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# Introduction of VISIONSENSE® for indocyanine green fluorescence-guided parathyroidectomy: Report of a case

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ABSTRACT

*INTRODUCTION:* VISIONSENSE® is a new near-infrared (NIR) fluorescence laparoscope and has an NIR overlay threshold function that allows us to set a floor for the NIR signal to be included in the overlay. We report the case of a patient who underwent indocyanine green (ICG) fluorescence-guided parathyroidectomy for primary hyperparathyroidism due to parathyroid adenoma using the threshold-adjustment function of VISIONSENSE®.

*PRESENTATION OF CASE:* A 40-year-old man was referred to our department for examination and treatment of hypercalcemia. ICG fluorescence-guided parathyroidectomy using VISIONSENSE® was planned on diagnosis of primary hyperparathyroidism due to parathyroid tumor. In the operation, we were unable to readily recognize the parathyroid gland (PG). After intravenous injection of ICG, fluorescence from ICG appeared from the left thyroid lobe to the PG, but PG contours remained unclear. We therefore used the threshold-adjustment function of VISIONSENSE® to discard NIR signal values <50%. Clear contours of the PG were subsequently obtained, allowing recognition of the gland and successful ICG-guided parathyroidectomy. No postoperative complications were encountered and the pathological diagnosis was parathyroid adenoma.

*DISCUSSION:* In our case, both PG and thyroid showed ICG fluorescence, but the intensity of thyroid fluorescence was slightly little lower than that of PG fluorescence. To differentiate between fluorescence from PG and thyroid, the threshold-adjustment function of VISIONSENSE® may prove useful.

*CONCLUSION:* This case suggests that the threshold-adjustment function of VISIONSENSE® may be useful to readily identify the PG in parathyroid surgery.

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## 1. Introduction

Intraoperative identification of the parathyroid gland (PG) during thyroid and parathyroid surgery is crucial. Identification of the PG can be a challenging problem even for experienced surgeons, and unexpected parathyroid excision has been reported to occur in up to 15% of thyroidectomies [1–5].

Misidentification of the PG can cause postoperative complications such as postoperative hypocalcemia following total thyroidectomy or damage to surrounding organs during parathyroidectomy.

Recent reports have described innovative techniques using near-infrared (NIR) fluorescence, such as indocyanine green (ICG) fluorescence or PG autofluorescence imaging, to address current limitations in PG localization [6–8]. In most previous reports, ICG fluorescence-guided parathyroidectomy has been performed using the PINPOINT system (Stryker, Kalamazoo, MI, USA) [6–8].

VISIONSENSE® (Medtronic, Minneapolis, MN, USA) is a new NIR fluorescence laparoscope for bright-field, full-color observation. This system allows adjustment of the intensity of excitation light and has an NIR overlay threshold function, allowing a floor value to be set for NIR signals that will be included in the overlay. Intraoperative identification of the PG might be easier in ICG fluorescence-guided surgery using these functions. We report the case of a patient who underwent ICG fluorescence-guided parathyroidectomy for primary hyperparathyroidism due to parathyroid adenoma using VISIONSENSE®.

*Abbreviations:* PG, parathyroid gland; ICG, indocyanine green; NIR, near-infrared.

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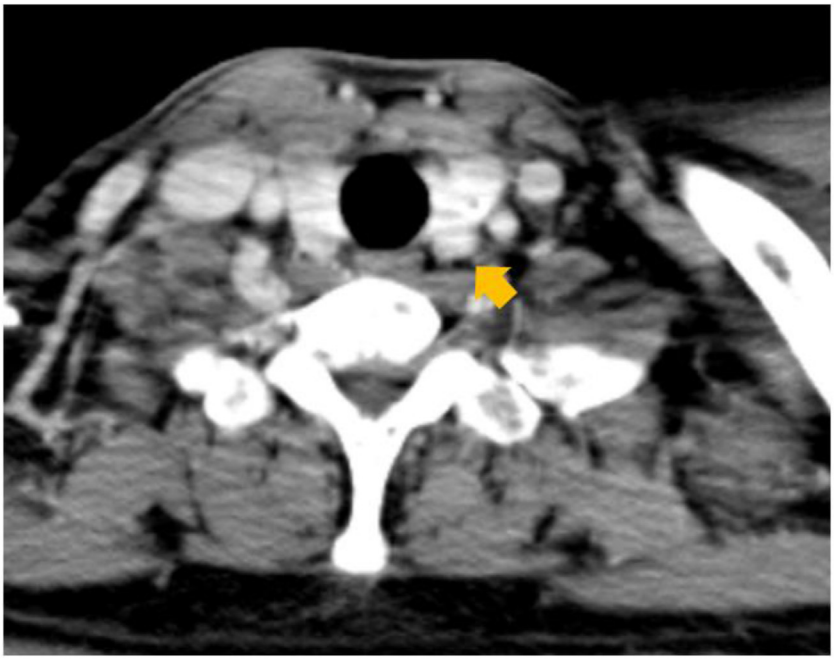

**Fig. 1.** An enhanced CT of the neck showed a 11 × 10 mm well enhancing and circumscribed soft tissue mass abutting posterior aspect of the left thyroid lobe. (arrow).

