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# A case of incarcerated femoral hernia with intestinal blood flow assessment by brightfield full-color near-infrared fluorescence camera: Report of a case



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## ABSTRACT

**INTRODUCTION:** Indocyanine green (ICG) fluorescence has been reported for examining intestinal blood flow (IBF), but not in the case of bowel released from entrapment in a femoral hernia. We report the case of a patient with incarcerated obturator femoral hernia in whom the bowel was preserved after evaluation of IBF with ICG fluorescence using a brightfield full-color near-infrared fluorescence camera. **PRESENTATION OF CASE:** A woman in her 60s was diagnosed with incarcerated femoral hernia and underwent surgery. Laparotomy was performed to reduce bowel incarceration via an anterior approach. The small bowel showed deep-red discoloration on gross evaluation, but intravenous injection of ICG revealed uniform fluorescence of the mesentery and bowel wall. This indicated an absence of irreversible ischemic changes to the bowel, so resection was not performed and a modified Kugel herniorrhaphy was performed. The patient showed a good postoperative course.

**CONCLUSION:** In herniorrhaphy with mesh, minimization of bowel resection is important for preventing postoperative infection of the mesh. In this case, ICG fluorescence with a near-infrared fluorescence camera was central to reducing bowel resection.

ICG fluorescence may be useful for evaluating IBF in surgery for incarcerated femoral hernias.

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## 1. Background

In surgery for incarcerated hernia, intestinal blood flow (IBF) and the possible need for bowel resection must be evaluated after reducing the incarceration.

The use of indocyanine green (ICG) fluorescence has been reported for IBF [1–4], but evaluation of IBF with a brightfield full color near-infrared fluorescence camera in cases of femoral hernia have not been described in the existing literature.

We report herein the case of a patient with incarcerated femoral hernia in whom IBF was evaluated with ICG fluorescence. We used a brightfield full-color near-infrared fluorescence camera (PINPOINT®; Novadaq, Mississauga, ON, Canada). The PINPOINT®

*List of abbreviations:* IBF, intestinal blood flow; ICG, indocyanine green; CT, computed tomography.

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system was approved (approval No. 13-B-60) by the Research Ethics Committee at the International University of Health and Welfare Hospital, Tochigi, Japan.

## 2. Case presentation

**Patient:** A woman in her 60s.

**Chief complaint:** Right femoral swelling and abdominal pain.

**Past medical history:** Diabetes (well controlled with oral medications).

**History of present illness:** The patient was admitted to hospital with a 4-h history of right femoral swelling and abdominal pain.

**Vital signs:** Vital signs were normal. Body temperature was 36.7 °C.

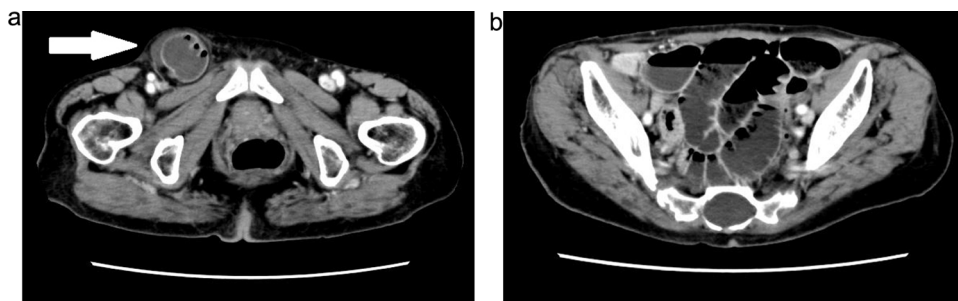
**Physical examination:** On physical examination, a non-reducible golf-ball-sized bulge just caudal to the right inguinal ligament was palpated and abdominal distension was recognized.

**Blood test findings:** Laboratory data were normal.

**Abdominal contrast-enhanced computed tomography (CT):** CT was performed to examine the content of the hernia [5,6], and it revealed a right femoral hernia containing small intestine and ascites in the hernial sac, as well as dilatation of the small intestine in the abdominal cavity (Fig. 1a,b)

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**Fig. 1.** (a,b) CT. Imaging reveals a right femoral hernia containing small intestine and ascites in the hernial sac (white arrow), as well as dilatation of the small intestine in the abdominal cavity.



**Fig. 2.** Surgical findings. The small bowel that had been incarcerated (white arrow) is dilated and discolored to dark-red.

The patient was diagnosed with incarcerated femoral hernia and surgery was performed.

### 3. Surgical findings

The operation was performed via an anterior approach and the incarcerated bowel was reduced. We opened the hernia sac and observed the small bowel.

