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Journal of Parathyroid Disease

Journal of Parathyroid Disease 2014,2(1),55–56

News and Views

Parathyroid hormone, glucose metabolism and diabetes mellitus

Zohreh Rahimi[1*]

The parathyroid glands secrete parathyroid hormone (PTH) in response to reduced calcium levels resulting in an increase in bone resorption and subsequently normalization of calcium levels. In vitamin D deficiency, secondary hyperparathyroidism leads to increased bone turnover and increased bone loss (1). PTH is a polypeptide containing 84 amino acids (2) that maintains the extracellular calcium levels within a narrow normal range and regulates plasma calcium homoeostasis (3).

There are conflicting reports related to the role of PTH on glucose hemostasis. Limited studies suggest a role for this hormone in insulin sensitivity through its role in increases the production of 1,25-dihydroxyvitamin D [1,25(OH)2D] (4). Animal studies indicated that, in 1,25(OH)2D-deficient rats, the insulin synthesis and release decreased in islet cells, and following treatment of rats with 1,25(OH)2D the function of insulin secretion of the beta cells is restored (4). However, most studies suggest that high level of PTH is associated with abnormal glucose metabolism and is related with the prevalence of diabetes mellitus. Both primary and secondary hyperparathyroidism are involved in abnormal glucose metabolism. There is higher prevalence of diabetes mellitus in patients with primary hyperparathyroidism (5), while removing parathyroid glands improve glucose tolerance in these individuals (6). Diabetes mellitus is more prevalent in patients with high levels of PTH by two to four times. Epidemiological studies demonstrated that serum level of PTH was positively and negatively associated with glucose level and insulin sensitivity, respectively. The relationship between PTH and insulin resistance is also supported by intervention studies as parathyroidectomy, and a reduction in serum PTH concentration in patients with high levels of PTH, normalizes blood glucose levels. Furthermore, when exogenous PTH is administered to laboratory animals there is an increase in plasma glucose concentrations. These observations suggest that PTH may interfere with either the ability of the pancreas to release insulin, the actions of insulin on glucose metabolism, or both. Association between serum PTH levels and abnormal glucose metabolism or diabetes has been supported through inhibition of insulin signaling in adipocytes by PTH. PTH through binding to a G-protein coupled receptor stimulates, adenylate cyclase enzyme that increases the production of cAMP. Increased level of cAMP through activation of protein kinases results in phosphorylation of insulin receptor substrate 1 (IRS-1) on serine 307. Reduction of expression of IRS-1 and glucose transporter 4 (GLUT4) and decreases in insulin-induced glucose transport explains an association between high serum levels of PTH and insulin resistance and incidence of diabetes (2). Furthermore, It has been demonstrated that plasma intact PTH level is inversely correlated with insulin sensitivity index in healthy subjects that could support the role of hyperparathyroidism in the pathogenesis of diabetes mellitus (7).

In obese girls, PTH and PTH/25-OHD were negatively associated with homeostasis model assessment of insulin resistance (HOMA-IR) (4). An inverse relationship between PTH or PTH/25-OHD with insulin resistance measures might be due to PTH-suppressive effects of insulin (4). Low serum levels of calcium and 25 (OH) D along with elevated level of PTH have been demonstrated in type 1 diabetes mellitus (T1DM) patients (6).

New onset diabetes mellitus is occurred after renal transplantation. An association between this condition and higher PTH level has recently been reported through suppression of insulin signal transduction in adipocytes that resulted in insulin resistance (5).

Implication for health policy/practice/research/medical education

Both primary and secondary hyperparathyroidism are involved in abnormal glucose metabolism. There is higher prevalence of diabetes mellitus in patients with primary hyperparathyroidism, while removing parathyroid glands improve glucose tolerance in these individuals.

Received: 21 May 2014, Accepted: 13 June 2014, ePublished: 1 September 2014

[1]Medical Biology Research Center, Kermanshah University of Medical Sciences, Kermanshah, Iran

***Corresponding author:** Prof. Zohreh Rahimi, E-mail: zrahimi@kums.ac.ir

Finally, the presence of metabolic syndrome is associated with higher risk of type 2 diabetes mellitus (T2DM) and cardiovascular disease. It has been suggested that lowering PTH through medication, higher intake of calcium and vitamin D or weight reduction decreases the risk of metabolic syndrome in women (8). In obese adolescences, metabolic syndrome is associated with a higher intact PTH:25 (OH) D ratio than those without a metabolic syndrome (9).

Author's contribution

ZR is the single author of the manuscript.

Conflict of interests

The author declared no competing interests.

Ethical considerations

Ethical issues (including plagiarism, misconduct, data fabrication, falsification, double publication or submission, redundancy) have been completely observed by the author.

Funding/Support

None.

References

1. Frost M, Abrahamsen B, Nielsen TL, Hagen C, Andersen M, Brixen K. Vitamin D status and PTH in young men: a cross-sectional study on associations with bone mineral density, body composition and glucose metabolism. Clin Endocrinol 2010; 73: 573-80.
2. Chang E, Donkin SS, Teegarden D. Parathyroid hormone suppresses insulin signaling in adipocytes. Mol Cell Endocrinol 2009; 307: 77-82.
3. Komaba H, Kakuta T, Fukagawa M. Diseases of the parathyroid gland in chronic kidney disease. Clin Exp Nephrol 2011; 15: 797-809.
4. Stanley T, Bredella MA, Pierce L, Misra M. The ratio of parathyroid hormone to vitamin D is a determinant of cardiovascular risk and insulin sensitivity in adolescent girls. Metab Syndr Relat Disord 2013; 11: 56-62.
5. Ivarsson KM, Clyne N, Almquist M, Akaberi S. Hyperparathyroidism and new onset diabetes after renal transplantation. Transplant Proc 2014; 46: 145-50.
6. Hamed EA, Abu FaddanNH, Adb Elhafeez HA, Sayed D. Parathormone – 25(OH)-vitamin D axis and bone status in children and adolescents with type 1 diabetes mellitus. Pediatr Diabetes 2011; 12: 536-46.
7. Chiu KC, Chuang LM, Lee NP, Ryu JM, McGullam JL, Tsai GP, *et al.* Insulin sensitivity is inversely correlated with plasma intact parathyroid hormone level. Metabolism 2000; 49: 1501-5.
8. Røislien J, Calster BV, Hjelmesæth J. Parathyroid hormone is a plausible mediator for the metabolic syndrome in the morbidly obese: a cross-sectional study. Cardiovasc Diabetol 2011; 10: 17.
9. Alemzadeh R, Kichler J. Parathyroid hormone is associated with biomarkers of insulin resistance and inflammation, independent of vitamin D status, in obese adolescents. Metab Syndr Relat Disord 2012; 10: 422-9.

Please cite this paper as: Rahimi Z. Parathyroid hormone, glucose metabolism and diabetes mellitus J Parathyr Dis 2014; 2(1): 55-56.