



Role of ICG-fluorescence imaging in laparoscopic hepatectomy

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Fluorescence cholangiography

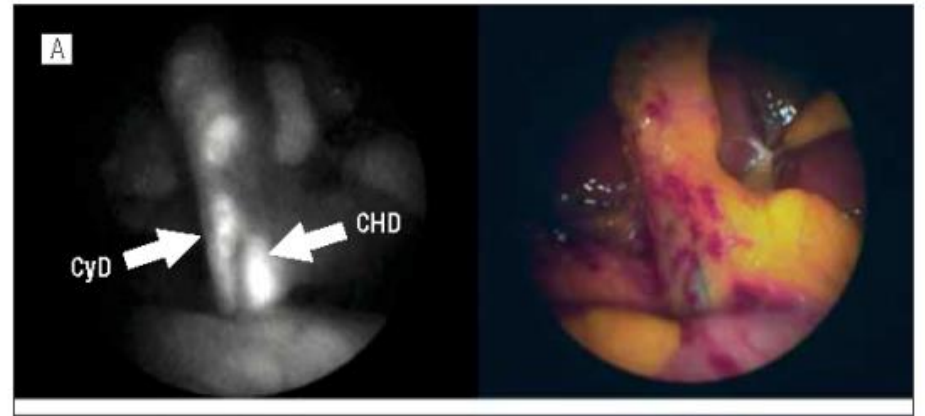
Administration of ICG

- 1) Intrabiliary injection of ICG (0.025 mg/mL)
- 2) Intravenous injection of ICG (2.5 mg)

RESEARCH LETTER

Fluorescent Cholangiography Using Indocyanine Green for Laparoscopic Cholecystectomy: An Initial Experience

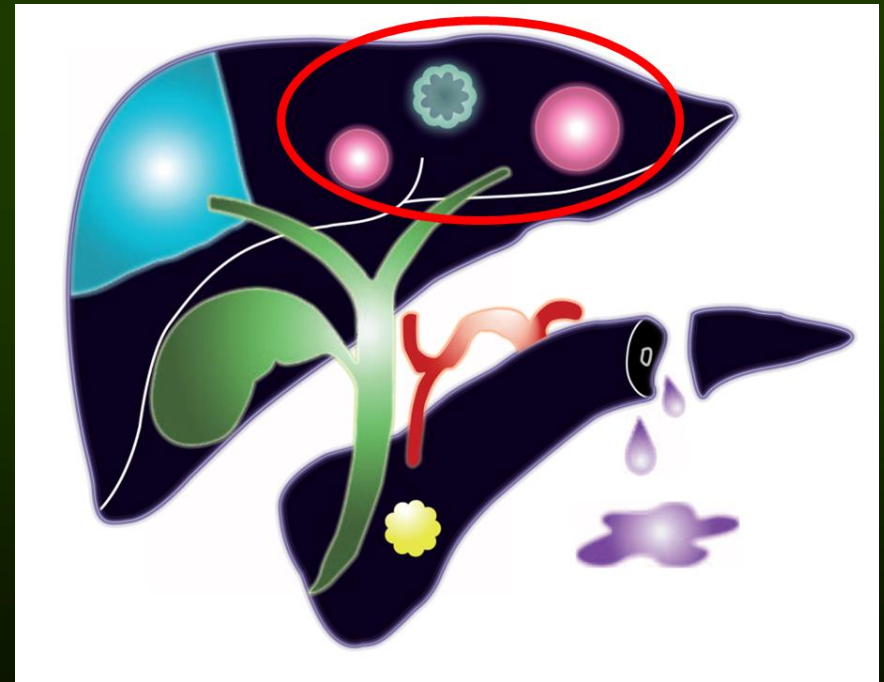
T intraoperative cholangiography (IOC) is recom-



Ishizawa T, Kokudo. JACS 2008, Arch Surg 2009, BJS 2009

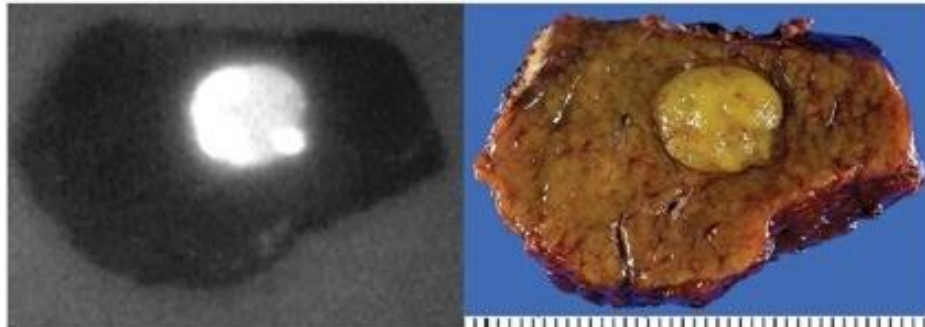
Current applications of Intraoperative ICG- fluorescence imaging in HPB surgery

- 1) Fluorescence cholangiography
- 2) Identification of hepatic malignancies
- 3) Identification of hepatic segments

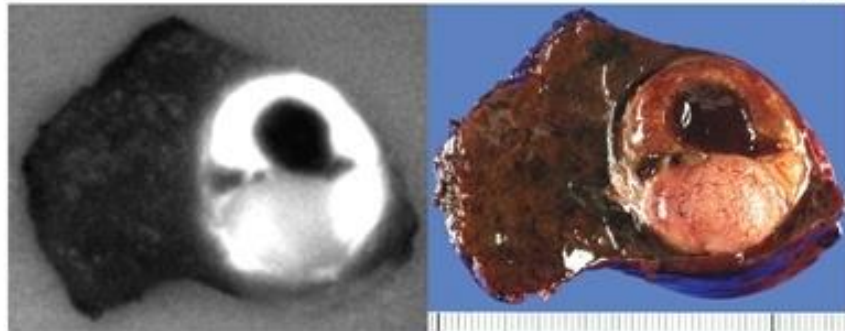


Fluorescent patterns of HCC

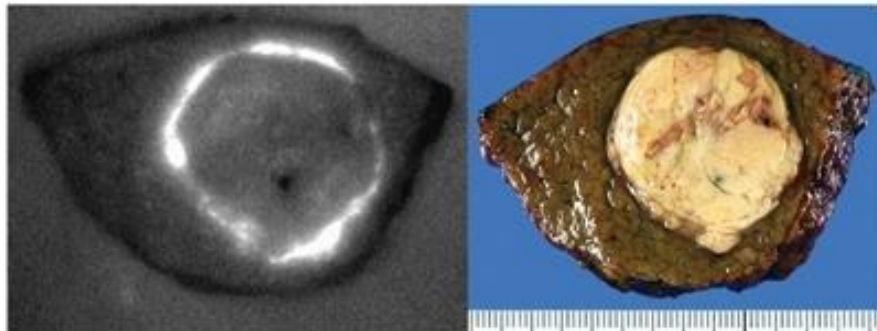
Differentiation n=277



Total	Well	58
	Moderate	72
	Poor	0



Partial	Well	9
	Moderate	100
	Poor	5

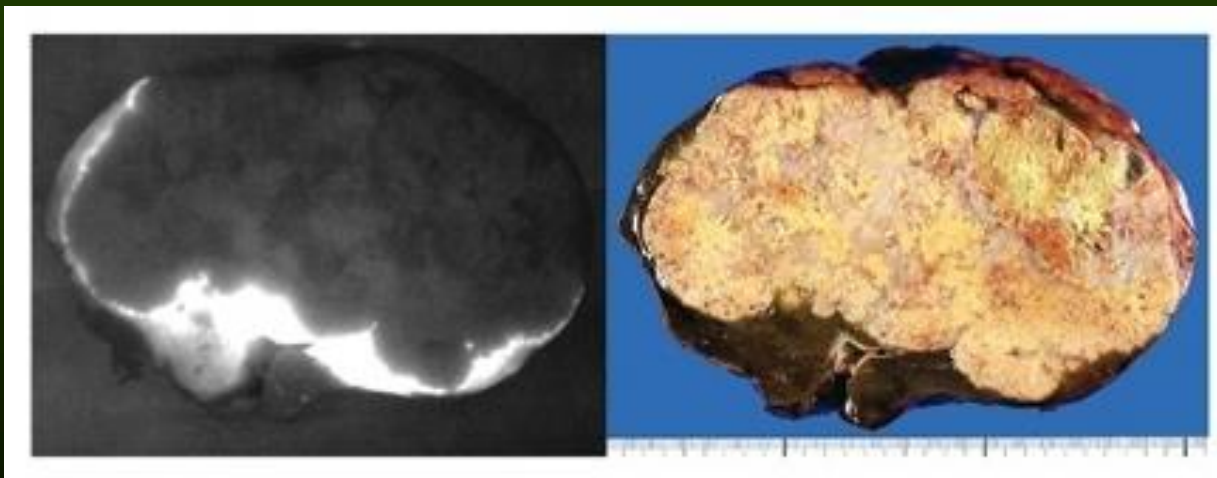
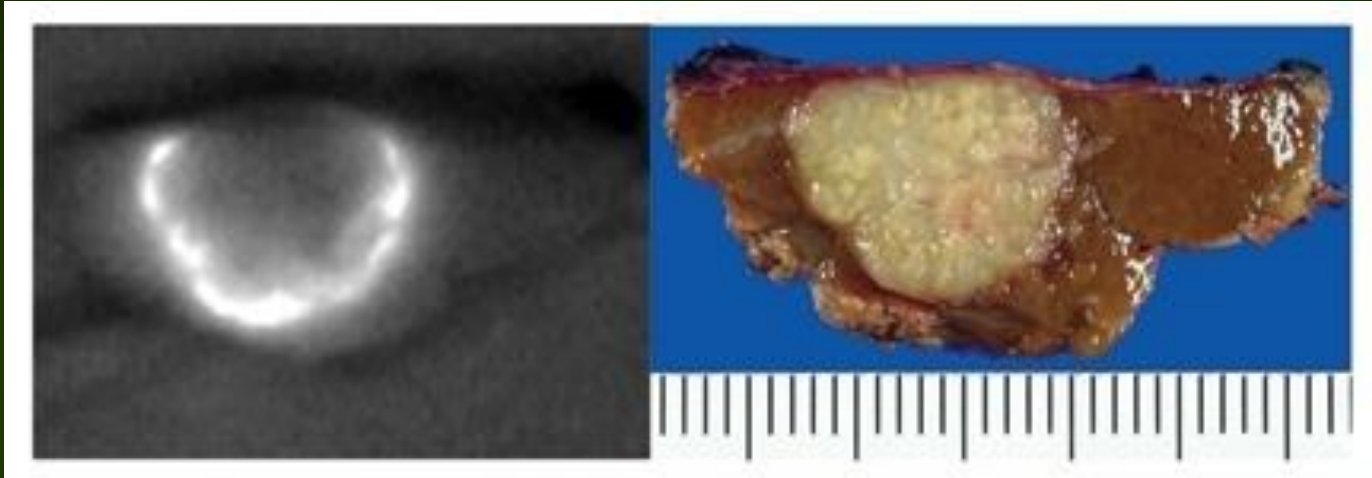


Rim	Well	1
	Moderate	14
	Poor	18

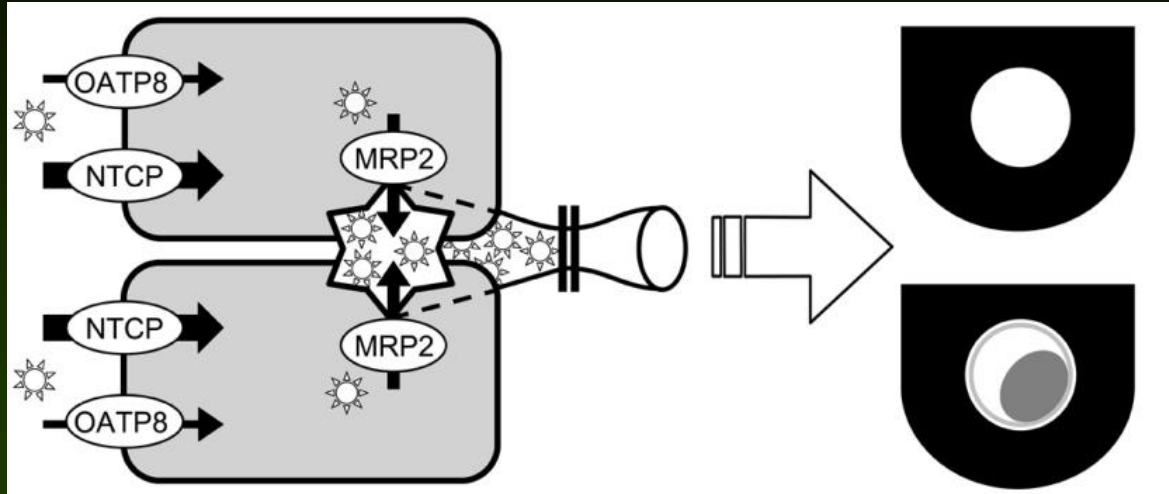
(Non-fluorescing HCCs, n = 3)

