needle sticks, particularly if the PTH does not drop after the initial removal of the suspected adenoma. Venous blood may be drawn from the forearm or dorsum of the foot. Arterial blood can be obtained with insertion of an arterial catheter into the radial artery after induction of anesthesia, offering an easily accessible site, which can be used repeatedly for obtaining multiple blood samples during the procedure. We sought to establish whether routine insertion of an arterial catheter for sampling of intraoperative PTH would be appropriate and specifically if there was any difference in arterial and venous blood levels drawn at the time of surgery.

METHODS

Approval was obtained from the Marshfield Clinic institutional review board. Patients were
Fifteen consecutive patients were evaluated over a 10-month period. There were 11 women and 4 men, with an average age of 65 years. All patients underwent a preoperative technetium Tc 99m sestamibi scan for localization. A scan was performed to detect the presence of adenoma and venous PTH levels were obtained. The arterial blood was drawn from an indwelling arterial catheter that had been inserted after induction of anesthesia, usually in the radial artery of the left lower arm. Venous blood was drawn directly from the most accessible area, either the superficial veins of the forearm or access ports of the opposite side, until the abnormal parathyroid tissue was identified and removed. This resulted in multiple PTH level blood sampling until the levels dropped to below 50% of the baseline.

RESULTS

These results provide evidence that arterial blood samples may be used instead of venous blood samples for the intraoperative determination of PTH levels before and after adenoma excision.

Although hyperfunctioning parathyroid tissue can be localized with technetium Tc 99m sestamibi scanning to improve preoperative localization and the gamma probe can be used as an adjuvant technique that helps with accurate localization at the time of surgery, completeness of excision in the past could only be predicted by decreased calcium levels in the postoperative period. The development of assays to measure the intact PTH molecule during parathyroidectomy was a big advance. The concentration of biologically active PTH in the healthy patient is usually low (<50 pg/mL) but can easily be measured with heterogeneous immunoassays. The half-life of biologically active PTH is short (2-5 minutes), and the decrease in intraoperative intact PTH is particularly useful in predicting removal of all abnormal parathyroid tissue. A drop in intact PTH levels greater than 50% at 10 minutes after excision of abnormal parathyroid tissue is predictive of postoperative normocalcemia. A persistently elevated level of intact PTH at the time of surgery requires further exploration, and this was indeed the case in 3 of our patients. Thus, postoperative success can be predicted before surgical closure, potentially avoiding a second procedure in some patients.

Intraoperative PTH levels have been most commonly determined by selective venous sampling. While venous sampling may be performed readily and conveniently in those critically and chronically ill patients who may already have an indwelling central venous catheter, venipuncture can be problematic for surgical patients who do not. Ability to access peripheral veins is affected by chronic diseases, hydration status, age, and number of previous venipunctures.

Sampling from a peripheral arterial catheter was thought to be a viable alternative. It is almost universally used in the operating room during major surgery and the intensive care environment for continuous hemodynamic monitoring and blood sampling. It was important, however, to establish whether there was a difference between arterial and venous PTH levels because the biological half-life of intact PTH is only 2-5 minutes. Our findings revealed no significant difference, suggesting that blood can easily be drawn from an indwelling arterial site without the need for multiple venous needle sticks caused by difficult access.

Arterial cannulation has proven to be a safe procedure. Trained nonphysician personnel can safely insert arterial catheters following protocol. As with central vein catheters, the use of portable ultrasound guidance in insertion of radial artery catheters can increase the rate of success at the first attempt and reduce the number of cannulae used for successful catheter insertion, both of which potentially represent cost savings.

Few serious complications are reported for arterial cannulation. When sterile barrier precautions are fol-
lowed during arterial catheter insertion, the incidence of catheter-related infectious complications is comparable with the incidence of central venous catheter-related infections.13,14 The most common complication in radial artery cannulation is temporary occlusion of the artery, but this generally has no serious sequelae.13 Other rare but serious complications include pseudoaneurysm with an associated increased risk for infection, sepsis and rupture, formation of extracorporeal pseudoaneurysm, hematoma formation, bleeding at the puncture site, abscess, cellulites, paralysis of the median nerve, suppurrative thromboarteritis, air embolism, compartment syndrome, and carpal tunnel syndrome. When the radial artery is not accessible, the femoral or axillary artery provides an alternative site for cannulation with comparable levels of safety.11

In conclusion, arterial and venous blood levels are similar for peripheral sampling of PTH during minimal access parathyroid surgery. Using an indwelling arterial catheter facilitates exposure and blood drawing during the procedure and avoids multiple needle sticks and difficult access associated with venous sampling.

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REFERENCES