Submitted May 2021; Accepted January 2022

CASE REPORT

Postoperative graft spasm after coronary artery bypass surgery in a patient with hyperparathyroidism

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Keywords - CABG, graft spasm, hypercalcaemia, hyperparathyroidism

Abstract

We present the case of a 70-year-old man who developed postoperative graft spasm after coronary artery bypass surgery, which was successfully treated with calcium channel blockers. An elevated ionised calcium was found and subsequently he was diagnosed with primary hyperparathyroidism. This case emphasises the importance of being aware of endocrine disorders as underlying cause of cardiovascular symptoms, such as perioperative graft spasm.

Introduction

Perioperative graft spasm is reported in 0.43% of coronary artery bypass grafting (CABG) procedures.[1] It is considered an extreme form of vasoconstriction in which calcium plays a central role.[2] We report a patient with perioperative hypercalcaemia due to primary hyperparathyroidism de novo and discuss the cardiovascular effects of hyperparathyroidism.

Case

A 70-year-old man was admitted to our hospital for elective CABG with mitral valve replacement. His medical history included a mitral valve prolapse with severe mitral valve regurgitation caused by chordae tendineae rupture, single-vessel coronary artery disease of the left anterior descending (LAD), essential hypertension, chronic hypertensive nephrosclerosis (estimated glomerular filtration rate had been stable for many years at 52 mml/1.73 m^2), and a non-toxic multinodular goitre. His antihypertensive medication consisted of a calcium channel blocker (amlodipine 10 mg/day) and an angiotensin receptor blocker (valsartan 80 mg/day). The patient also suffered from a small focal prostate carcinoma for which he was under surveillance by the urologist. The plasma calcium level had not been measured before, not in the hospital nor by the general practitioner.

On-pump CABG was performed in which the left internal mammary artery (LIMA) was anastomosed to the LAD. Papaverine soaked gauze was used to prevent coronary graft spasm of the LIMA. An annuloplasty ring was used for mitral valve repair. Weaning from the cardiopulmonary bypass machine was successful. No vasopressors were used during surgery. Shortly after chest closure the electrocardiogram showed dynamic ST elevations in leads V1-V6, without arrhythmias, caused by anterior wall infarction. Immediately, a coronary angiography was performed which revealed a normal functioning LIMA-LAD with a component of graft spasm of the distal LIMA *(figure 1)*. The native LAD had not changed compared with the preoperative coronary angiography, with competitive flow distally. The right coronary artery showed some wall irregularities. Nitrates and a calcium channel blocker (diltiazem) were administered which resulted in adequate reduction of the ST elevations. The patient was transferred to the intensive care unit (ICU).

Additional analysis of the arterial blood gas within the first hour of the surgery showed an elevated ionised calcium of 1.56 mmol/l (normal 1.24-1.34). Further laboratory analysis was performed showing an elevated parathyroid hormone (PTH) at 57.6 pmol/l (normal <68) and a normal 25-hydroxy-vitamin D of 51 nmol/l (normal 50-151). Thyroid function was normal. Renal function had not deteriorated further. These laboratory results were suggestive of primary hyperparathyroidism. Treatment with hyperhydration in combination with loop diuretics and bisphosphonates (zoledronic acid) and noradrenaline (maximally 0.3 mg/hour) was started. During the first 48 hours after surgery, the noradrenaline was tapered successfully. Cardiac enzymes reached their peak around 14 hours after coronary angiography (CK 778 U/l and CK-MB 119 U/l). Further recovery was uncomplicated and no more signs of graft spasm were observed during hospital admission.