Fluorescent patterns of liver metastasis

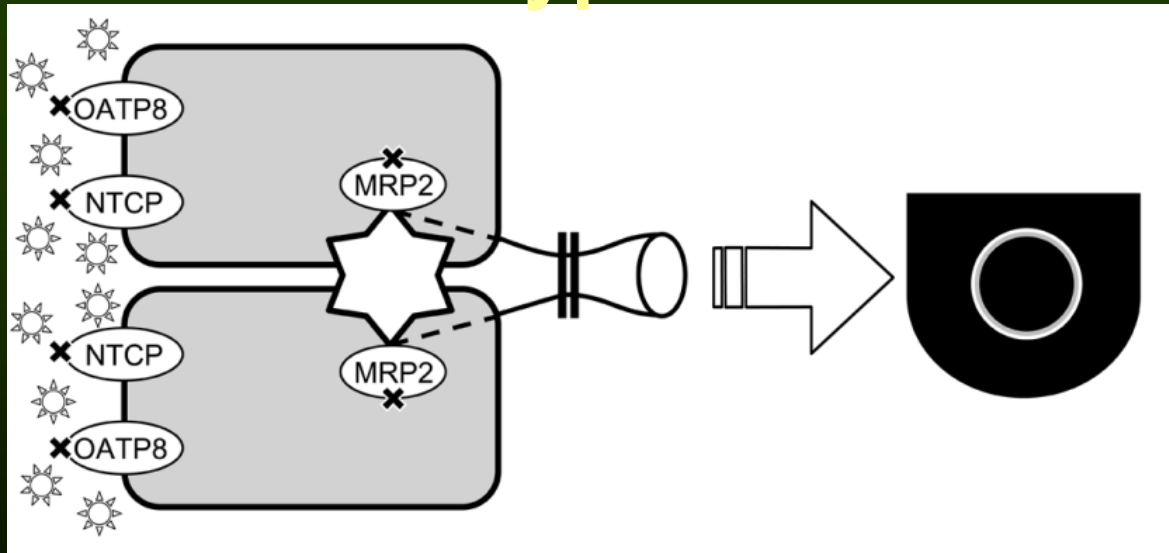
- All the 55 CRLM showed rim-type fluorescence



HCC with cancerous fluorescence



Rim-type HCC



Methods of liver cancer imaging

Administration of ICG

- ICG (0.5 mg/kg) was intravenously injected within 2 weeks before surgery as part of a routine liver function test

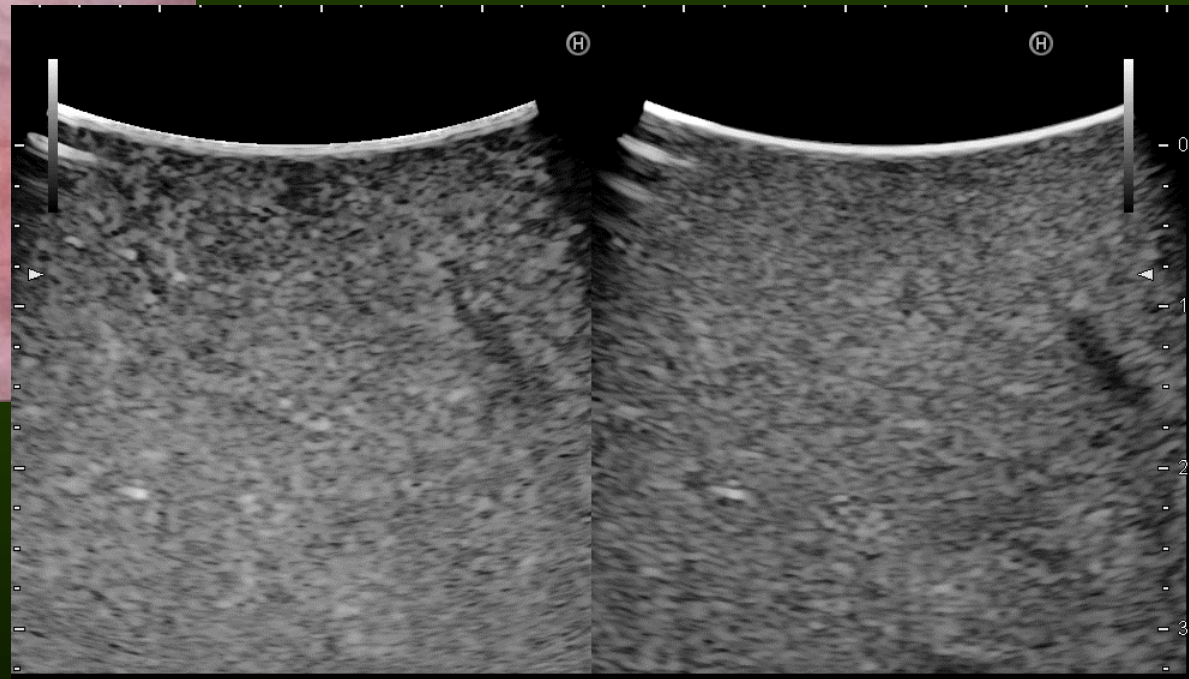
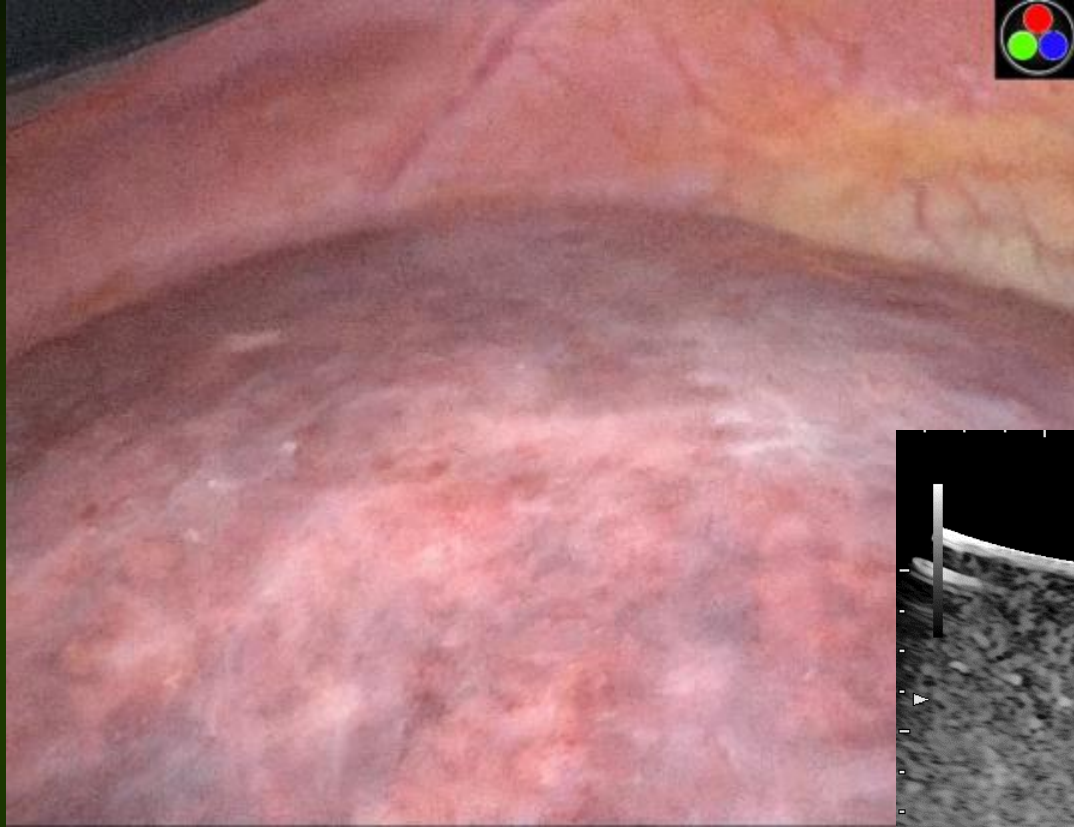
Intraoperative examination

- Fluorescent images of liver surfaces and resected specimens were obtained using fluorescence imaging system

Limitations liver cancer imaging

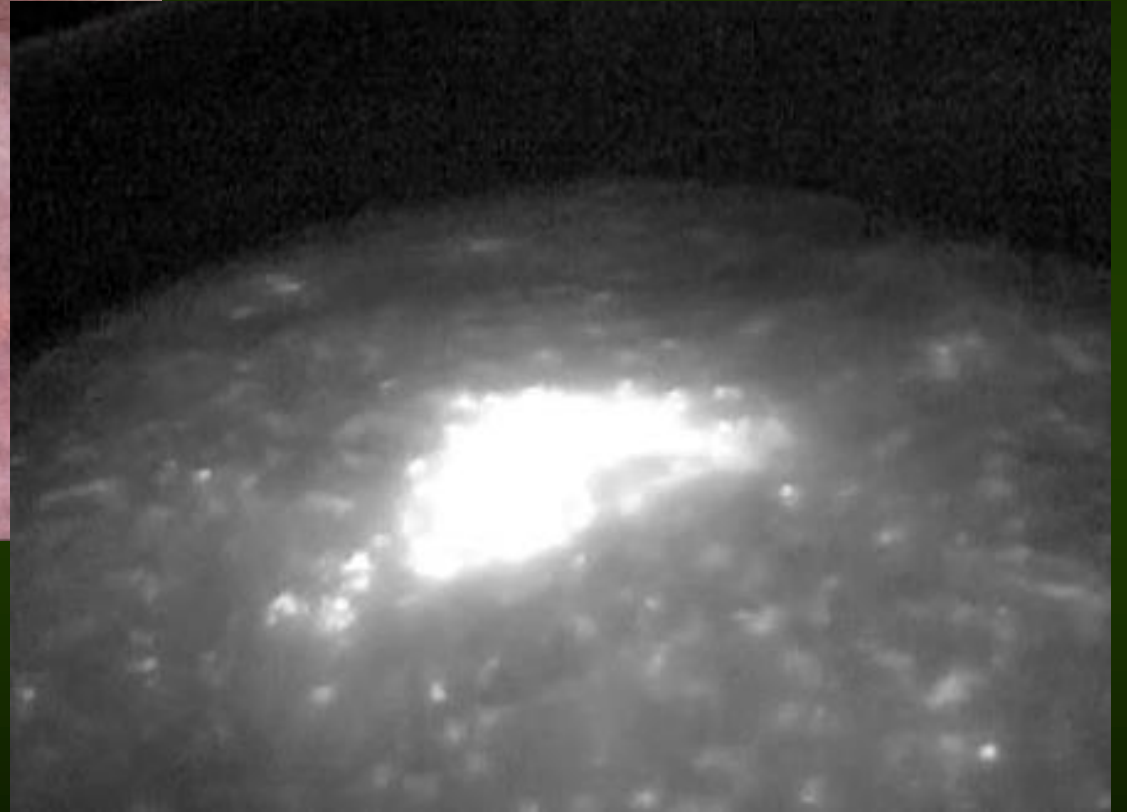
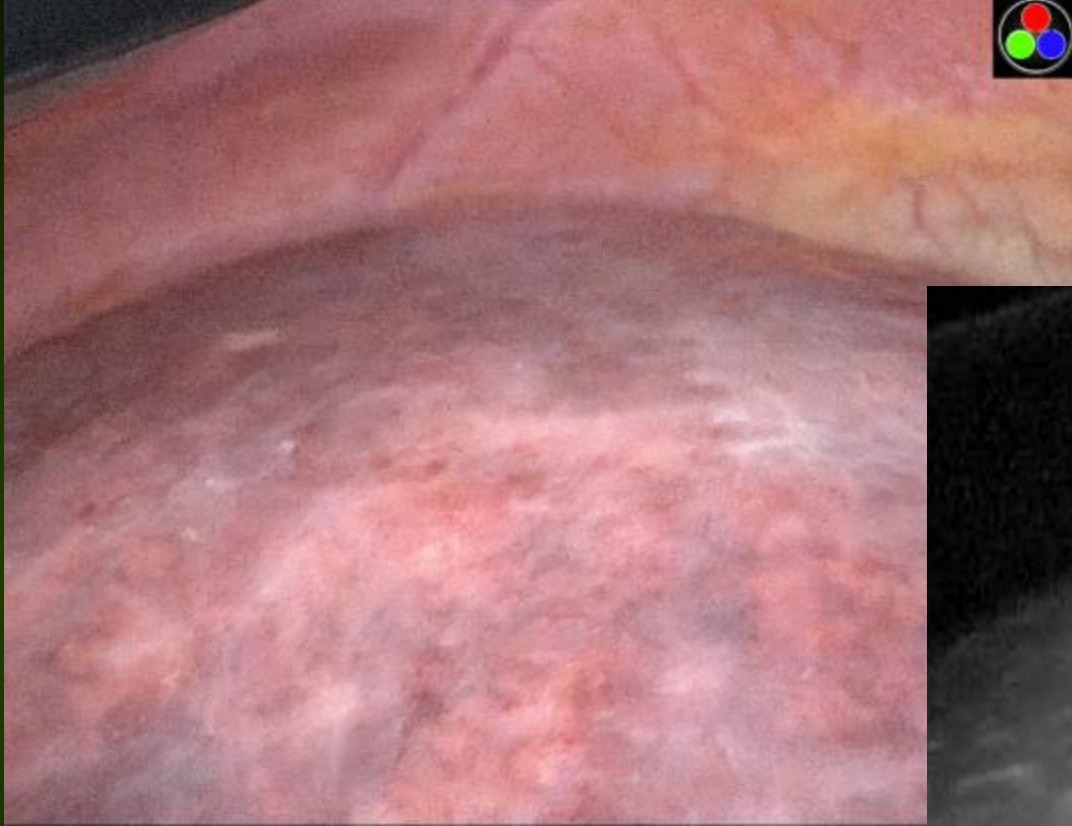
- False positive rate (- 40%)
- Tissue permeability (< 8 mm)