This work has been registered at research registry. (UIN: researchregistry6035) [9]

This work has been reported in line with SCARE criteria [10].

## 2. Presentation of case

A 40-year-old man was referred to our department for examination and treatment of hypercalcemia. He had no past history or comorbidities.

Blood examination revealed: Ca, 12.2 mg/dL; parathyroid hormone (PTH)-intact, 150 pg/mL.

Contrast-enhanced CT of the neck showed a 11 × 10-mm, well-enhancing, well-circumscribed soft tissue mass abutting the posterior aspect of the left thyroid lobe (Fig. 1). Subsequent ultrasonography of the neck showed a hypoechoic soft-tissue mass with hypervascularity. Abnormal uptake of Tc-99m-methoxy isobutyl isonitrile (MIBI) was shown in the area of the lower pole of the left thyroid lobe in the late phase.

ICG fluorescence-guided parathyroidectomy was planned at diagnosis of primary hyperparathyroidism due to parathyroid tumor. The protocol for the ICG fluorescence method was approved by the Ethics Committee for Biomedical Research at our hospital, and the patient provided written informed consent (approval no. 13-B-60).

VISIONSENSE® was utilized for observation of ICG fluorescence.

We mobilized the left thyroid lobe, and a nodule was identified in the middle posterior aspect of the left thyroid lobe. Since abnormal uptake of Tc-99m-MIBI was located in the lower pole area, we were unable to readily decide whether this area represented the PG (Fig. 2a). First, we tried to confirm the existence of PG autofluorescence, but this failed.

Subsequently, 5 mg of ICG was injected intravenously. ICG fluorescence appeared after 45 s from the left thyroid lobe to the PG, and contour of PG was unclear (Fig. 2b).

We therefore used the threshold-adjustment function of VISIONSENSE® to discard NIR signal values below 50%, and providing clear contours for the PG. We were able to identify the PG shortly thereafter (Fig. 2c).

Parathyroidectomy was performed successfully, and preservation of the recurrent laryngeal nerve was confirmed intraoperatively.

The operation time was 130 min, with 30 mL of intraoperative bleeding.

The patient showed no complications postoperatively and the pathological diagnosis was parathyroid adenoma. As of 1 month postoperatively, Ca was 9.7 mg/dL with a PTH-intact of 55 pg/mL.

## 3. Discussion

In this case, the threshold-adjustment function of VISIONSENSE® was useful for intraoperative identification of PG during parathyroidectomy. This method might improve conventional ICG fluorescence-guided parathyroidectomy.

Recently, ICG fluorescence-guided parathyroidectomy has been performed to identify PGs [6–8]. Chakedis et al. provided the first report of successful ICG fluorescence-guided redo-parathyroidectomy in 2015 [6].

Zaidi et al. reported the usefulness of ICG NIR fluorescent imaging in patients undergoing surgery for primary hyperparathyroidism. In that study, of 112 PGs in 33 patients identified by the naked eye, 104 (92.9%) demonstrated ICG uptake. A trend was seen toward increased ICG fluorescence in patients <60 years old ($P$ = 0.05). A higher degree of fluorescence was seen in patients presenting with preoperative calcium values >11 mg/dl ($P$ = 0.04) and in those with PGs >10 mm ($P$ < 0.01). They concluded that ICG can reliably localize the PG during parathyroidectomy, allowing assessment of parathyroid perfusion in patients undergoing subtotal resection [7].

In our case, the patient was 40 years old and the PG was >10 mm in diameter, and preoperative Ca level was >11 mg/dl. We confirmed increased ICG fluorescence of the PG, coinciding with the results of the previous report.

Furthermore, DeLong et al. reported that ICG angiography has the potential to assist surgeons in identifying PG rapidly with minimal risk [8]. In their study, ICG fluorescence angiography was performed during 60 parathyroidectomies for primary hyperparathyroidism. Of the 60 patients, 43 (71.6%) showed strong

