

Intraoperative Indocyanine Green Fluorescence Imaging in Thyroid Surgery: Technical Protocol, Evaluation Window and Interpretation Pitfalls — Single-Centre Experience in a Prospective Series of 42 Cases

Dana-Roxana Boanță^{1,2}, Mihaela Mișcă^{2,3}, Valentin Titus Grigorean^{2,4}, Victor Dan Eugen Strâmbu^{2,5}, Iulian Brezean^{2,3}

¹Department of Endocrine Surgery, C.I. Parhon National Institute of Endocrinology, Bucharest, Romania

²Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

³2nd Department of Surgery, Dr. I. Cantacuzino Clinical Hospital, Bucharest, Romania

⁴Department of Surgery, Bagdasar-Arseni Clinical Emergency Hospital, Bucharest, Romania

⁵Department of Surgery, Dr. Carol Davila Clinical Hospital of Nephrology, Bucharest, Romania

Abstract

Background: Postoperative hypoparathyroidism remains the most frequent complication of total thyroidectomy (20-40% transient, 1-4% permanent). Intraoperative NIR imaging with indocyanine green (ICG) is validated for parathyroid gland (PG) perfusion assessment - recognized in the EAES 2023 consensus - but data on practical implementation, temporal parameters and interpretation pitfalls remain limited. **Aim:** To describe the ICG technical protocol with the Karl Storz IMAGE1 S™ Rubina® system, to quantify the evaluation window (tev) and to systematize the interpretation pitfalls encountered.

Materials and methods: Prospective, observational, single-centre study (retrospective analysis of prospectively collected data; enrolment dependent on the intraoperative availability of the ICG preparation, therefore not strictly consecutive), including 42 cases in which intraoperative ICG was used during thyroid surgery (37 women, 5 men; mean age 52.6 years; BMI 27.5 kg/m²), performed between February 2024 and February 2025. Uniform protocol: 5 mg ICG IV (2.5 mg/mL) at approximately 66% of the estimated skin-to-skin time; Vidal Fortuny score (0/1/2). Parameters: time of injection (tinj), fluorescence onset (tf) and ICG evaluation window (tev, from injection to score notation and resumption of surgery).

Results: Operative time (tOR): 88.6 ± 30.2 min. Fluorescence onset (tf): 37.5 ± 5.2 sec. ICG evaluation window (tev): 6.4 ± 2.3 min overall; 5.2 ± 1.8 min in standard cases vs 7.8 ± 2.0 min in complex cases (p<0.05). First 21 vs last 21 cases: tev 7.7 vs 5.1 min (Δ = -2.6 min; p<0.05). Re-injection in 8/42 cases (19.0%). Perfusion scores: 64.3% score 2, 32.1% score 1, 3.6% score 0. Zero adverse reactions, zero permanent recurrent laryngeal nerve palsy.

Conclusions: In this series, NIR/ICG imaging with the Karl Storz IMAGE1 S™ Rubina® system proved feasible and safe. The tev parameter (mean 6.4 min) objectively quantifies the efficiency of the assessment and reflects consolidation of the operator's technique after 15–20 cases. The four documented interpretation pitfalls and the re-injection protocol (19.0%) may provide a replicable technical framework for centres implementing this technology.

Keywords: indocyanine green, near-infrared imaging, thyroid surgery, Karl Storz Rubina, technical protocol, ICG evaluation window, interpretation pitfalls