Fusion ICG-fluorescence imaging



*Keller D, Chand M, Ishizawa T, et al.
Lancet Gastroenterology & Hepatology (in press)*

Fusion ICG-fluorescence imaging



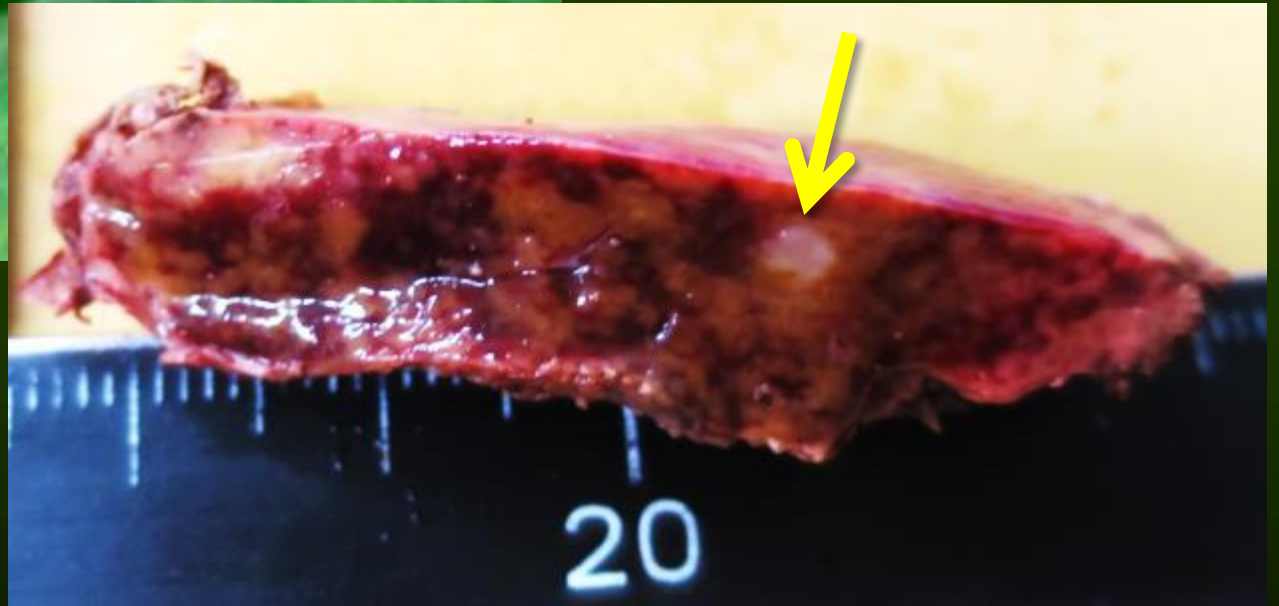
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Fusion ICG-fluorescence imaging



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Fusion ICG-fluorescence imaging

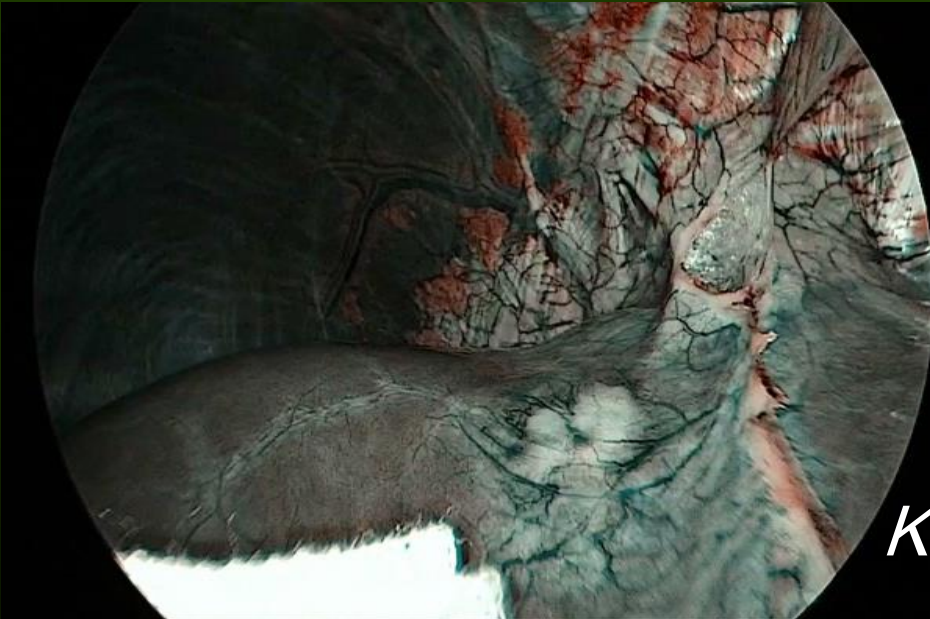
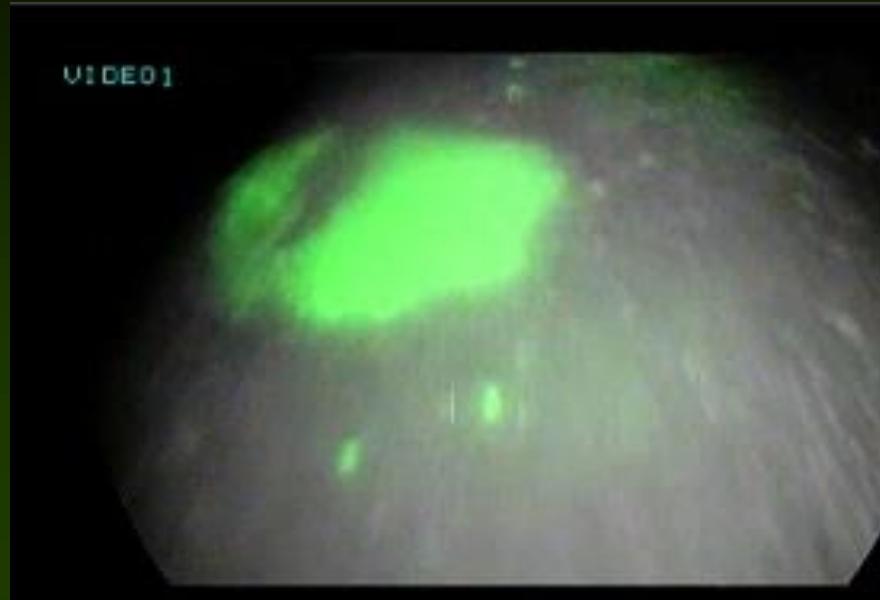


*Keller D, Chand M, Ishizawa T, et al.
Lancet Gastroenterology & Hepatology (in press)*

Fusion ICG-fluorescence imaging (n=52)

- 44 tumors (85%) were identified on the liver surfaces prior to hepatectomy
 - (23) -- identifiable by both FI and white-light color imaging
 - (21) -- grossly unidentifiable, visualized by FI
 - (4) -- undetectable by IOUS

Development of imaging systems

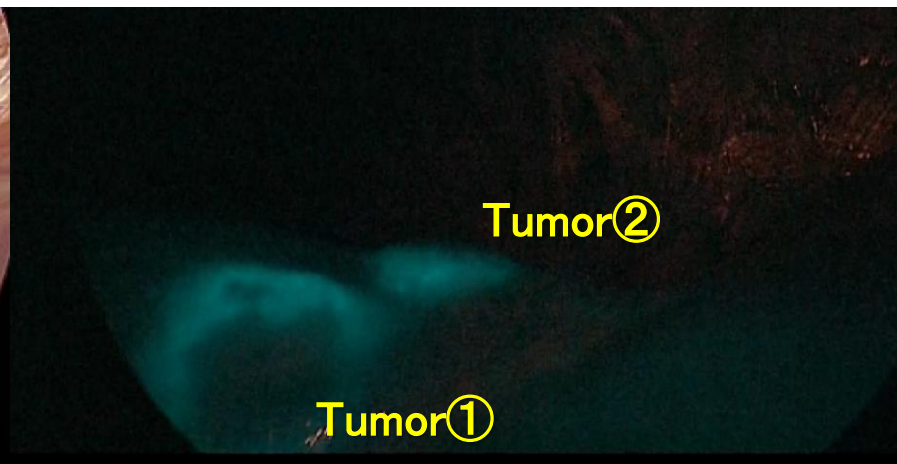
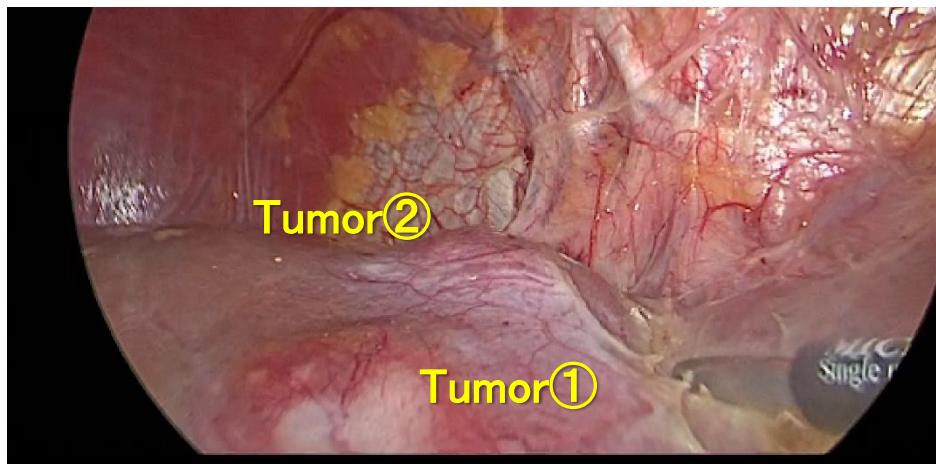
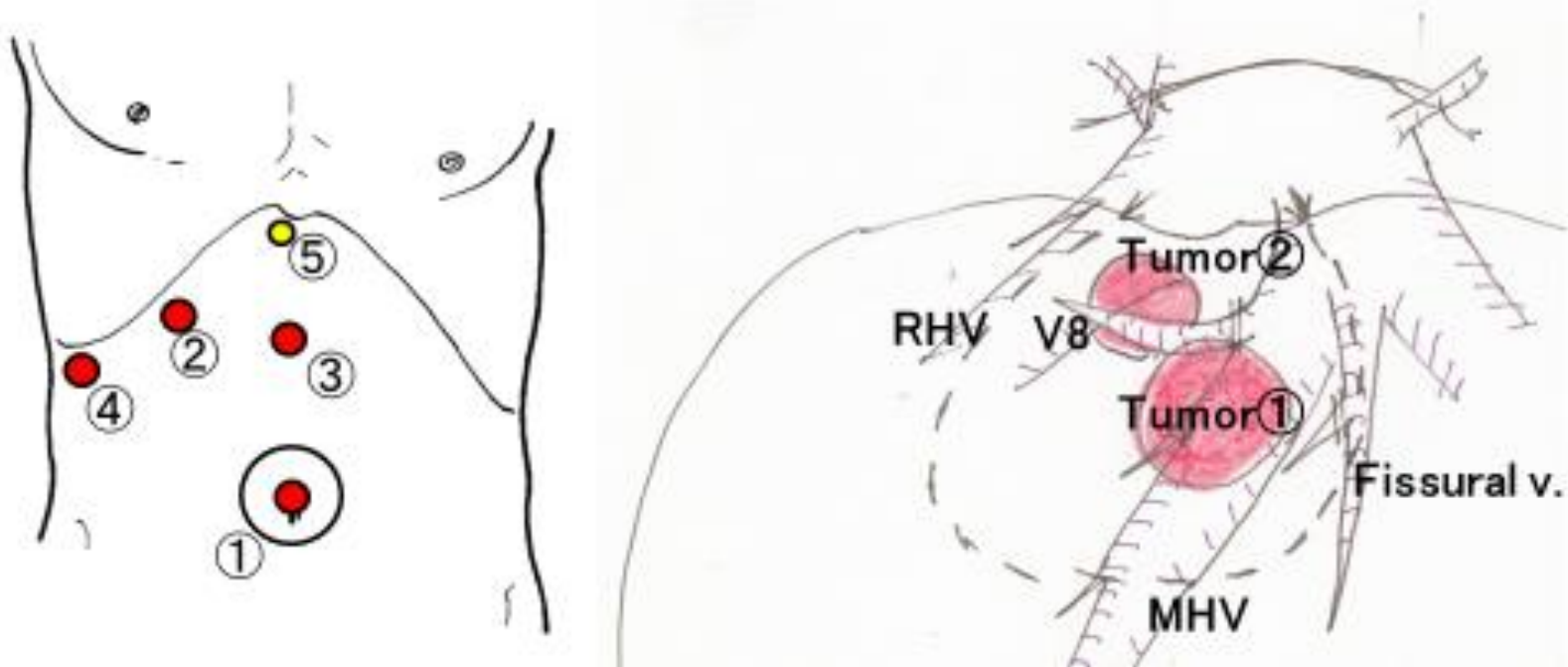


*Kudo H, Ishizawa T. Surg Endosc 2014
Kono Y, Ishizawa T. Medecine 2015*

A photograph of a garden filled with various shades of purple iris flowers. The flowers are in full bloom, showing intricate petal patterns and yellow centers. They are surrounded by long, green, sword-shaped leaves. A semi-transparent dark grey banner is positioned across the top of the image, containing white text.

