DOES PARATHYROID GLAND AUTOFLUORESCENCE DETECTION DURING TOTAL THYROIDECTOMY AFFECT THE RATES OF POSTOPERATIVE HYPOPARATHYROIDISM? INITIAL EXPERIENCE FROM A SPECIALIZED CENTER IN ENDOCRINE SURGERY.

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Objectives: The present study aimed to investigate whether parathyroid gland detection with the use of autofluorescence really affects the rates of postoperative hypoparathyroidism, compared to visual identification of the glands.

Methods: This is a retrospective study conducted at a specialized center in endocrine surgery in Athens, Greece. Our first 10 patients that underwent total thyroidectomy (TTx) with near-infrared parathyroid autofluorescence (Group 1) were compared with 10 patients that underwent TTx without parathyroid autofluorescence (Group 2). Temporary and permanent hypoparathyroidism were defined as postoperative hypoparathyroidism that resolved within the first 6 months or persisted after the 6th postoperative month, respectively. After detailed information, an informed consent of all participants in this study was obtained. Statistical analysis was performed via IBM SPSS Statistics version 26.0. The level of statistical significance was set at 5%.

Results: There was no significant difference between the 2 groups regarding age, gender and surgical indications for TTx. The present study did not demonstrate any significant difference in postoperative hypoparathyroidism rate between the 2 groups (0 vs 1 hypoparathyroidism cases, all temporary, group 1 and 2, respectively, p = 0.30). A significant increase in total operative time was demonstrated between the 2 groups (106.3 vs 96.2 minutes, group 1 and 2, respectively, p = 0.04).

Conclusions: Parathyroid gland autofluorescence demonstrated a tendency towards decreasing the rate of postoperative hypoparathyroidism, although it did not reach a statistical significance. Its application in a larger number of patients will definitely shed light on this interesting topic.
INTRAOPERATIVE PARATHYROID GLAND IDENTIFICATION USING AUTOFLUORESCENCE IN THYROID CANCER SURGERY WITH CENTRAL NECK DISSECTION: IMPACT ON POST-OPERATIVE HYPOCALCEMIA.

Authors and affiliations

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Abstract

Objectives. Hypoparathyroidism is the most frequent complication in thyroid surgery, particularly when a central neck dissection is performed. The aim of this study was to evaluate the impact of intraoperative parathyroid gland identification using autofluorescence in thyroid cancer surgery on the rate of post-operative (PO) hypoparathyroidism.

Methods. Patients undergoing total thyroidectomy with central neck dissection from 2018 to 2022 were included. A prospective cohort of 77 patients operated on using near infrared autofluorescence (NIR+) with the Fluobeam® (Fluoptics, Grenoble, France) system was compared to a retrospective cohort of 94 patients (NIR-). The main outcomes were the rate of PO hypocalcemia with three cutoffs: corrected calcium (Cac) < 2.10 mmol/L (8.4mg/dL), Cac <2.00 mmol/L (8mg/dL) and Cac<1.875 mmol/L (7.5mg/dL), and the rate of permanent hypoparathyroidism.

Results. The rate of PO Cac< 2.10 mmol/L was statistically lower in the NIR+ group compared to the NIR- group (respectively 36% and 60%, p=0.003). No statistically significant difference was observed for the two others thresholds: 19% in the NIR+ group had a PO Cac<2.00 mmol/L compared to 27% in the NIR- (p=0.36); 3% in the NIR+ group had a PO Cac<1.875 mmol/L compared to 11% in the NIR- group (p=0.07). There was no significant difference on the rate of permanent hypoparathyroidism (8% in the NIR+ group, 14% in the NIR- group, p=0.23).

Conclusions. NIR autofluorescence is a surgically non-invasive adjunct and can improve patients’ outcomes for thyroid cancer surgery, by reducing post-operative temporary hypoparathyroidism. Larger prospective studies are warranted to validate our findings.
INDOCYANINE GREEN ANGIOGRAPHY FOR PREDICTING HYPOPARATHYROIDISM AFTER TOTAL THYROIDECTOMY: A PHASE II STANDARDIZATION AND QUANTIFICATION STUDY


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Objectives: (Transient) postoperative hypoparathyroidism (HPT) is the most common complication after total thyroidectomy, reported in up to 38% of patients. Hypoparathyroidism can lead to a higher mortality rate. To predict hypoparathyroidism, the fluorescent dye Indocyanine Green (ICG) is used to assess parathyroid perfusion during thyroid surgery. However, to date, subjective assessment has led to mixed results. We therefore aim to validate our Workflow model of ICG-angiography integrating Standardization and Quantification (WISQ) for the prediction of hypoparathyroidism after total thyroidectomy.