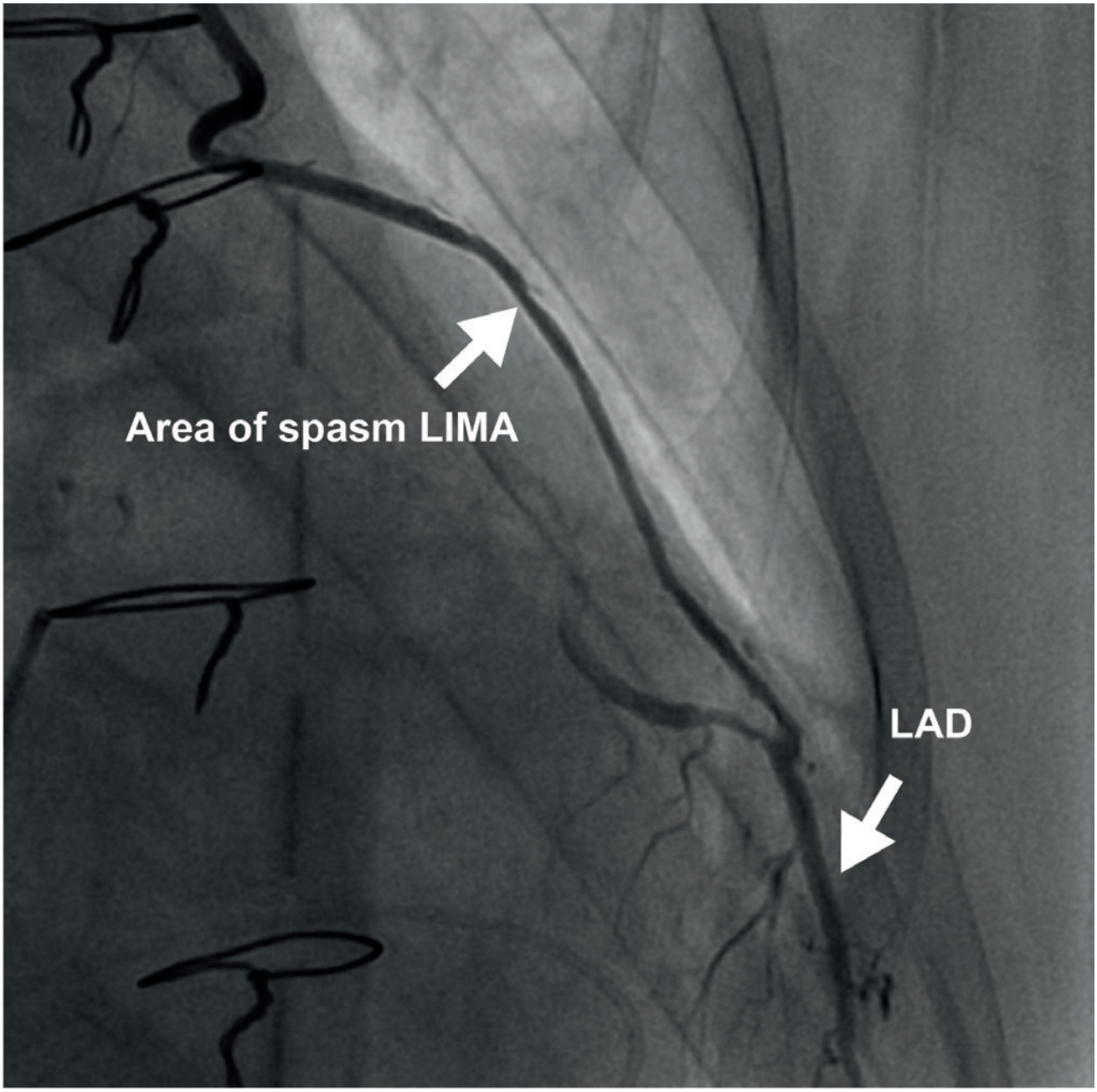

Figure 1. Coronary angiography showing graft spasm in distal LIMA. LIMA, left internal mammary artery; LAD, left anterior descending artery

After hospital discharge, the patient was referred to the outpatient clinic of internal medicine. Single-photon emission computed tomography with $^{123}I/^{99m}Tc$-sestamibi revealed an active parathyroid adenoma *(figure 2)*. Recent cytology of the largest nodus (3.9 cm) in his multinodular goitre revealed a benign nodus (Bethesda 2). A dual-energy X-ray absorptiometry showed signs of osteoporosis with a bone mineral density T-score of -1.3 for the lumbar spine and -3.6 for the femoral column. Because of persistent high serum calcium levels >3.0 mmol/l and osteoporosis, the patient underwent parathyroidectomy after which he completely recovered. Pathological examination confirmed the diagnosis of a parathyroid adenoma and a multinodular goitre of the right thyroid gland. The thyroid function remained normal.