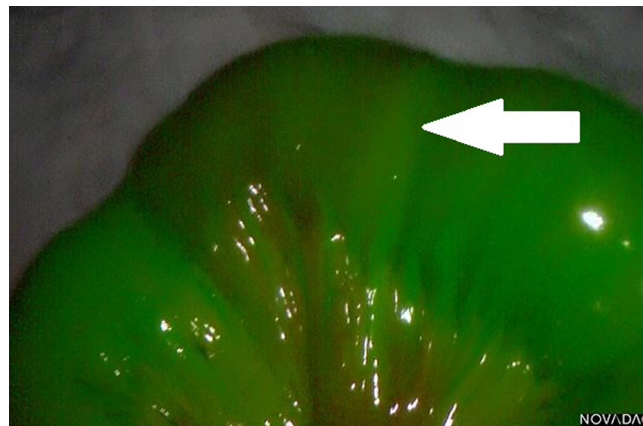
The small bowel that had been incarcerated was dilated and discolored to a dark red (Fig. 2).

Two milliliters of ICG (5 mg/ml) was injected intravenously, and blood flow was observed using the PINPOINT® system. Fluorescence was seen in the arteries of the mesentery, followed by uniform fluorescence throughout the bowel wall. The small bowel that had shown dark-red discoloration after release from incarceration also showed fluorescence (Fig. 3). This suggested adequate perfusion and that the ischemic changes were reversible, so the bowel was not resected.

Based on the operative findings, femoral hernias were diagnosed and transversalis fascia was vulnerable. A modified Kugel herniorrhaphy as proposed by Suwa et al. [1] was performed.

### 4. Postoperative course

The postoperative course was uneventful. The patient resumed eating on day 3 after surgery and was discharged on day 8.



**Fig. 3.** Observation with PINPOINT®. Small bowel with dark-red discoloration (white arrow) also shows fluorescence.

## 5. Discussion

### 5.1. ICG fluorescence using a near-infrared fluorescence camera

Conventional near-infrared fluorescence cameras are dark-field, black and white or monochromatic. Observation of IBF by the ICG fluorescence method has previously been reported using a bright-field full-color near-infrared fluorescence camera, the HyperEye Medical System® (Mizuho, Tokyo, Japan) [2].

When ICG is injected from a peripheral vein, ICG combines with serum albumin in the circulation. IBF can thus be confirmed by the observation of ICG fluorescence. The PINPOINT® brightfield full-color near-infrared fluorescence camera can be used for such purposes in laparoscopic surgery. The PINPOINT® system simultaneously displays fluorescence and color images in a single video, enabling simultaneous observation of usual fluorescence and color images. Surgery can therefore proceed without interruption during fluorescence imaging.

This system was able to be used in open surgery in the present case.

### 5.2. Evaluation of incarcerated hernias and intestinal ischemia

IBF and the possible need for bowel resection must be assessed after reducing an incarceration. IBF is usually evaluated by observing bowel color, the presence or absence of peristalsis, the presence or absence of bleeding from the resected bowel stump, and arterial pulsations in the mesentery. Bowel resection is necessary if signs of irreversible ischemia are apparent in the previously incarcerated bowel, but evaluation of bowel ischemia is difficult in some patients.

ICG fluorescence evaluation of blood flow has already been reported for superior mesenteric artery occlusion [7], strangulation ileus [8], and non-occlusive mesenteric ischemia [9].

With evaluation of ICG fluorescence, blood flow can be observed by injecting ICG from a peripheral vein. Radiation-protective equipment and digital-subtraction angiography systems are unnecessary. ICG can be used regardless of renal function. ICG fluorescence is repeatable and useful, because ICG has a half-life of 3 min. This can be highly useful from the perspectives of convenience, speed, and allowing observation of a wide area [4]. However, application following release of incarcerated femoral hernias has not previously been described.

The small bowel in our patient was discolored by the incarceration, and deciding whether to perform bowel resection was difficult. However, ICG fluorescence confirmed good IBF, so we completed surgery without bowel resection. The patient subsequently showed a good postoperative course. If we had not monitored ICG fluorescence, we probably would have performed bowel resection for safety.

ICG fluorescence may be useful for evaluating IBF in patients with incarcerated hernias. Further evidence from more patients must be accumulated to confirm this.

## 6. Conclusions

We have reported the case of a patient with incarcerated femoral hernia in whom the bowel was able to be preserved after intraoperative evaluation of IBF using ICG fluorescence with the PINPOINT® system. ICG fluorescence may be useful for evaluating IBF in surgery for incarcerated femoral hernias.

## Conflicts of interest

The authors declare that they have no conflicts of interest.

## Funding

The authors have no sponsors.

## Ethical approval

This study was approved (approval No. 13-B-60) by the Research Ethics Committee at the International University of Health and Welfare, Tochigi, Japan.

## Consent

Written informed consent was obtained from the patient for publication of this Case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

## Competing interests

The authors declare that they have no competing interests.

## Authors' contributions

SR have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data.

MY have been involved in drafting the manuscript or revising it critically for important intellectual content.

OH have get in on a discussion about this study.

NT have get in on a discussion about this study.

NS have get in on a discussion about this study.

EI have get in on a discussion about this study.

KN have get in on a discussion about this study.

SY have get in on a discussion about this study.

MK have get in on a discussion about this study.

YS have given final approval of the version to be published.

All authors read and approved the final manuscript.

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