Methods: In this phase II multicenter prospective cohort study, parathyroid ICG-angiography was performed in patients undergoing total thyroidectomy at the end of the procedure, using a standardized protocol. Hypoparathyroidism was defined as a perioperative PTH decrease of ≥80%. Parathyroid flow curves were created by plotting the fluorescence intensity against time, after which various time-dependent parameters were calculated and correlated to the occurrence of hypoparathyroidism. Results: 68 patients from three Dutch academic centers that underwent total thyroidectomy took part in this study. The Area Under the Curve (AUC) during the first 30 seconds of the outflow phase was found to a significant predictive value for postoperative hypoparathyroidism (mean 1560.54 for postoperative HPT vs. 1091.10 for no HPT, p=0.023) with a cut-off value of 1705 (sensitivity 100%, specificity 42.5%). The data is currently being analyzed more thoroughly. During the symposium, the additional results will be shared. Conclusions: This phase II study demonstrates that postoperative hypoparathyroidism can be predicted using standardized and quantified parathyroid ICG-angiography. Presumably, in the future, WISQ can contribute to intraoperative decision-making regarding parathyroid autotransplantation and thus prevent postoperative hypoparathyroidism.
AUTONOMOUS AND SELF-SUSTAINED CIRCADIAN OSCILLATORS DISPLAYED IN HUMAN PRIMARY PARATHYROID CELL CULTURE DRIVE PARATHORMONE SECRETION

Volodymyr Petrenko, Claudio De Vito, Marco Stefano Demarchi, Olivier Golaz, Frédéric Triponez and Charna Dibner

Objectives: Most cells in our body possess circadian oscillators controlling diurnal rhythmicity of body metabolism. The role of molecular clocks in regulating the function and disfunction of human parathyroid gland (PG), responsible for calcium homeostasis, has not been unraveled. Hyperparathyroidism is a common endocrine pathology, characterized by an unadapted PTH secretion to calcium levels. Here we aimed at characterizing molecular makeup of circadian clocks in human primary parathyroid cell culture (HPPCC), and at establishing differential transcriptional patterns of normal and pathological PGs.

Methods: RNA extracted from normal, adenomatous, and hyperplastic PG tissues was subjected to RNA sequencing (RNAseq) analysis. The rim of normal PG tissue was dissected from parathyroid adenoma specimens based on the higher autofluorescence intensity assessed by the near infra-red imaging. HPPCCs were established from adenomatous and hyperplastic PG biopsies. The functionality of circadian clock machinery was assessed by continuous recording of circadian bioluminescence introduced via lentivectors and paralleled with around-the-clock measurement of PTH secretion using perifusion system.

Results: The RNAseq analyses revealed transcriptional signatures that distinguished between pathological and normal PGs, and among adenomatous and hyperplastic PGs. We report, for the first time, robust anti-phasic circadian rhythmicity of Per2-luciferase and Bmal1-luciferase reporters in HPPCCs synchronized in vitro. Strikingly, we observed circadian rhythmicity of PTH secretion by parathyroid adenoma cells.

Conclusions: Our data indicate presence of cell-autonomous molecular clock in human PG cells paralleled with circadian rhythmic PTH secretion and provide large-scale transcriptional pattern of parathyroid adenoma and hyperplastic tissues.
INTRAOPERATIVE PREVENTION OF POSTOPERATIVE HYPOPARATHYROIDISM

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Objectives.
intrathyroid injection of a 1% brilliant green for parathyroid glands’ identification during thyroid surgery.

Methods. We included 143 patients who underwent thyroid surgery in 2019. The patients were divided into 3 groups: 1–using ICG-angiography (24 cases), 2–intrathyroid injection of 1% brilliant green (58), 3–control group (61).