Discussion

The exact mechanism of postoperative graft spasm is still unknown, but it is thought to be an extreme form of vasoconstriction. Both mechanical and nerve stimulation provoke vasoconstriction as well as spasmogens such as

prostaglandins, α-adrenoceptor agonists (e.g. norepinephrine and phenylephrine) and platelet-derived substances (e.g. 5-hydroxytryptamine). These factors influence calcium influx through the calcium channels located in the membrane and release of calcium from the intracellular sarcoplasmic reticulum. The rise of intracellular calcium ultimately facilitates actin and myosin filament binding resulting in contraction. On the other hand, different endothelium-derived relaxing factors such as nitric oxide, prostacyclin and endothelium-derived hyperpolarising factor are released by the intact endothelium in order to maintain balance between vasoconstriction and vasodilatation.[2] Retrospectively, the patient had hypercalcaemia within the first hour of surgery and no spasmogens or α-adrenoceptor agonists were administered during surgery. We presume that the hypercalcaemia already existed preoperatively and could have been the sole cause of the graft spasm. Noradrenaline was administered postoperatively after arrival to the ICU. Despite hyperhydration, diuretics and bisphosphonate, the calcium levels remained high accompanied by intermittent graft spasm with cardiac damage reaching its peak 14 hours after the coronary angiography. After enough calcium channel blockade was reached, further graft spasm disappeared despite elevated plasma calcium levels.

To our knowledge, there are no previous reports of patients with perioperative graft spasm due to hyperparathyroidism with hypercalcaemia. Oguchi et al. reported a patient with coronary artery spasm during spinal anaesthesia with hyperparathyroidism.[3] Hong et al. described a patient admitted to hospital with coronary artery spasm and hyperparathyroidism.[4] Furthermore, Rasool et al. presented a 27-year-old female with hyperparathyroidism and cerebral vasospasm resulting in ischaemic stroke.[5] All these reports suggest a relation between hypercalcaemia due to hyperparathyroidism and vasospasm.

Primary hyperparathyroidism is the most common cause of hypercalcaemia and is the result of excessive secretion of PTH by one or more of the parathyroid glands. Commonly this is a single, benign, parathyroid adenoma. The secretion of PTH is modulated by serum calcium, phosphorus and vitamin