Wedge S4/8 resection for CRLMs

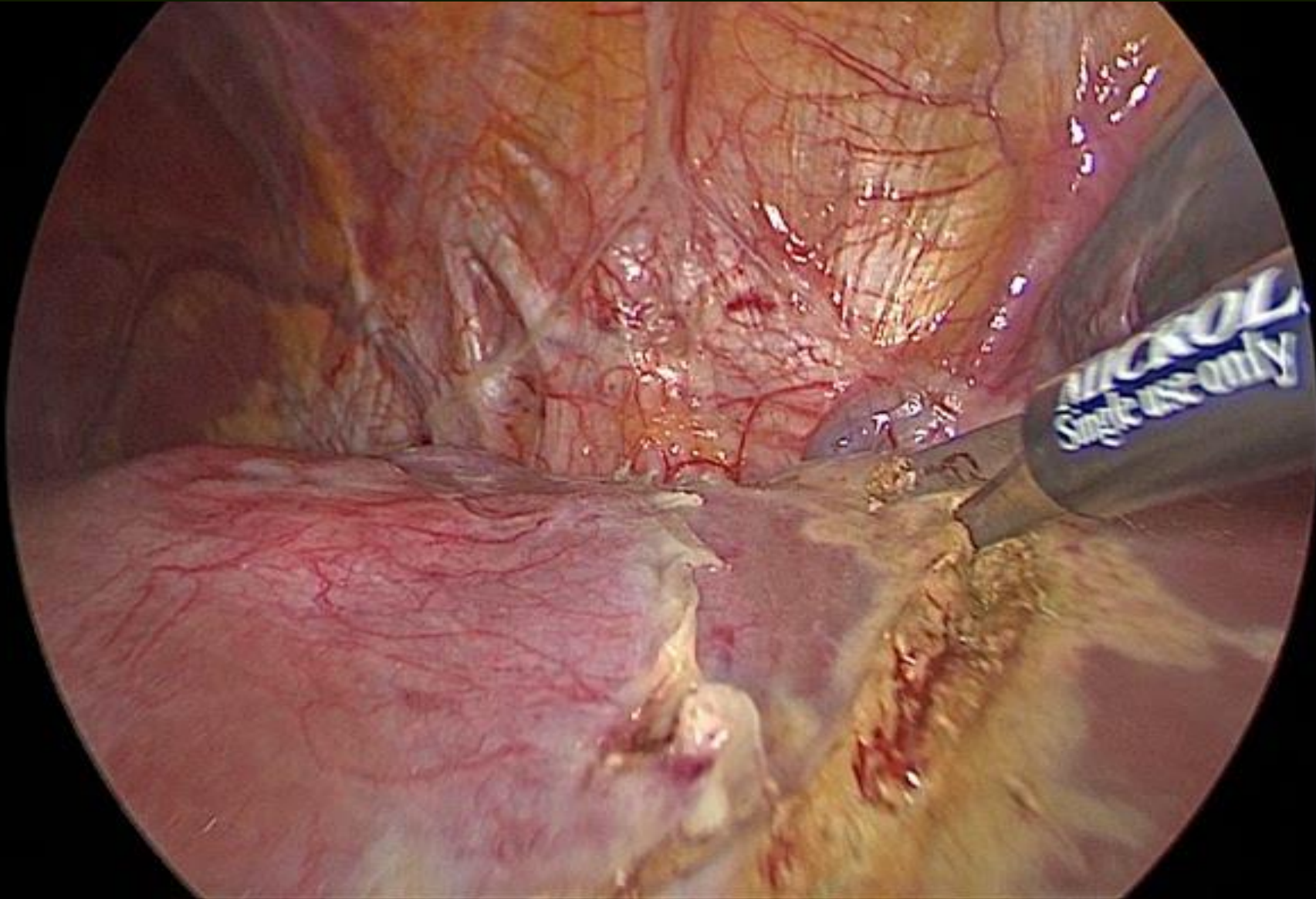
Lap-H (wedge resection of S4/8 for CRLMs)