Results. There were no differences between sCa and iPTH before surgery in all groups. The level of hypocalcemia in group 1 was 8%, it was significantly lower than in the other two groups (14% and 26%). Significant difference (≥95%) in sCa and iPTH was detected in the postoperative period between groups 1 and 3 (p<0.05). There were no side effects of ICG-angiography and intrathyroid injection of 1% brilliant green.

Conclusions. Both methods were effective and safe. Intrathyroid injection of 1% brilliant green administration of diamond green is less effective then ICG-angiography, but it also significantly reduces the risk of hypoPT.
PARATHYROID DETECTION IN TRANSORAL SURGERY: hANDY-I ENDOSCOPIC ATTACHMENT

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Objective: There are currently no standardized methods for locating parathyroid glands (PGs) in patients undergoing transoral endoscopic thyroidectomy vestibular approach (TOETVA). This can result in parathyroid injury and subsequent hypoparathyroidism and hypocalcemia. Our group previously introduced the hANDY-i, a non-invasive, dual-sensor handheld imager for intraoperative PG autofluorescence. This study’s aim is to describe the endoscopic attachment to hANDY-i for utilization in TOETVA cases.

Methods: This was a clinical feasibility study in two transoral cases consisting of one cadaver and one patient. hANDY-i was mounted to a 10-mm 30-degree endoscope which together delivered a split screen, Red-green-blue (RGB) and near-infrared autofluorescence (NIRAF), view of the surgical field.

Results: For both cases, standard TOETVA procedure was followed, then hANDY-i endoscopic attachment was inserted through the 10mm central trocar. In the cadaver, the left superior PG was visualized by the surgeon and fluorescence was confirmed with hANDY-i. A second area of fluorescence was identified along the inferolateral edge of the thyroid lobe, corresponding to a subcapsular, intra-thyroidal PG. In the patient, a transoral total thyroidectomy was performed. The left superior, right superior, and inferior PGs were successfully detected with hANDY-i. The left superior and right inferior PGs appeared devascularized and were autotransplanted into the respective sternohyoid muscles. Postoperative parathyroid hormone levels were within normal limits and the patient was discharged to home on the same day without event.

Conclusions: We have demonstrated the clinical applicability of the hANDY-i endoscopic attachment in both cadaver and patient cases. The ability to leverage parathyroid autofluorescence during TOETVA may lead to improved PG localization and preservation.
PRELIMINARY REPORT FOLLOWING IMPLEMENTATION OF POINT OF CARE (POC) INTRAOPERATIVE PTH (IOPTH) ASSAY USING WHOLE BLOOD DURING SURGERY FOR PRIMARY HYPERPARATHYROIDISM

Authors: Mohankumar R, Pannu A, Balasubramanian SP.

Objective: To report preliminary experience using a novel point of care (POC) assay (NBCL CONNECT) for parathyroid hormone (PTH) using whole blood during surgery for primary hyperparathyroidism (PHPT).

Methods: Data from patients who underwent surgery for PHPT using the NBCL CONNECT intraoperative PTH (IOPTH) assay between March and Nov 2022 (group 1) was reviewed to determine concordance between NBCL and lab PTH values and diagnostic test parameters of the NBCL CONNECT assay. ‘In-theatre’ times were then compared with a historical cohort where the lab-based IOPTH assay (group 2) was used.

Results: In group 1; of the 141 paired samples, correlation between NBCL and the lab assay was high (rho=0.82; p<0.001). PTH levels using the NBCL assay dropped satisfactorily (>50% of the basal or 0 min sample; whichever was lower – i.e. positive test) in 23 patients; giving a positive predictive value of 100%. Of the 9 patients that did not demonstrate a drop, two were true negative (negative predictive value of 22%) leading to cure after excision of a further gland.

Group 1 had a significantly shorter ‘in-theatre’ time (p=0.013) compared to group 2; despite much higher use of near infra-red autofluorescence (NIRAF) (72% vs 11.6% in group I and 2 respectively).

Conclusions: The NBCL CONNECT POC IOPTH assay gives comparable results to lab-based PTH assays and can be performed without need for a centrifuge or qualified technicians. Surgeons however need to be aware of the potential for false-negative results.
TITLE: DOES NEAR-INFRARED FLUORESCENT IMAGING ADD VALUE IN FIRST-TIME SURGERY FOR PRIMARY HYPERPARATHYROIDISM?