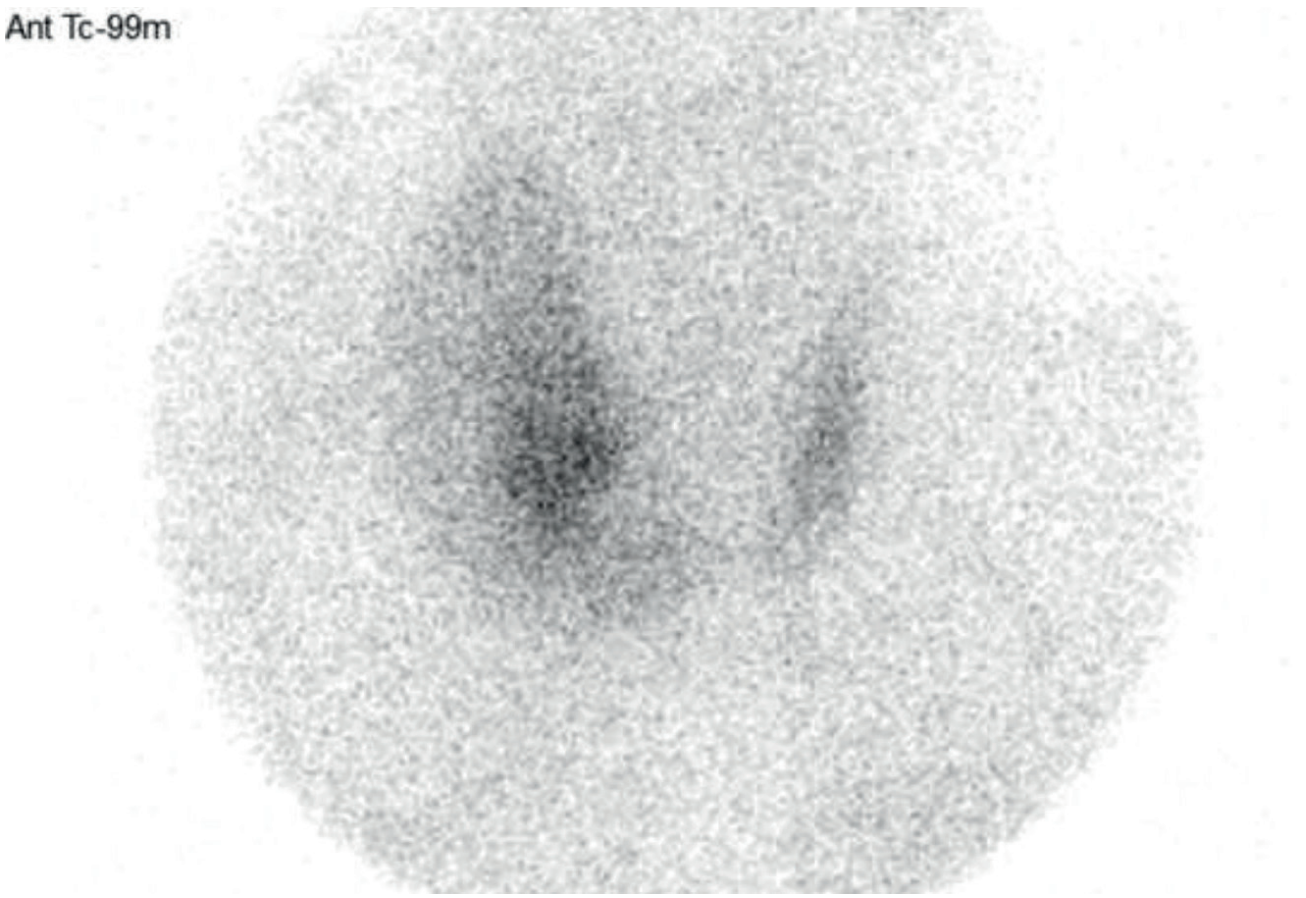

Figure 2. 99mTc-Sestamibi scintigraphy of the thyroid (anterior view) showing increased uptake central in the right thyroid bed.

D through negative and positive feedback loops. The PTH acts in the kidney to increase renal calcium reabsorption, stimulate the conversion 25-hydroxyvitamin D3 to the active 1,25-dihydroxyvitamin D and decrease phosphate reabsorption. In the bones it leads to osteoclastic bone resorption in order to release both calcium and phosphorus from the skeleton. The production of 1,25-dihydroxyvitamin D stimulates the absorption of calcium and phosphorus in the intestines.

The exact mechanism between vasospasm and hyperparathyroidism is not known, but several cardiovascular effects of PTH have been described. Infusion of PTH leads to vasodilation in smooth vascular muscle.[6] On the contrary, excess exposure to PTH leads to hypertension and hypercalcaemia-driven atherosclerosis.[7] Other literature suggests a higher vascular tone and endothelial dysfunction in patients with hyperparathyroidism.[8-9] Metabolic diseases such as diabetes mellitus are known causes of endothelial dysfunction and have shown to increase the risk of radial artery spasm.[10] As described above, the PTH leads to a rise in serum calcium. Allen et al. demonstrated varying degrees of cerebral arterial spasm related to different levels of extracellular calcium.[11]

Both hypercalcemia and endothelial dysfunction could have played a role in the development of graft spasm in our presented case.

Conclusion

Endocrine disorders such as hyperparathyroidism have a wide range of effects on the cardiovascular system. Perioperative graft spasm is a rare but severe complication of CABG. Endocrine disorders, particularly hypercalcaemia due to hyperparathyroidism, should be considered when treating a patient with perioperative graft spasm.

Disclosures

All authors declare no conflicts of interest. No funding or financial support was received.

Informed consent

Written informed consent was obtained from the patient presented in this case report.

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