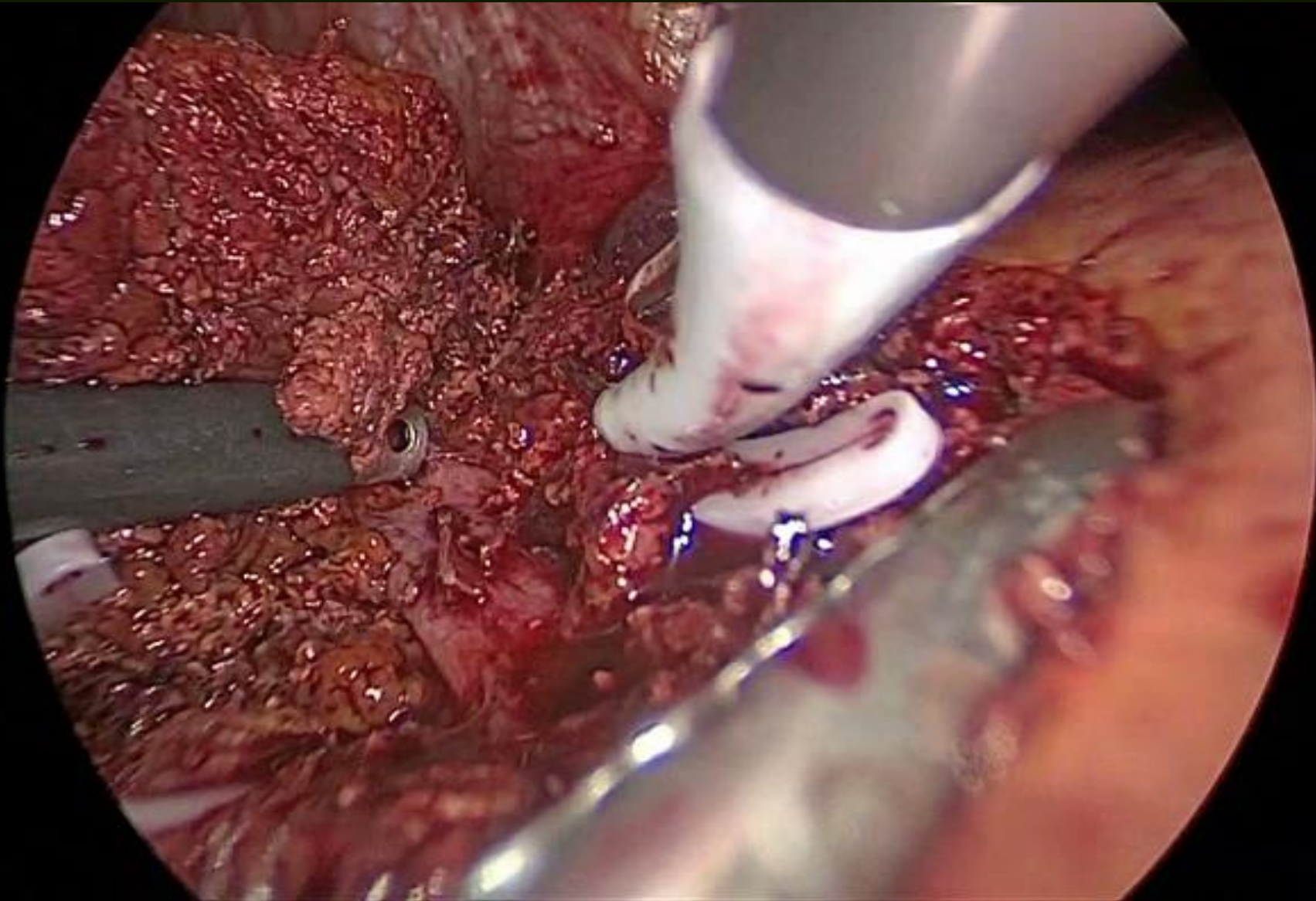
Lap-H for CRLMs in S4/8



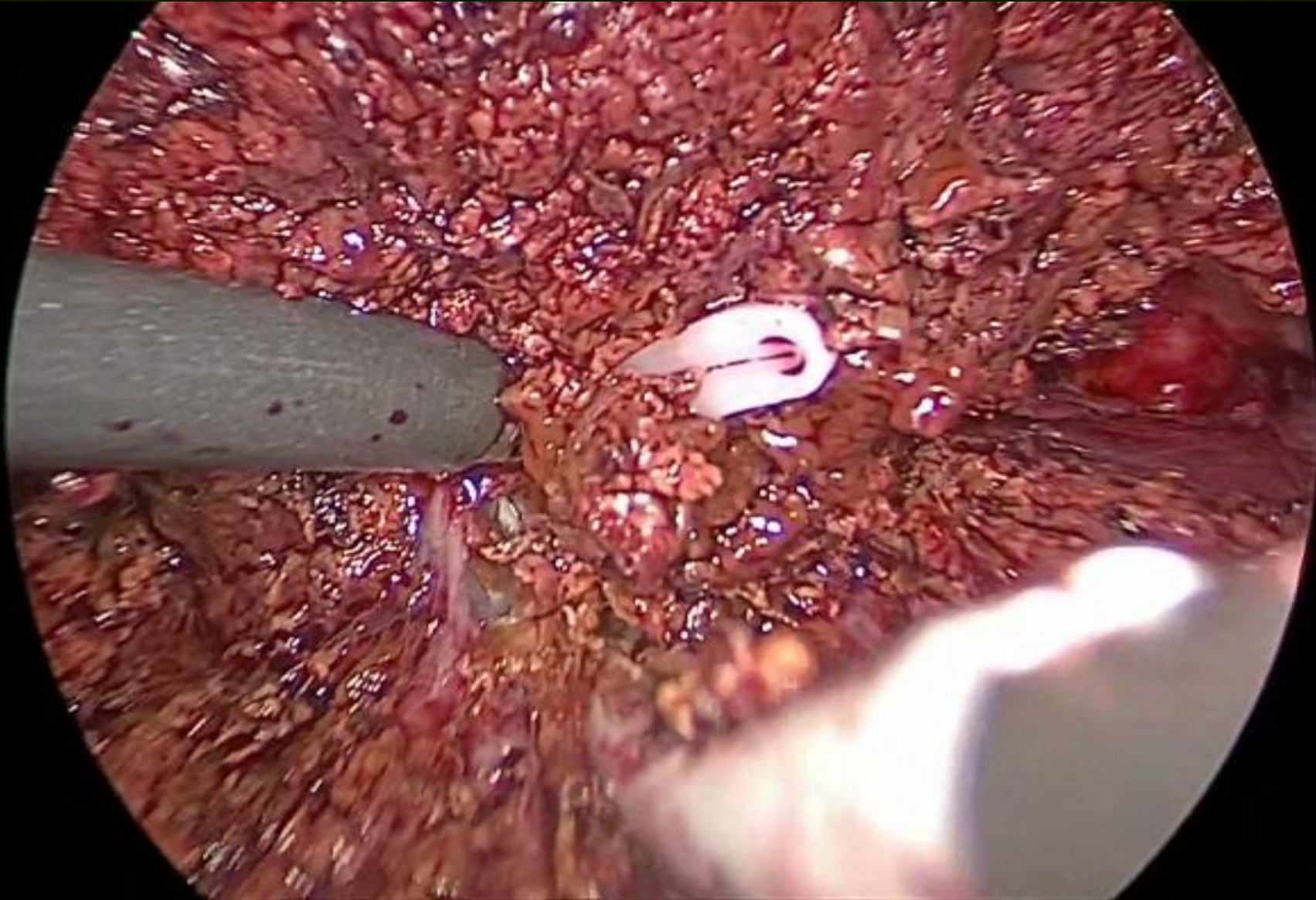
Lap-H for CRLMs in S4/8



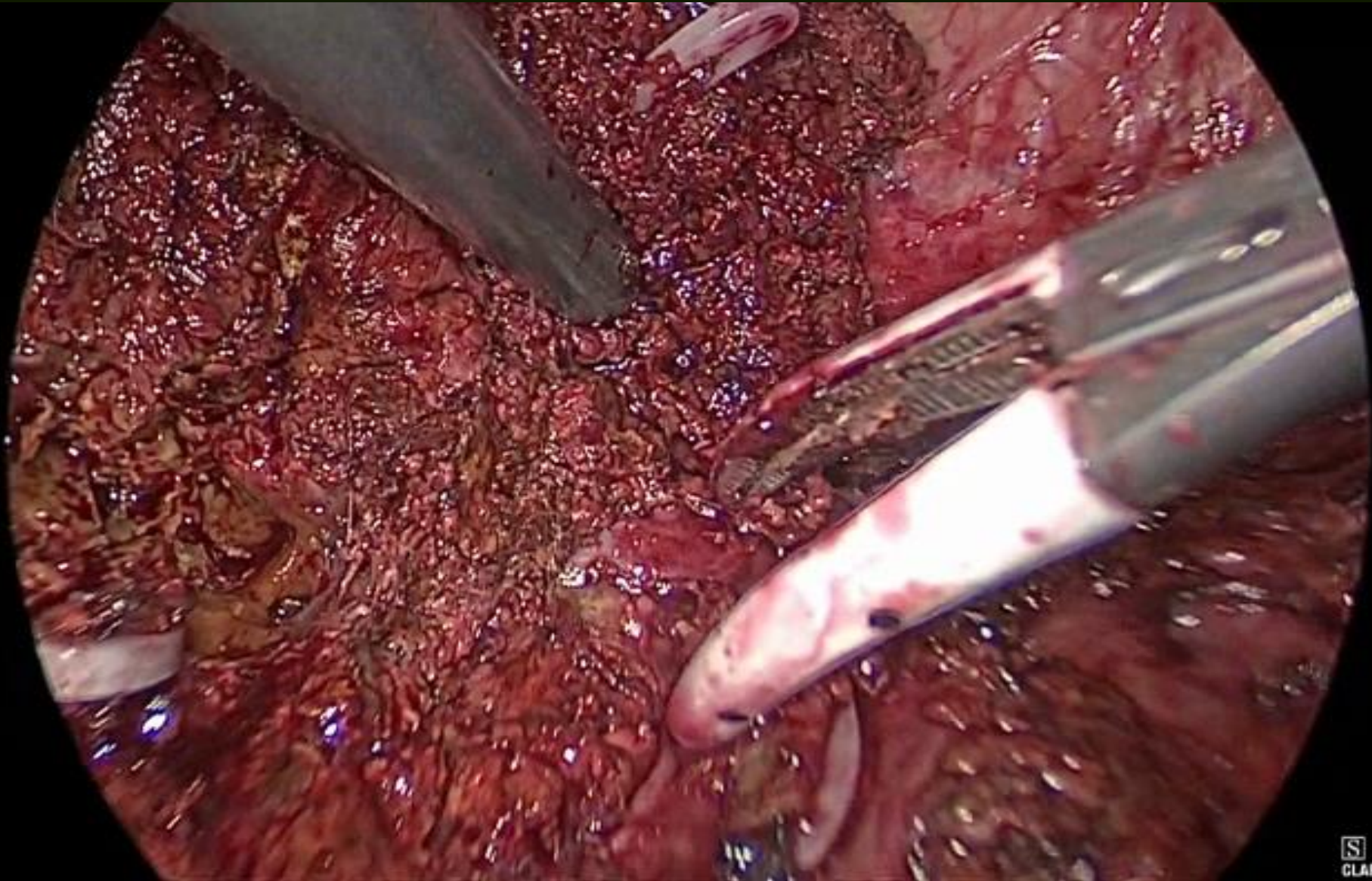
Lap-H (wedge resection of S4/8 for CRLMs)



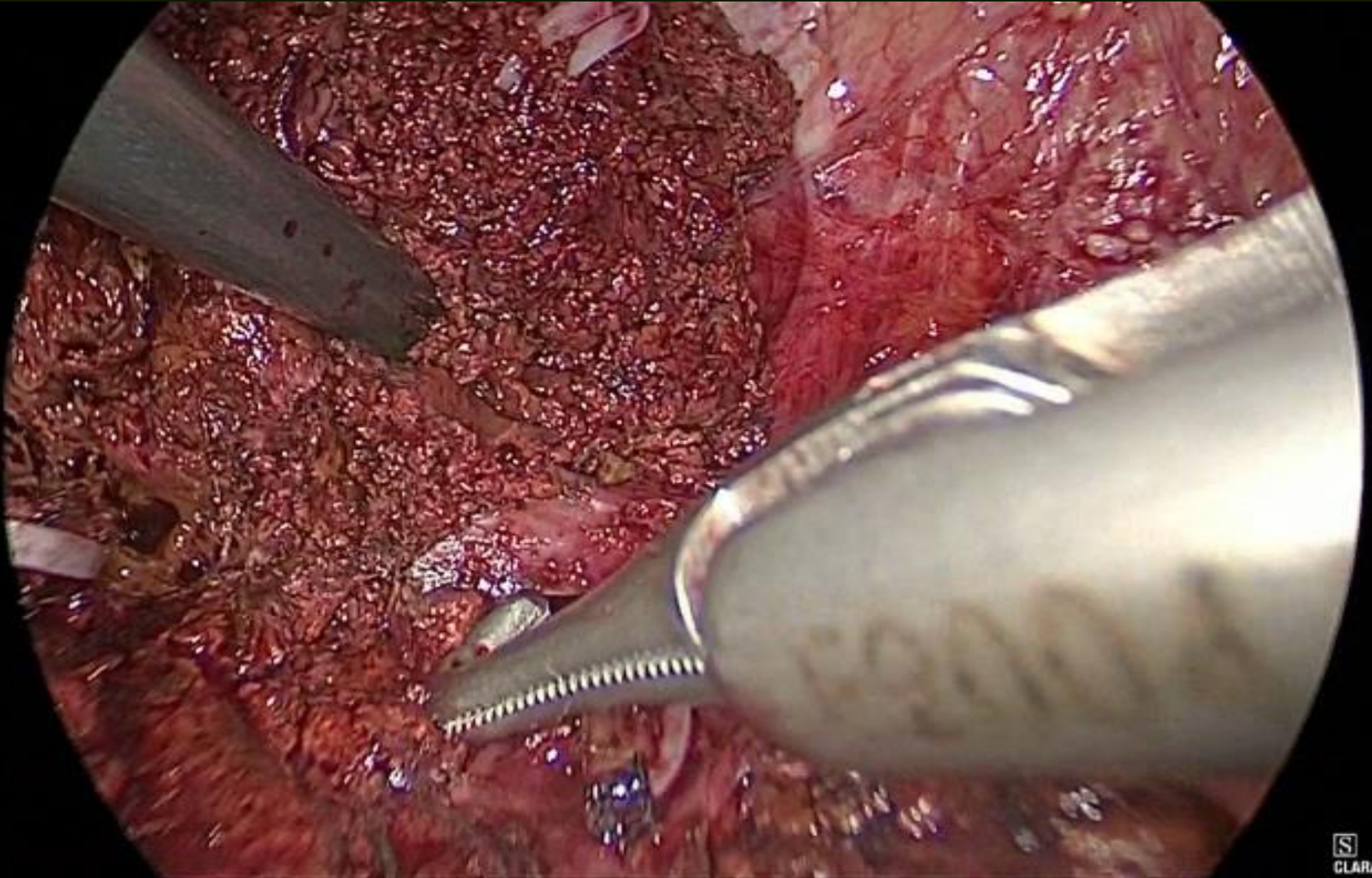
Lap-H (wedge resection of S4/8 for CRLMs)



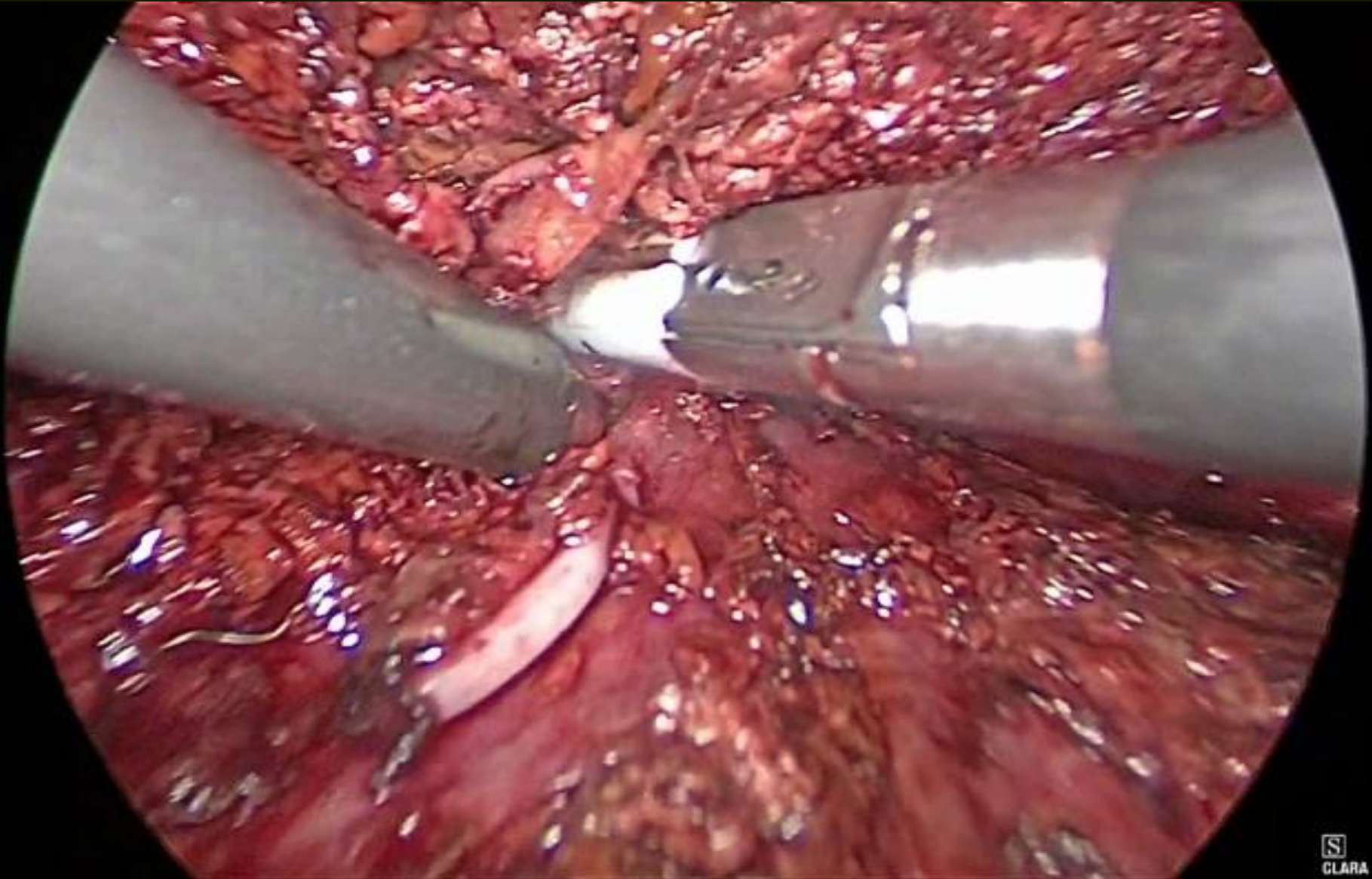
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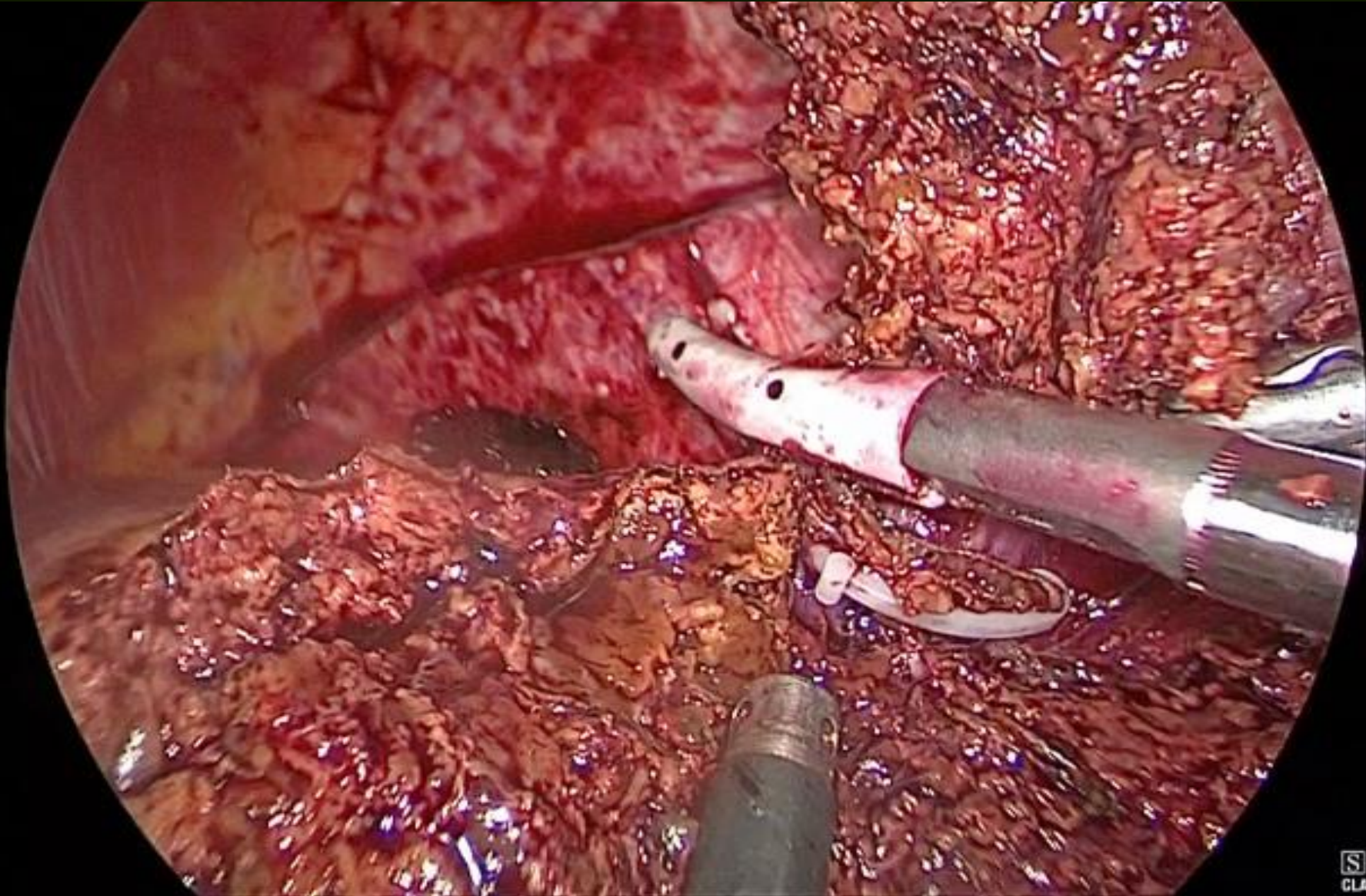
Lap-H (wedge resection of S4/8 for CRLMs)