Authors:

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Objectives:

This study aims to assess the role of detection of near-infrared auto fluorescence (NIRAF) in first-time surgery for primary hyperparathyroidism (PHPT) in a single centre.

Methods:

Adult patients undergoing first-time surgery for PHPT over 3 years were included (n=230). Data on demographic features, clinical, radiology, surgical and postoperative outcomes were reviewed. EleVisionTM IR Platform by Medtronic® and FluobeamTM by Fluoptics® were used to assess NIRAF in 50 patients. Outcomes included cure rates, operating times and 'surgeon-perceived' benefits of NIRAF.

Results:

Unilateral neck exploration (UNE) and bilateral neck exploration (BNE) were performed in 111 and 119 patients respectively. Overall cure rate was 96.5%. Cure rate was not affected by extent of surgery (UNE vs BNE), use of intra-operative PTH assay or NIRAF. In 18% of patients, NIRAF was considered by the operating surgeon to be beneficial in parathyroid identification. In patients undergoing BNE, median (inter-quartile range) operating times were 92 (78-115) minutes in no-NIRAF group compared to 116 (89-136) minutes in the NIRAF group (p=0.024). In patients undergoing UNE, these were 92 (68-105) and 86 (72-110) minutes respectively (p=0.826). In patients undergoing BNE, use of NIRAF resulted in less discrepancies (8.0% vs 12.8%) in nature of identified tissue between intraoperative findings and histology.

Conclusion:

In this early report, use of NIRAF significantly increased operating times with some potential 'surgeon-perceived' benefit without improvement in cure rates. Further work needs to be done on larger cohorts of patients, assessment of differences in fluorescence between normal, adenomatous, and hyperplastic glands and evaluation of the role of experience in NIRAF use.
Why does diseased parathyroid appear weak or heterogeneous intensity during NIR autofluorescence?

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Objects:

It is quite often that during autofluorescence the imaging intensity of diseased parathyroid glands is lower than normal parathyroid gland, and some of diseased glands appeared heterogeneous intensity especially in secondary hyperparathyroidism. This study is designed for investigating the reasons.

Methods:

After formalin and paraffin fixation and bivalve cutting, 18 diseased glands from primary hyperparathyroidism patients, 35 diseased parathyroid glands from uremic hyperparathyroidism patients, the surrounding thyroid and thymus tissue were measured the intensity by NIR autofluorescence, using Flurobeam imaging system (Fluoptics, France). None of the tissue has been stained by ICG. The pathology by H&E stain was matched the intensity of autofluorescence. Results:

Using the bright white intensity of adult normal parathyroid gland as reference- index 2, the chief cell, oxyphilic cell tissue of diseased parathyroid has the same intensity-score 2 as normal parathyroid gland, and their glandular architecture including trabecular, follicular or solid arrangement does not affect the intensity. Clear water parathyroid cell, thyroid cell, and cystic change of parathyroid tissue appear weaker white intensity-score 1. Thymus, fat, fibrosis, and necrosis, and red blood cell appear dark black intensity-score 0. The thickness of fibrotic capsule varied on the diseased parathyroid gland, however, only very thin capsule on normal the parathyroid gland

Conclusions:

Various degree of fibrotic capsule of diseased parathyroid gland may be the main factor contributing lower intensity during autofluorescence, and different cell type, necrosis, fibrosis, and hemorrhage could explain the heterogeneous intensity in the diseased parathyroid glands.
Intraoperative assessment of parathyroid perfusion using indocyanine green angiography in robotic thyroidectomy

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In recent da Vinci robot systems, near infrared fluorescence imaging (Firefly technology) is applicable. It is possible to see important structures well beyond the limits of the surgeon's eyes so that the surgeon can safely operate and make critical decision-making accurately using image guided surgery. Because parathyroid glands (PTG) are small and is embedded in the surrounding tissues such as lymph nodes and fat, it is often very hard for surgeons to identify PTGs. To preserve the PTGs well, the surgeon must be able to identify the PTG well, and preserve the vasculature and perfusion to the PTG. Herein, we report assessment of PTG perfusion using indocyanine green angiography in transoral robotic thyroidectomy.

