Thoracoscopic resection with intraoperative use of methylene blue to localize mediastinal parathyroid adenomas

Yoshin Adachi, MD · Hiroshige Nakamura, MD
Yuji Taniguchi, MD · Ken Miwa, MD
Shinji Fujioka, MD · Tomohiro Haruki, MD

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Abstract We report a case of thoracoscopic resection of mediastinal parathyroid adenomas using methylene blue to localize the tumors during the operation. After methylene blue 4 mg/kg was injected intravenously, we easily identified methylene blue-stained parathyroid glands and successfully resected them with sufficient surgical margins. The use of methylene blue for detection of parathyroid adenoma is a useful technique.

Key words Mediastinal parathyroid adenoma · Methylene blue · Video-assisted thoracoscopic surgery

Introduction For surgery to remove ectopic parathyroid adenomas, it is important to localize the adenomas preoperatively. Preoperative technetium-99m methoxyisobutyl isonitrile (99mTc-MIBI) scintigraphy is excellent for diagnosing tumors but often presents difficulties with identifying them in adipose tissue during surgery. On the other hand, intravenous methylene blue administration has been reported to be useful for staining the parathyroid glands,1–3 and its usefulness for parathyroid localization has recently been recognized. We report a patient with ectopic mediastinal parathyroid adenomas in whom thoracoscopic surgery was performed and the preoperative administration of methylene blue was useful for tumor localization.

Case report The patient was a man in his thirties with chief complaints of pain of the femur and pruritus. He had been undergoing hemodialysis for Alport’s syndrome since the age of 18 years. As blood tests showed an increased parathyroid hormone (PTH) level, he was referred to our hospital with a suspected diagnosis of secondary hyperparathyroidism. 99mTc-MIBI scintigraphy showed increased uptake in the mediastinum, which constituted an indication for surgery. Blood tests showed an elevated alkaline phosphatase 1022 IU/l, blood urea nitrogen 80 mg/dl, creatinine 12.54 mg/dl, phosphorus of 8.3 mg/dl, and intact PTH 1780 pg/ml. The calcium was normal (9.0 mg/dl).

Chest computed tomography (CT) (Fig. 1) revealed two small nodules, 11 × 7 and 13 × 7 mm, in the upper mediastinum. 99mTc-MIBI scintigraphy (Fig. 2) showed two areas of increased uptake in the upper mediastinum. The patient and his mother gave informed consent, and they approved the use of methylene blue.

At the time of anesthesia induction, methylene blue (4 mg/kg) was injected intravenously to identify the parathyroid adenomas. With the patient in supine position, three ports were inserted, and a right-sided video-assisted thoracoscopic approach was used. When the left brachiocephalic vein was exposed and adipose tissue was stripped, methylene blue-stained parathyroid glands were easily identified (Fig. 3). Two tumors with sufficient
surgical margins were excised. The operating time was 64 min, and intraoperative bleeding was 5 g.

Histopathologically, the tumors were well-circumscribed lesions exhibiting solid growth of the tumor cells with almost uniform, small, ovoid nuclei, leading to a diagnosis of parathyroid adenoma. His postoperative course was uneventful, the intact PTH level decreased to 121 pg/ml, and the femoral pain diminished markedly.

Discussion

A method to identify adenomas by administering methylene blue at the time of parathyroid surgery was first reported in 1971. Thereafter, it was described as a simple, safe procedure in a few reports. Although the mechanism by which methylene blue is taken up by the parathyroid glands is unclear, they do stain blue, facilitating their resection. Dudley noted that the staining intensified up to 1 h and lasted for 20 min before diminishing over the next 2.5 h. Therefore, we should start the infusion of methylene blue within 60 min of the surgical incision. Few studies have reported the side effects of methylene blue administration. Robert et al. reported that 120 patients given methylene blue experienced no significant side effects. However, in rare cases, mental symptoms and hyperthermia have been reported. The half-life of methylene blue in patients with a normal kidney function is reported to be 5.25 h, and the symptoms resolve within 48–72 h. Hemodialysis can provide symptomatic relief. However, some studies have reported symptoms of more than 2 weeks’ duration or severe mental symptoms leading to encephalopathy. The proposed causes include increased central serotonin transmission and nitric oxide inhibition by the methylene blue. Pollack et al. indicated that many patients receiving selective serotonin uptake inhibitors developed encephalopathy. This condition often subsides spontaneously, but the patient should be monitored carefully.

Methylene blue is generally administered intravenously at a dose of 5–7 mg/kg; however, the UK National Poisons Information Service recommends 4 mg/kg because of reported complications, including mental symptoms. Our patient received 4 mg/kg and did not develop complications. Other points of care include an intraoperative decrease in SpO2, which is the mechanical problem of a monitor display associated with methylene blue administration, posing no real problems in the blood gas analysis. In the present patient, the SpO2 could not be measured for several minutes after methylene blue administration, but blood gas analysis revealed no abnormalities.