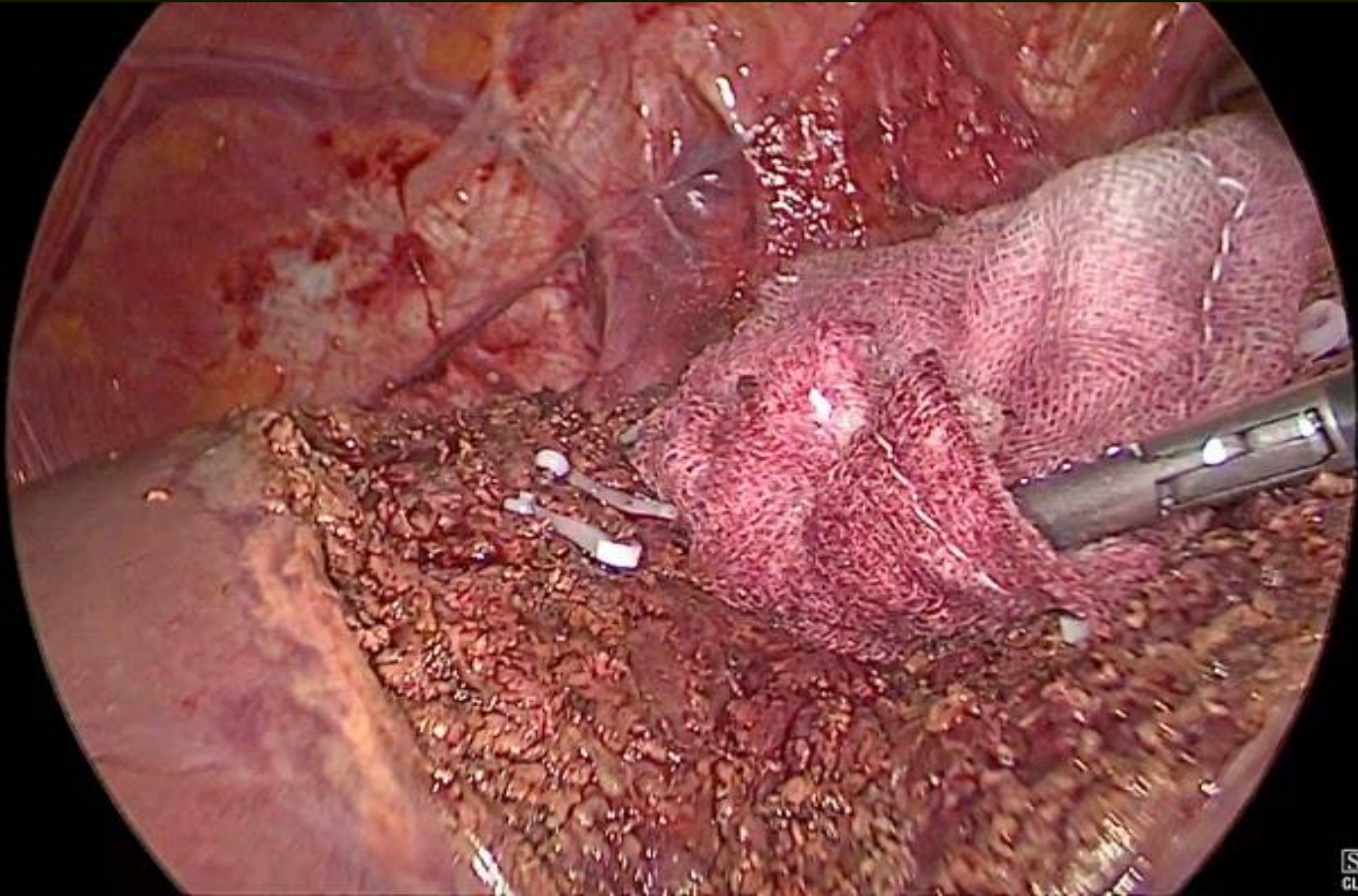
Lap-H (wedge resection of S4/8 for CRLMs)



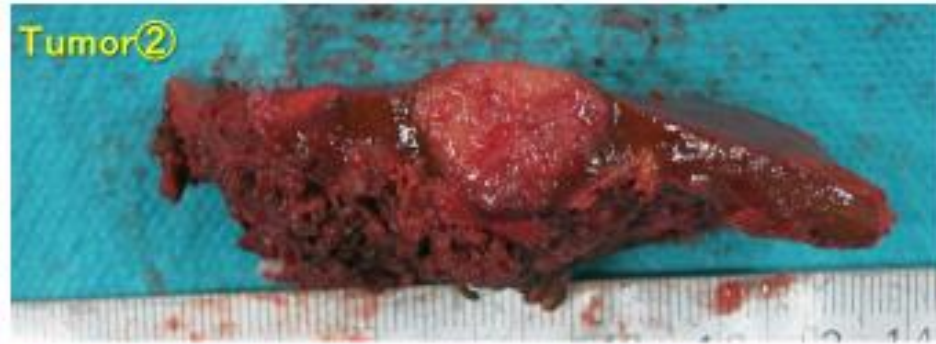
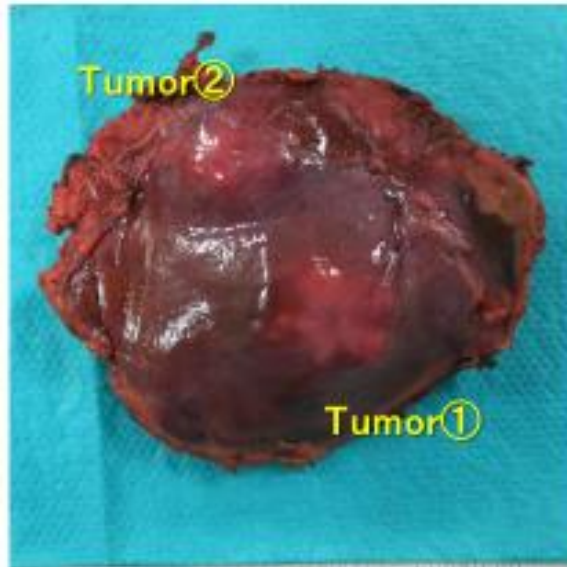
Lap-H (wedge resection of S4/8 for CRLMs)



Lap-H (wedge resection of S4/8 for CRLMs)



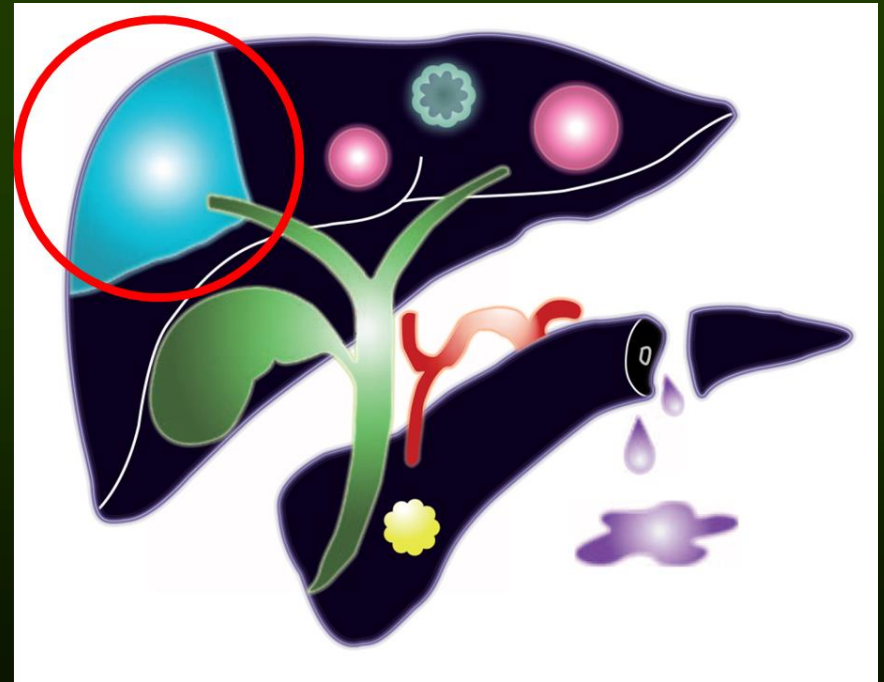
Lap-H (wedge resection of S4/8 for CRLMs)



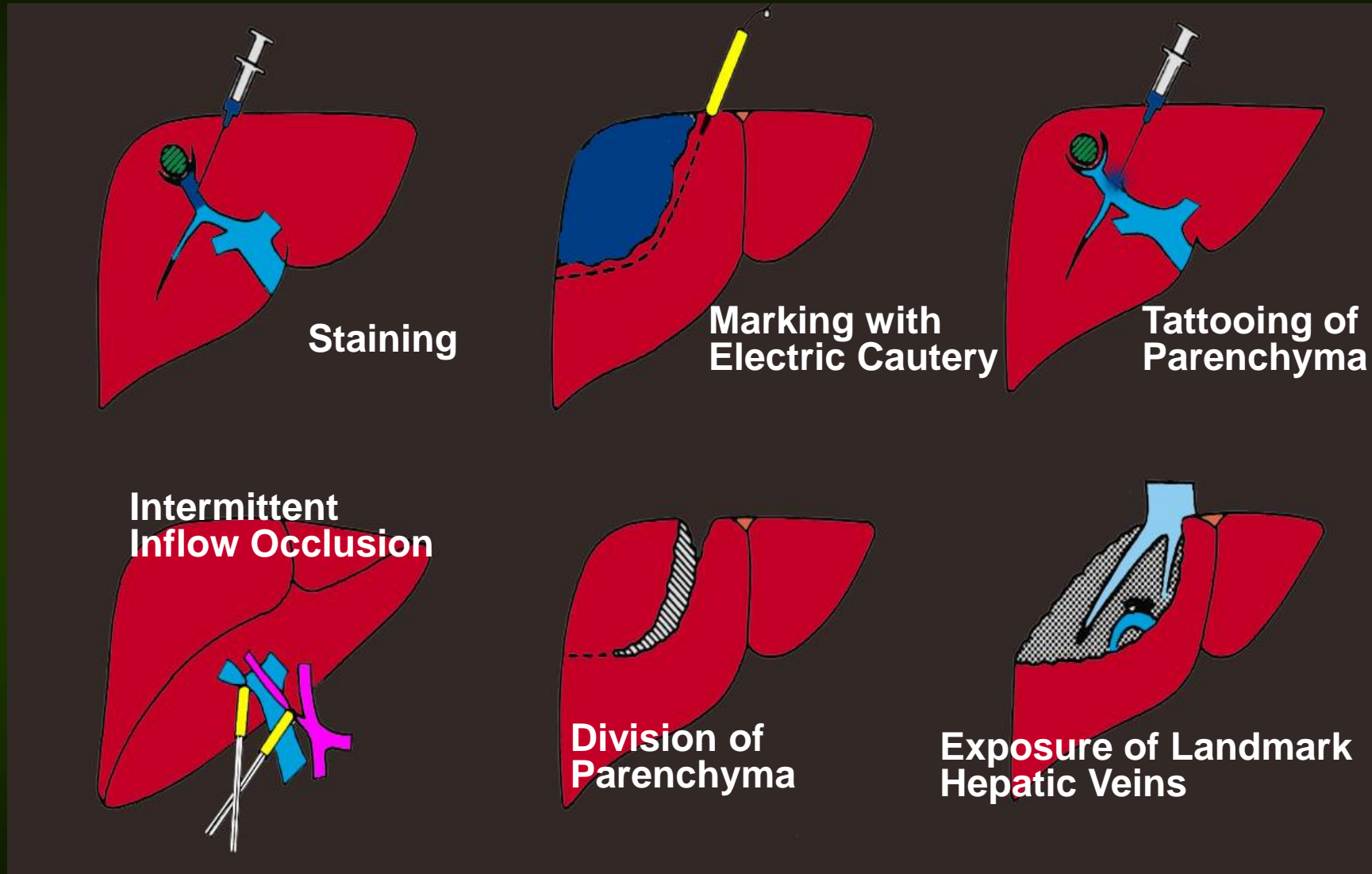
Op. time: 7h 20 min (Lap-LAR+Hx)
Op. time: 4h 12 min (Lap-Hx)
Blood loss: 10 mL