The patient underwent transoral robotic total thyroidectomy and prophylactic CLND with a da Vinci Xi Surgical System (Intuitive Surgical, Sunnyvale, CA, USA). For ICG angiography, 10 cc normal saline was added to 1 vial of Diagnogreen (25 mg) and mixed; then, 6 ml (15 mg of ICG) was injected into the patient intravenously. Approximately 40 seconds after ICG injection, the inferior thyroidal artery started to be gradually enhanced under fluorescence imaging (Firefly mode), and the PTG started to be enhanced after approximately 1 minute. The surgeon determined that the left inferior PTG was normal based on shape and color and was observed that the PTG was well-perfused based on good enhancement in ICG angiography. The left superior PTG looked normal when it was assessed by the surgeon, and it was expected that perfusion would be good because there was a feeding vessel around the area; however, there was no perfusion in the PTG when the area evaluated by ICG angiography. The right inferior subcapsular PTG had a normal shape and color; however, it had no peripheral feeding vessels, and there was no perfusion by ICG angiography. Therefore, this PTG was safely autotransplanted into the sternocleidomastoid muscle. The right superior PTG was slightly darker in color; however, it was partially perfused by ICG angiography, so it was deemed as a moderately perfused PTG and left in place without autotransplantation. According to the results of left superior PTG reassessment, there was still no perfusion, so it was regarded as a nonperfused PTG, and autotransplantation was performed. Postoperative laboratory tests showed that calcium and parathyroid hormone levels were within normal range (calcium 9.5 mg/dL (normal range; 8.7-10.4), PTH 34.7 pg/mL (normal range; 18.5-88.0)), and the patient did not experience a tingling sensation.

In summary, ICG angiography could be used to conduct a more objective evaluation of PTG perfusion than a surgeon’s visual assessment could provide. This approach is very helpful for surgeons when they are deciding whether to perform autotransplantation or leave the PTG in situ after the PTG has been identified as having suitable perfusion or having no perfusion.
ICG FLUORESCENCE ANGIOGRAPHY PRESERVES PARATHYROID FUNCTION AFTER SUBTOTAL PARATHYROIDECTOMY IN PATIENTS WITH RENAL HYPERPARATHYROIDISM.

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Objectives
Hyperparathyroidism (HPT) impair outcome in chronic kidney disease and can be treated surgically with a subtotal parathyroidectomy (sPTX). The aim is to remove sufficient parathyroid tissue, while still maintaining parathyroid function. Intraoperative use of indocyanine green fluorescence angiography (IFA) may help to preserve parathyroid function.
The aim of this study was to compare long term parathyroid function in patients operated with IFA vs. without. Secondary outcome measures were operative results, complications, and mortality.

Methods
We retrospectively compared a consecutive cohort of 80 patients with renal HPT from a five-year period. The first 43 patients had a sPTX without IFA, while the next 37 patients had sPTX with IFA. We included surgical reports, pathology reports, and biochemical results with 6 months follow-up.

Results
At 6 months, patients in the IFA group had a tendency towards lower risk of impaired parathyroid function (5% vs. 17%, p=0.1).
Patients in the IFA group were operated more extensively, as 89% vs. 44% had 31/2 parathyroid glands removed.
Hospital stay was shorter in the IFA group (median 1 day vs. 2 days, p=0.01).
There were no (0%) immediate complications (recurrent nerve palsy, infection, bleeding, or mortality) in either group.

Conclusions
sPTX in renal HPT can be performed safely with a very low risk of complications. Additional use of IFA leads to a clinically meaningful reduction in risk of impaired parathyroid function.
AUTOFLUORESCENCE OF THE PARATHYROID GLANDS IN THE HANDS OF HIGH-VOLUME ENDOCRINE SURGEONS.

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Objective: To assess whether, in the hands of high-volume surgeons, near-infrared autofluorescence imaging, reduces the incidence of postoperative hypoparathyroidism in patients undergoing total thyroidectomies.

Methods: The study was performed at the Department of General and Oncological Surgery of the Medical University in Łódź. 61 patients- 59(96.7%) women, aged 39 to 64, were included. Total thyroidectomy was performed in all patients, for benign, nontoxic goiter, excluding autoimmune diseases.

