

Negative developing of parathyroid using carbon nanoparticles during thyroid surgery

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Introduction

Subtotal thyroidectomy and total thyroidectomy are two main options to treat thyroid nodules. Due to the special anatomical location of parathyroid, the incidence of permanent hypoparathyroidism due to parathyroid damage is about 9-32% postoperatively (1). This condition can seriously affect the quality of life of patients and post great challenges to surgeons; therefore, it is particularly important to protect the parathyroid during the thyroid surgery.

Given the strong lymphoid tropism of nano-carbon materials, we can black-stain the thyroid and its surrounding lymph nodes without changing the anatomic color of parathyroid, which facilitates the doctors to identify and protect the parathyroid and lowers the risk of resecting the parathyroid by accident or affecting its blood supply; as a result, we may reduce the accidental injury of parathyroid and lower the incidence of hypoparathyroidism.

Principles

Nano-carbon Suspension Injection is a suspension with nanoscale carbon particles. The particles, 150 nm in diameter, have strong lymphatic tropism. As we know, the spaces among capillary endothelial cells range 20-50 nm, whereas those among the endothelial cells of lymph capillaries range 120-150 nm, along with the hypoplastic basement membrane. Therefore, after having been injected into the thyroid tissue, the carbon nanoparticles will not enter the blood vessels; rather, they will rapidly enter the lymphatic vessels and then enter the lymphatic capillaries after having been internized by macrophages; finally, they will accumulate in the lymph nodes, resulting in the black

staining of the lymph nodes (2). Meanwhile, the parathyroid still maintains its original color (brown or reddish-brown), remarkably distinguishing from the adjacent black-stained thyroid and lymph nodes.

Procedure

- (I) Retract the anterior neck muscles to expose the thyroid gland. Without excessive dissociation, the carbon nanoparticles suspension is slowly injected into the gland using a skin test needle in the upper, middle, and lower poles of the thyroid (0.1 mL each pole). Pull back on the syringe before injecting to make sure the suspension will not be injected into the bloodstream.
- (II) After the injection at each point, gently press the site for 1-2 minutes with sterile gauze. Otherwise, the extravasation of the suspension may black-stain the adjacent tissues and thus obscure the surgical field.
- (III) The surgical operation can be initiated 10 minutes later. Any damage to the posterior and lateral capsules of the thyroid should be avoided during the surgery to prevent the possibility that the extravasation of the suspension affects the surgical field.

Significance

It can be found during the surgery that the parathyroid still maintains its original color (brown or reddish-brown), remarkably distinguishing from the adjacent black-stained thyroid and lymph nodes, which is helpful for the identification and protection of the parathyroid and its

blood supply. During the thyroidectomy, therefore, the non-black-stained tissues should be preserved as well as their blood supplies whenever possible to maintain the normal functions of the parathyroid. It is particularly useful to identify and protect parathyroid when performing the level VI lymph node dissection.

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