Current applications of Intraoperative ICG-fluorescence imaging in HPB surgery

- 1) Fluorescence cholangiography
- 2) Identification of hepatic malignancies
- 3) Identification of hepatic segments

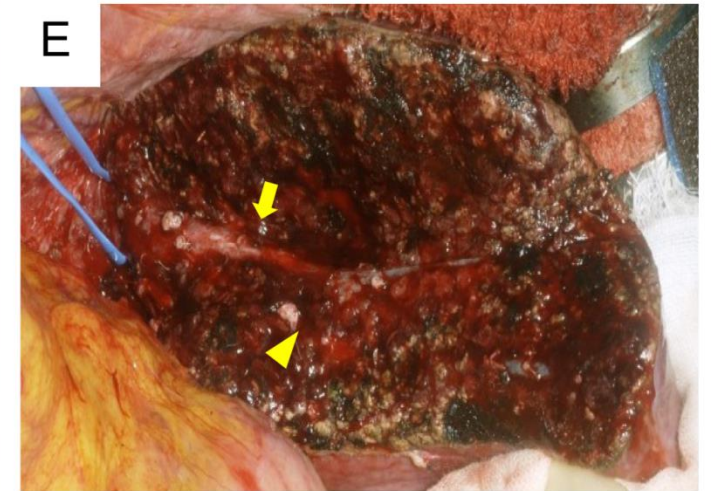
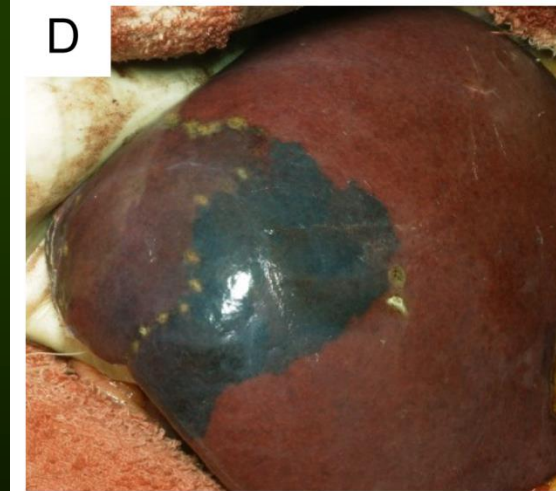
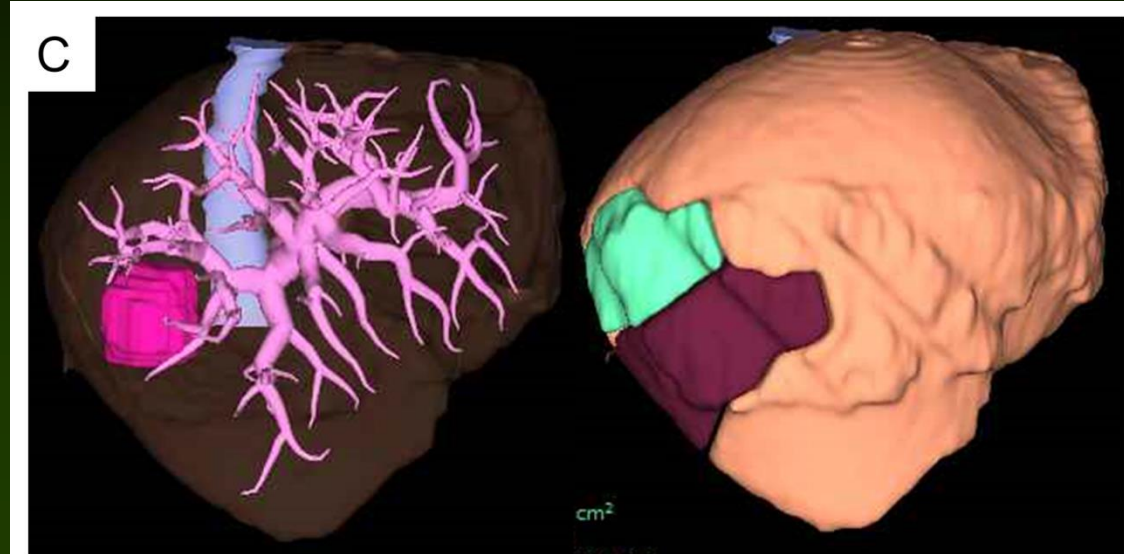


Identification of hepatic segments (conventional)



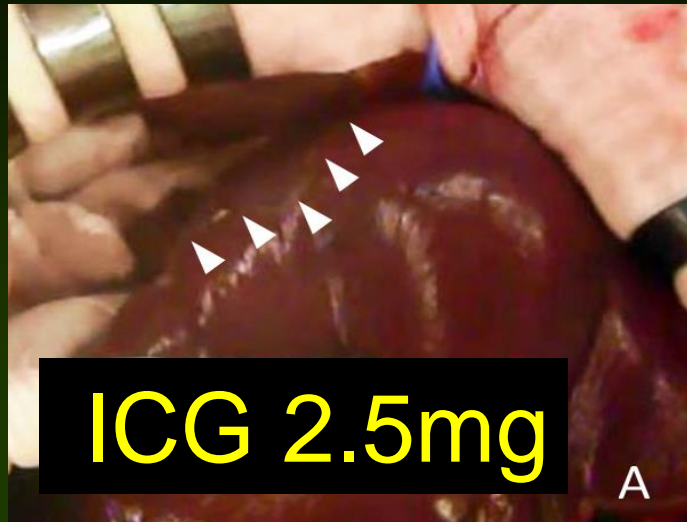
Makuuchi M. Surg Gynecol Obstet 1985

Identification of hepatic segments (conventional)

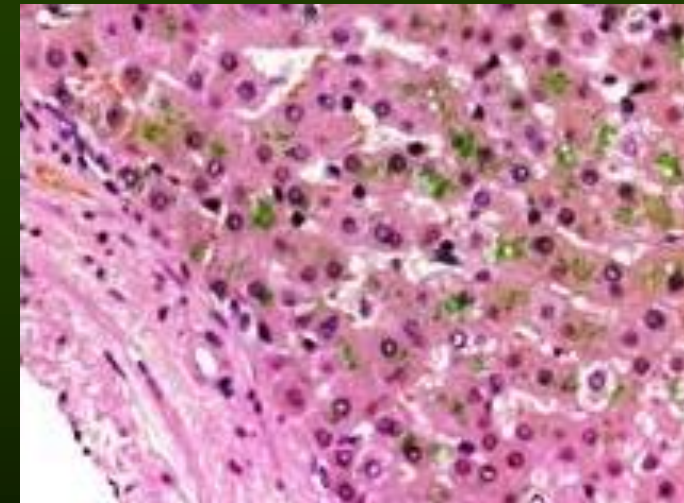
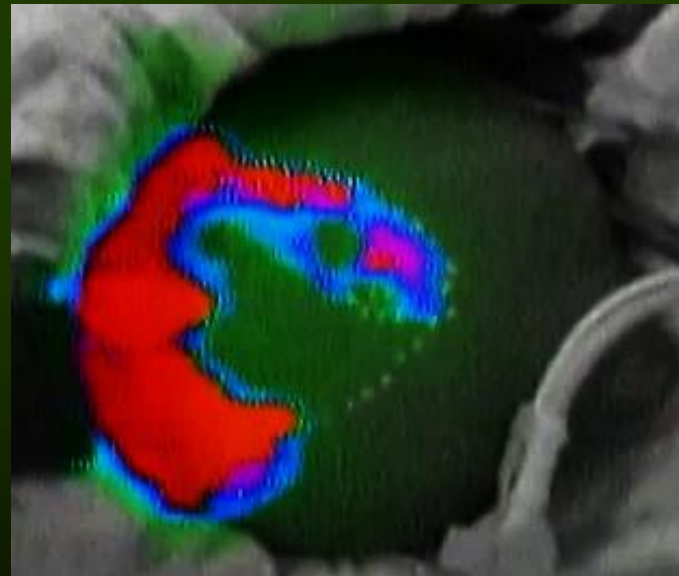
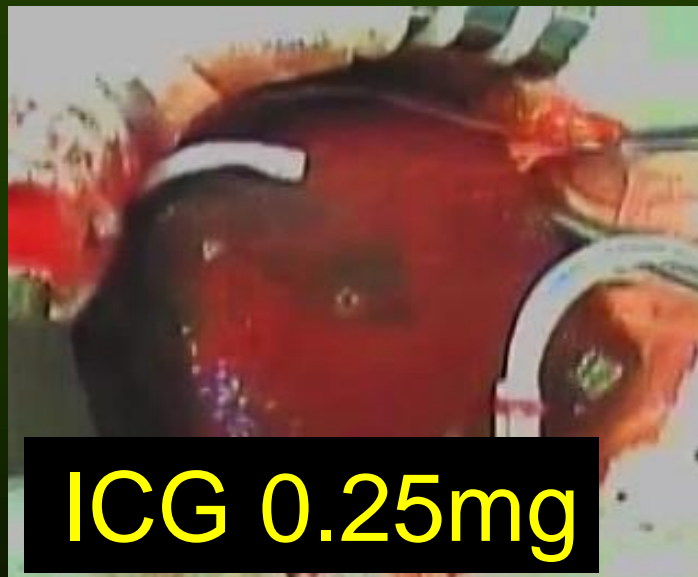


Lim C, Ishizawa T. Ann Surg 2015

Identification of hepatic segments (ICG, PV)