They were divided randomly into two groups with or without near-infrared autofluorescence imaging. The procedures were performed by 2 high volume surgeons (>100 thyroidectomies a year).

Analysis of parameters such as the number of parathyroid glands found, length of surgery, changes in PTH levels and total calcium levels were performed.

Results: A total of 101 parathyroid glands were identified visually and 111 with a near infrared autofluorescence device in the study group, while 116 parathyroid glands were identified visually in the control group (statistical significant difference p=0.005).

No statistically significant differences were found in the length of surgery, pre and postoperative PTH and total calcium levels between the two groups. Postoperative hypoparathyroidism (PTH<1.6 pmol/L) was seen in 9(29.03%) of patients from the study group and 12(40.00%) from the control group (no statistical, significant difference p=0.367).

Conclusion: The identification of the parathyroid glands using near-infrared fluorescence does not significantly decrease the incidence of postoperative hypoparathyroidism in the hands of an experienced surgeons.
PROBE-BASED ASSESSMENT OF ICG ENHANCED FLUORESCENCE OF VASCULARIZED PARATHYROID GLANDS

Larrabee KA, Singer MC

Objective: ICG enhanced fluorescence to gauge parathyroid gland (PG) perfusion has been well described utilizing image-based systems. However, these technologies provide qualitative rather than quantitative results, leading to subjective measures of fluorescence levels. In this study, a probe-based system is being employed to try to objectively characterize the fluorescence response of PGs after ICG injection.

Methods: This is an ongoing, prospective study of patients undergoing curative, single-gland parathyroidectomy. After excision of the adenoma, the ipsilateral normal PG is identified and 5 mg of ICG is infused. The PTeye system is then used to measure the degree of fluorescence of the normal parathyroid and thyroid tissues at different time points after injection.

Results: To date 8 patients have been enrolled in the study. All have been cured after removal of a single adenoma. After infusion of ICG, time until initial increase of fluorescence of the normal PG was $42.4 \pm 26.2$ seconds (range 20-92). Peak fluorescence of the PG occurred at $78.4 \pm 52.4$ seconds (range 23-152). In 6/8 patients the fluorescence of the PG reached the device’s upper measurable limit. In 6/8 patients, at the time of peak PG fluorescence, the PG level was a multiple of the thyroid fluorescence (mean= 2.4, range 1.3-3.8).

Conclusions: In the initial phase of this study, early results suggest that peak ICG enhanced fluorescence of PGs occurs rapidly after infusion. In most patients the degree of fluorescence of well perfused PGs reaches the maximum limit of the system’s numeric range.
PARATHYROID GLAND DETECTION USING AN INTRAOPERATIVE AUTOFLUORESCENCE HANDHELD IMAGER – EARLY FEASIBILITY STUDY

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Keywords: parathyroid glands; near infrared autofluorescence (NIRAF); hypocalcemia; hypoparathyroidism; thyroid surgery.

Abstract:

Introduction: Parathyroid glands may be compromised during thyroid surgery which can lead to hypoparathyroidism and hypocalcemia. Historically, identifying the parathyroid glands relied on the surgeon’s experience and the only way to confirm their presence was through tissue biopsy. Near infrared autofluorescence technology offers an opportunity for real-time, non-invasive identification of the parathyroid glands.

Methods: We used a new research prototype (hANDY-I) developed by Optosurgical, LLC. It offers coaxial excitation light and a dual-Red Green Blue/Near Infrared sensor that guides anatomical landmarks and can aid in identification of parathyroid glands by showing a combined autofluorescence and colored image simultaneously.

Results: We tested the imager during 23 thyroid surgery cases, where initial clinical feasibility data showed that out of 75 parathyroid glands inspected, 71 showed strong
autofluorescence signal and were correctly identified (94.7% accuracy) by the imager.

**Conclusions:** The hANDY-I prototype demonstrated promising results in this feasibility study by aiding in real-time visualization of the parathyroid glands. However, further testing by conducting randomized clinical trials with a bigger sample size is still required to study the effect on levels of hypoparathyroidism and hypocalcemia.
Title: Rapid intraoperative perfusion assessment of parathyroid adenomas with ICG using a wide-field portable hand-held fluorescence imaging system

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Abstract

Background:
Fluorescence angiography (FA) using indocyanine green dye (ICG) has recently been introduced for real-time identification of parathyroid adenomas. However, time to peak fluorescence has not yet been critically evaluated.

