On-line Case Report

Gamma probe radioguided parathyroid forearm surgery in recurrent hyperparathyroidism

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ABSTRACT

A case is described of a successful radioguided forearm graft parathyroidectomy. This is the first report of both pre-operative diagnostic and successful intra-operative localisation during a single procedure, of autologous transplanted parathyroid tissue.

Keywords: Multiple endocrine neoplasia – Recurrent hyperparathyroidism – Radioguided parathyroidectomy – Forearm graft

Surgical treatments for hyperparathyroidism include total, subtotal or total parathyroidectomy plus autologous grafting of several 1-mm³ fragments of parathyroid embedded within a muscle. In our unit, preference previously was for total parathyroidectomy with autologous grafting into the brachioradialis muscle of the forearm. This strategy was used to avoid the challenging situation of re-exploration of the neck with recurrent hyperparathyroidism. Re-exploration of the forearm, however, can still be a challenging procedure due to difficulty in accurately localising the residual parathyroid tissue. We have discontinued autotransplantation in the majority of patients with secondary hyperparathyroidism, although some units may, for young patients, still perform the procedure to prolong the period patients can avoid medication. Subfacial location, the use of suture, and the use of metallic clips have all been advocated in an attempt to facilitate re-exploration following autotransplantation.

Radioguided techniques have been described to facilitate localisation in primary hyperparathyroidism,¹

and to confirm forearm graft hyperplasia.² The use of these techniques to facilitate intra-operative localisation in a patient with forearm graft hyperplasia has been described, although a second surgical exploration was required.³ This is the first report of both pre-operative diagnostic and successful intra-operative localisation during a single procedure, of autologous transplanted parathyroid tissue.

Case report

A 31-year-old man with known MEN-1 presented with hyperparathyroidism. He had been treated with four gland parathyroidectomy and parathyroid transplant into his left forearm 8 years previously at our unit, and was known to have a strong family history of aggressive MEN-1. His surveillance calcium tests had demonstrated a gradually rising calcium level (2.73 mmol/l and 2.83 mmol/l; normal range within our unit 2.15–2.60 mmol/l). Simultaneous right and left arm parathyroid hormone (PTH) levels indicated that this was due to

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Figure 1 Sestamibi scan of left forearm 1 h prior to surgery. ^{99m}Tc -Sestamibi (707 MBq) was injected intravenously into the right antecubital fossa. The scan was performed 5 min following this with a gamma camera (Siemens Ecam). The image was acquired for 5 min using a 256×256 matrix LEHR collimator, with the left arm resting directly on the camera face. A ^{57}Co -marker was used to identify the position of increased uptake due to the parathyroid in the forearm.

hyperparathyroidism and suggested that the source was likely the left forearm implant (right antecubital fossa PTH 3 pmol/l, left antecubital fossa PTH 40.6 pmol/l; normal range within our unit 0.5–4.4 pmol/l). A ^{99m}Tc -Sestamibi scan supported this with a hot spot within the left forearm and no activity within his neck. Neither the forearm graft, nor Leiger clips that had been placed intra-operatively during the initial grafting, were visible on ultrasound scanning.

A Sestamibi scan was performed 1 h prior to surgery (Fig. 1). The area of increased uptake in the forearm on the scan was marked on the skin. A gamma probe (C-Trak) was then moved across the region to find the highest count. This corresponded with the ink mark on the skin. This was also the case following induction of anaesthesia. A directed surgical exploration was, therefore, performed and the Leiger clips placed at initial transplantation were quickly found. The point between the clips corresponded to the area marked on the skin pre-operatively and with the 'hot-spot' detected by the gamma probe.

The underlying area of muscle (approximately 5 mm^3) was then excised along with an equivalent amount of immediately adjacent muscle. Counts were then taken of these two pieces of tissue *ex situ* with the gamma probe. The counts over 10 s were 2197 for the sample taken from between the Leiger clips corresponding to the area of high activity, and 828 for the adjacent muscle sample. The background count of the axilla was 270 (*in situ*). Previous calibration of the probe had demonstrated that the mean sensitivity of the probe to 140 keV photons was 11,560 counts/MBq/ml for a point source in 1 ml, with no

attenuation, immediately in front of the probe. This was felt to be approximately equivalent to the geometry of the excised parathyroid or adjacent muscle measured when placed on top of the probe.

Intra-operative parathyroid hormone levels fell by over 50% during the procedure (from 6.4 pmol/l to 2.9 pmol/l), indicating that the parathyroid tissue had been successfully removed. In addition, intra-operative frozen section confirmed that the tissue removed contained cellular parathyroid, and postoperative PTH levels normalised the following day (0.8 pmol/l). Finally, when reviewed at 1 month, the patient's calcium level was within the normal range (2.49 mmol/l) with oral calcium and alphacalcidol supplementation.

Discussion

Radioguided parathyroidectomy has proponents¹ but is not widely used in routine neck exploration for primary hyperparathyroidism. There is, however, still a case to be made for the use of radioguided techniques in more complex or recurrent cases.⁴ In our unit, sentinel node localisation is used routinely both in melanoma and breast cancer surgery, and it is of note that the equipment, facilities and isotopes used (gamma probe and camera, nuclear medicine department, ^{99m}Tc) are the same for both radioguided sentinel node localisation and radioguided parathyroidectomy. In addition, it was felt that familiarity with the techniques and equipment used in sentinel node localisation enabled use of the radioguided technique which was found helpful in a potentially difficult and unusual case of forearm graft hyperplasia. The added advantage of the radioguided technique over the Sestamibi scan alone was that it enabled accurate localisation of the graft in theatre rather than relying on images and a skin mark.

Following autotransplantation, confirming that the graft is the cause of recurrent hyperparathyroidism can be extremely difficult. We demonstrated a high level of venous PTH in blood taken from the grafted side, but this may also be found in these patients in the presence of normocalcaemia indicating only a functioning graft. In addition, the absence of ^{99m}Tc -Sestamibi uptake in the neck does not prove that the neck is not the source. A modified Casanova test demonstrating a reduction in serum PTH following application of a tourniquet under general anaesthetic immediately prior to surgery may help confirm the diagnosis.⁵

Sestamibi scintigraphy has been described to detect forearm graft hyperplasia² but we could find only one report of radioguided forearm parathyroidectomy.³ In that report, possibly due to high background counts within forearm muscle, the intra-operative radioguided

localisation failed to demonstrate the ectopic parathyroid tissue at the initial surgical exploration. At a second exploration, the ^{99m}Tc was injected into the femoral vein rather than the ipsilateral hand and both the radioguided localisation and the procedure was successful.³ The experience from our case of a successful radioguided forearm graft parathyroidectomy is that the technique is useful for both pre-operative planning and for intra-operative gamma probe localisation of the parathyroid fragment.

References

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