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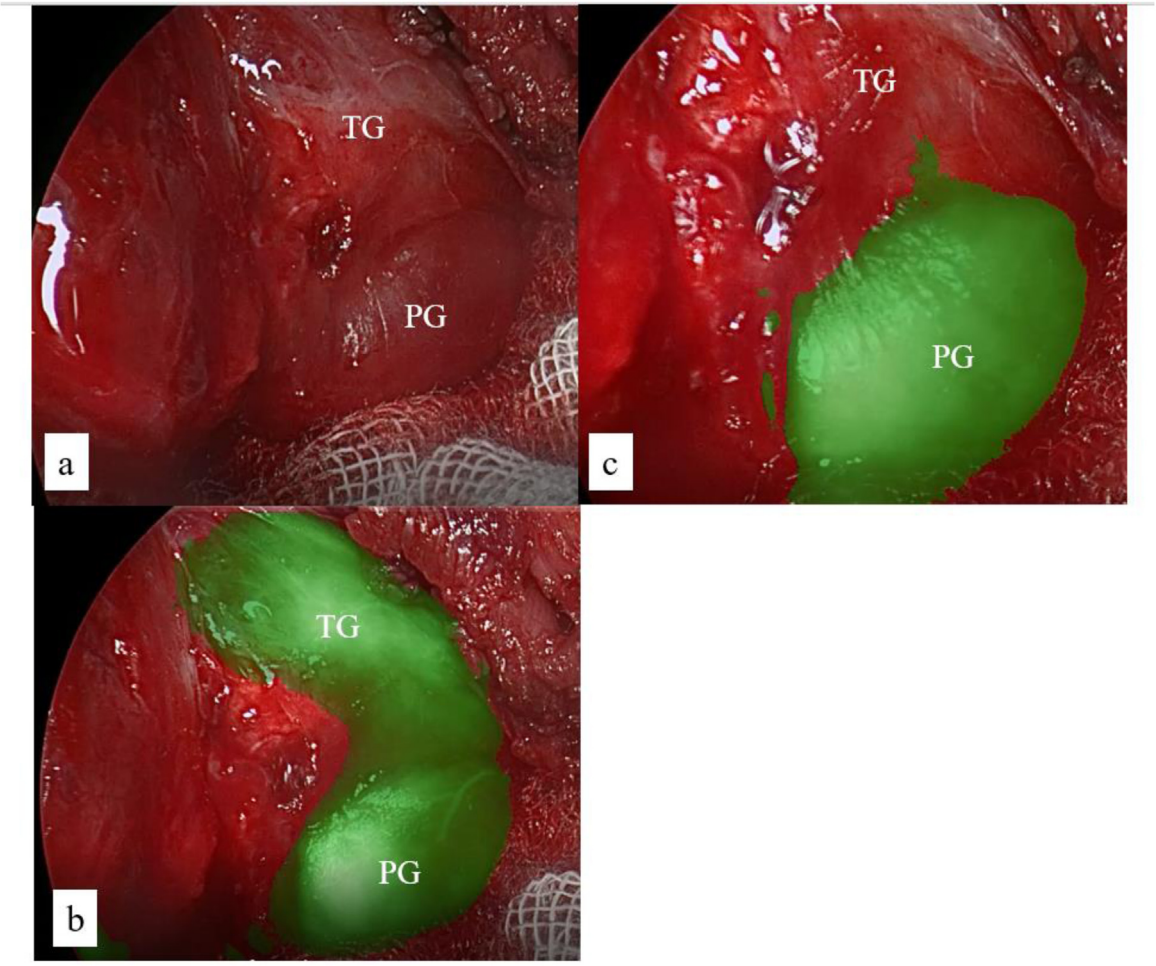


**Fig. 2.** Representative thyroid and PG ICG fluorescence images.
(a) White light image: Color of the thyroid and PG was similar and identification of PG was indefinite.
(b) Full color near infrared image: Both PG and thyroid had ICG fluorescence, but intensity of the thyroid fluorescence was a little lower than that of the PG fluorescence.
(c) Full color near infrared image using threshold adjustable function of VISION SENSE®: We adjust lower 50% of NIR signal value should not show up, and after that clear contour of PG was able to be obtained.

enhancement, 13 (21.7%) demonstrated mild to moderate vascular enhancement, and 4 (6.7%) exhibited little or no vascular enhancement. In 18 patients with failure to localize the parathyroid adenoma on preoperative sestamibi scan, all patients (100%) showed adenoma that fluoresced on ICG imaging.

In our case, both the PG and thyroid showed ICG fluorescence, but the intensity of thyroid fluorescence was slightly lower than that of PG fluorescence. To clarify differences in fluorescence between the PG and thyroid, the threshold function of VISIONSENSE® might be useful.

VISIONSENSE® allows adjustment of the intensity of excitation light and has an NIR overlay threshold function, allowing a floor to be set for the NIR signal to be included in the overlay. Use of this function enabled us to visualize differences in fluorescent intensity between the PG and thyroid more clearly.

We therefore adjusted the threshold so that NIR signals <50% were not shown on the color overlay, allowing visualization of PG fluorescence alone. This method enabled us to localize the PG in a short amount of time and thus facilitated safe completion of parathyroidectomy.

This method may represent a feasible procedure to identify the PG easily in parathyroid surgery. Further investigation is warranted.

## 4. Conclusion

This case suggests that the threshold-adjustment function of VISIONSENSE® could be useful for readily identifying PG in parathyroid surgery.

## Declaration of Competing Interest

There are no conflicts of interest.

## Funding

We have no sponsors.

## Ethical approval

This study has been exempted by our institution.

## Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

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## Author contribution

TK: study design, data collection, data analysis, writing.
MY, NS: critical revision
YS: final approval of the article
Any other authors: data collection
All authors read and approved the final manuscript.

## Registration of research studies

This paper is case report. The authors don't need to register this work.

## Guarantor

Teppei Kamada, the corresponding author of this manuscript accept full responsibility for the work and the conduct of the study, access to the data and controlled the decision to publish.

## Provenance and peer review

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