Methods:
This was a retrospective review of parathyroidectomies with ICG FA over a one-year period.

Results:
There were 66 patients with average age of 64 years. The average time to initial fluorescence was 26.7 seconds and to peak fluorescence was 38.0 seconds. The time to saline flush administration significantly correlated with times to initial and peak fluorescence (p<.0001). The rate of in-situ fluorescence was 97%. The rates of suspected adenoma detection were 69% for sestamibi scan, 71% for ultrasound, and 96% for CT scan. Imaging was discordant in 13 cases (20%), with the adenoma located on the opposite side of the neck in 4 cases.

Conclusions:
ICG FA is a rapid and effective adjunct for the intraoperative identification of parathyroid adenomas.
Abstract 16 - Friday February 24 - Session 7 - 10.45 AM

**FNA-derived Parathyroid Organoids: Advancing Multiplatform Applications**

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**Background:** Primary hyperparathyroidism (PHPT) is a common endocrine metabolic disease. We recently developed a spectrum of functionally intact endocrine patient-derived organoids (PDO). In this study, we examined the utility of parathyroid PDO for bioenergetic and metabolic screening as a proof-of-concept. We assessed the feasibility of parathyroid PDO metabolic profiling to affirm the recapitulation of PHPT tissue metabolism.

**Methods:** Using the FNA-based technique, we established parathyroid PDO from human PHPT patient tumors and optimized semi-solid culture conditions for organoid formation, growth, and proliferation. Structural and functional analyses were carried out using brightfield microscopy, immunofluorescence, immunohistochemistry, electron microscopy, near-infrared fluorescence (NIRAF) imaging, and ELISA hormone assays for parathyroid hormone (PTH). We performed bioenergetic metabolic profiling of parathyroid PDO using extracellular flux and metabolomic analyses.

**Results:** In parathyroid PDO, we observed preserved Calcium-sensing receptor (CaSR) expression, near-infrared autofluorescence (NIRAF), sustained parathyroid hormone (PTH) secretion, and responsiveness to fluctuating Calcium concentrations in vitro. We established the feasibility of parathyroid PDO use in metabolic and bioenergetic profiling.

**Conclusion:** Utilization of parathyroid PDO for metabolic profiling affirms the feasibility of future metabolic studies in endocrine organoid platforms and can further advance other multiplatform, translational, and therapeutic applications in endocrine diseases.
Title: Seracam: A first look at a new intraoperative gamma camera

Speaker: Andrew Farnworth, Loughborough University

Abstract:
The Seracam is a highly portable, high-resolution, small field of view (SFOV) gamma-optical camera, developed by Serac Imaging Systems Ltd. The Seracam features a pinhole-collimated, microcolumnar-CsI(Tl) gamma sensor and an optical sensor with a matched FOV. An automated collimator changing system allows rapid (~1 s) switching between internally housed collimators. This device miniaturises the planar functionality offered by current clinical large field of view gamma cameras and is well suited radioguided surgical applications.

We have conducted an extensive quantitative performance characterisation of the Seracam following adapted NEMA protocols, a qualitative study with anatomical thyroid phantoms to assess image quality, and have also explored the novel features of the device. The Seracam represents the current state-of-the-art of this development in SFOV gamma-optical camera systems. This device offers hybrid gamma optical imaging to provide gamma-signal landmarking signal within the surgical field, and an articulated, arm-based mounting system to allow positioning flexibility, needed to obtain images at the off-axis orientations required to delineate anatomical structures. The collimator switching system allows adjustment of image sensitivity and spatial resolution within the theatre, allowing users to tailor the imaging parameters to those best suited to answer the current clinical question.

Our benchtop results suggest that Seracam could be a useful tool for parathyroid surgeons however the flexibility, usability and the degree of integration within a surgical procedure all play a key role in intraoperative guidance device efficacy and this requires specialist knowledge from the surgical community. This talk will outline the qualitative and quantitative capabilities of the Seracam and open discussion of the clinical requirements needed for an effective gamma-imaging tool for radioguided surgery.