Inoue Y, Saiura A. Ann Surg 2015

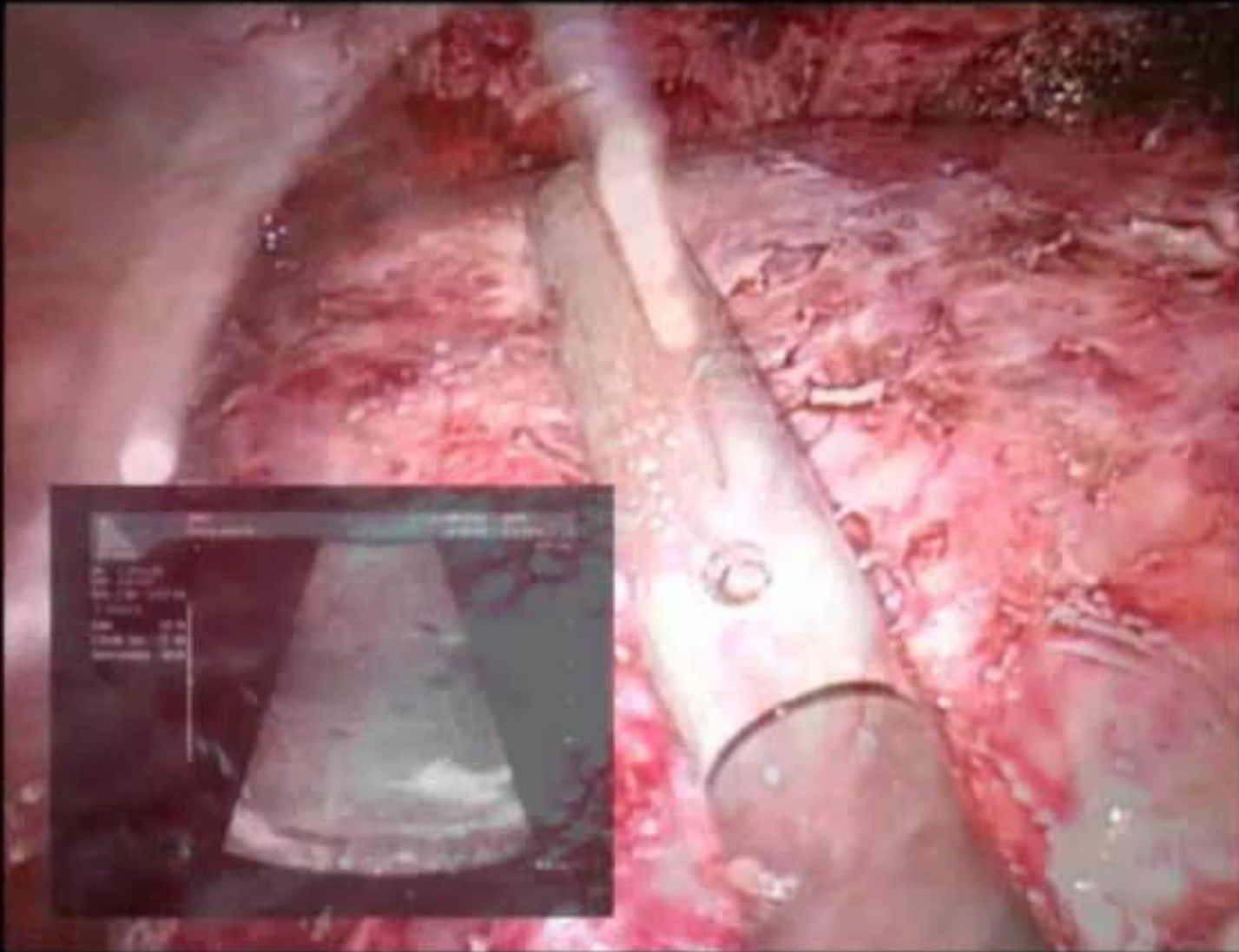


Miyata A, Ishizawa T. JACS 2015



@Institut Mutualiste Montsouris, 2011

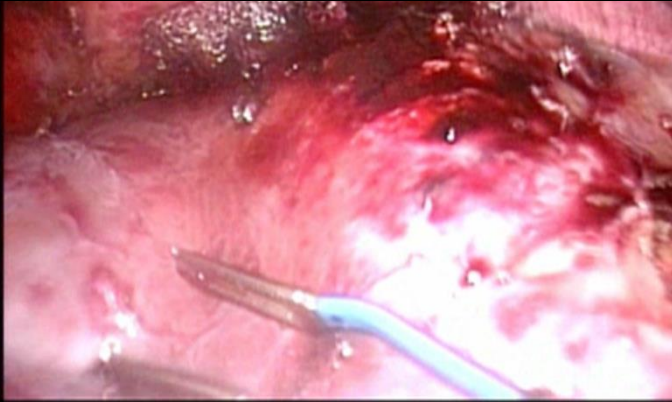
Identification of hepatic segments (Lap)



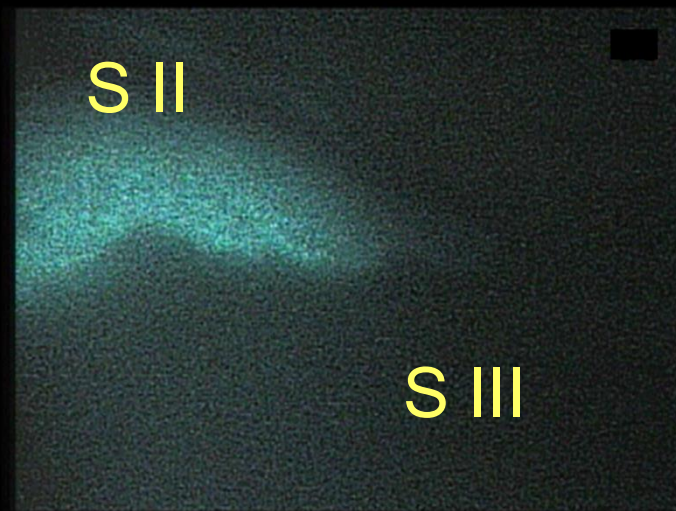
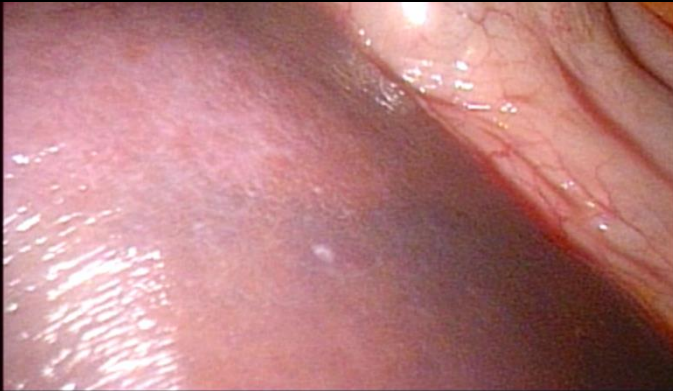
Ishizawa T, Gayet B. Arch Surg 2012

Identification of hepatic segments (Lap)

Positive staining



Negative staining



A photograph of several potted plants. In the foreground, there are two large, vibrant pink hydrangea flower heads. To their right is a pot containing a mix of green foliage, including some variegated ivy with yellow and white edges. The plants are set against a grey, textured wall. A semi-transparent dark grey banner with white text is overlaid across the middle of the image.

Anatomic S3 resection for HCC

Lap-H (resection of S3 for HCC)

2017/03/29 17:08:36

1

E6



Lap-H (resection of S3 for HCC)

2017/03/29 17:16:12

1

E6

IR

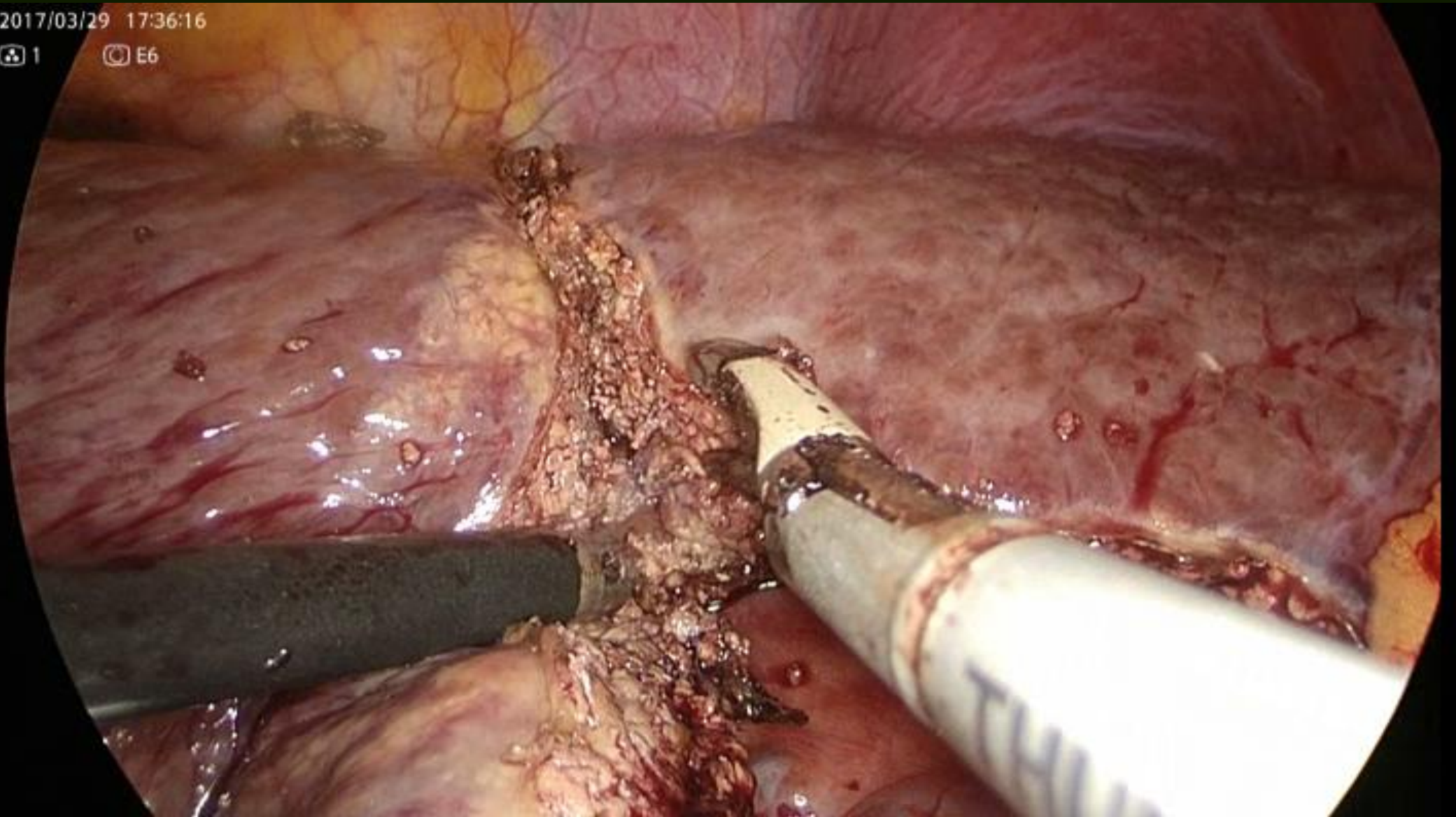


Lap-H (resection of S3 for HCC)

2017/03/29 17:36:16

1

E6



Lap-H (resection of S3 for HCC)

2017/03/29 17:38:20

1

E6

IR

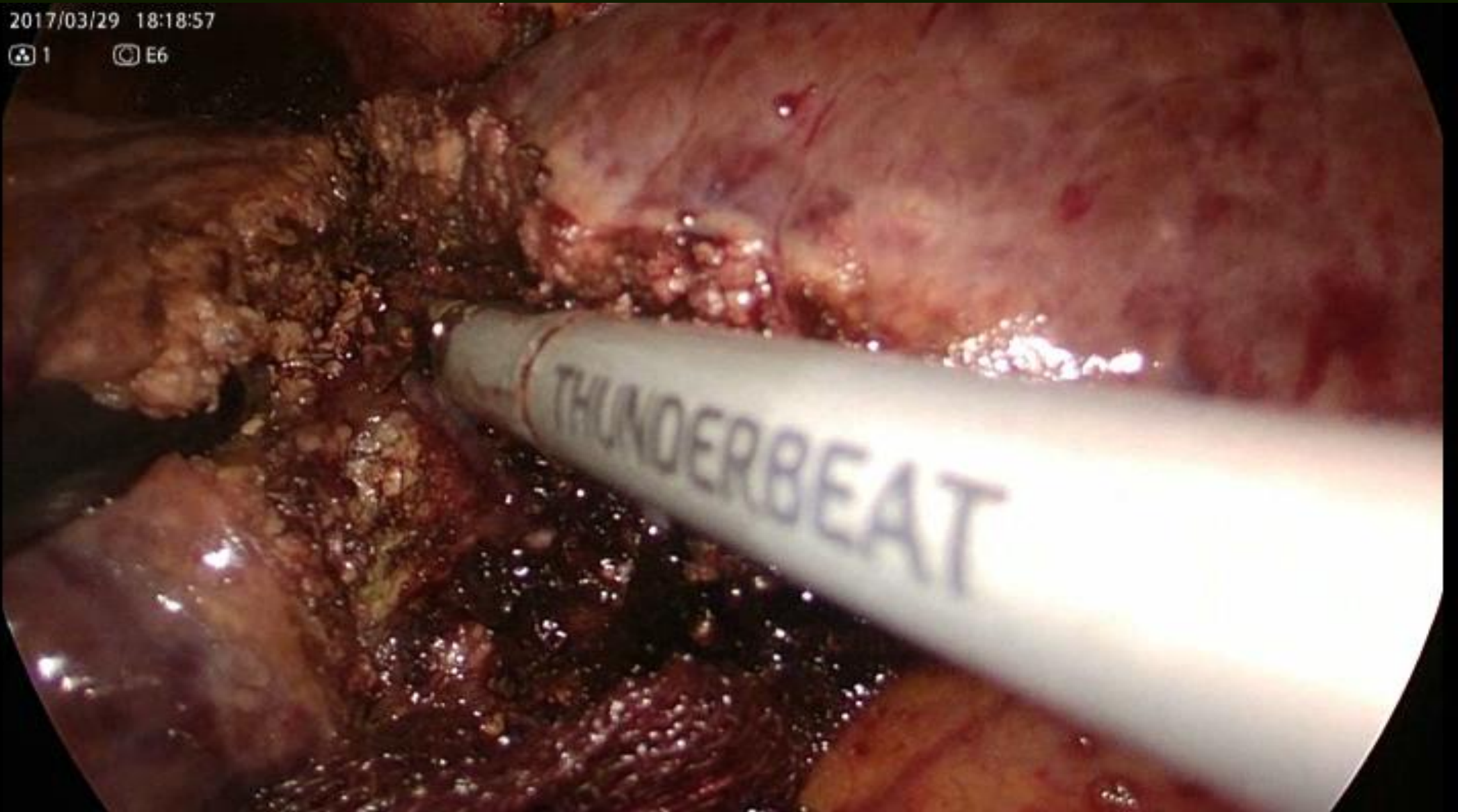


Lap-H (resection of S3 for HCC)

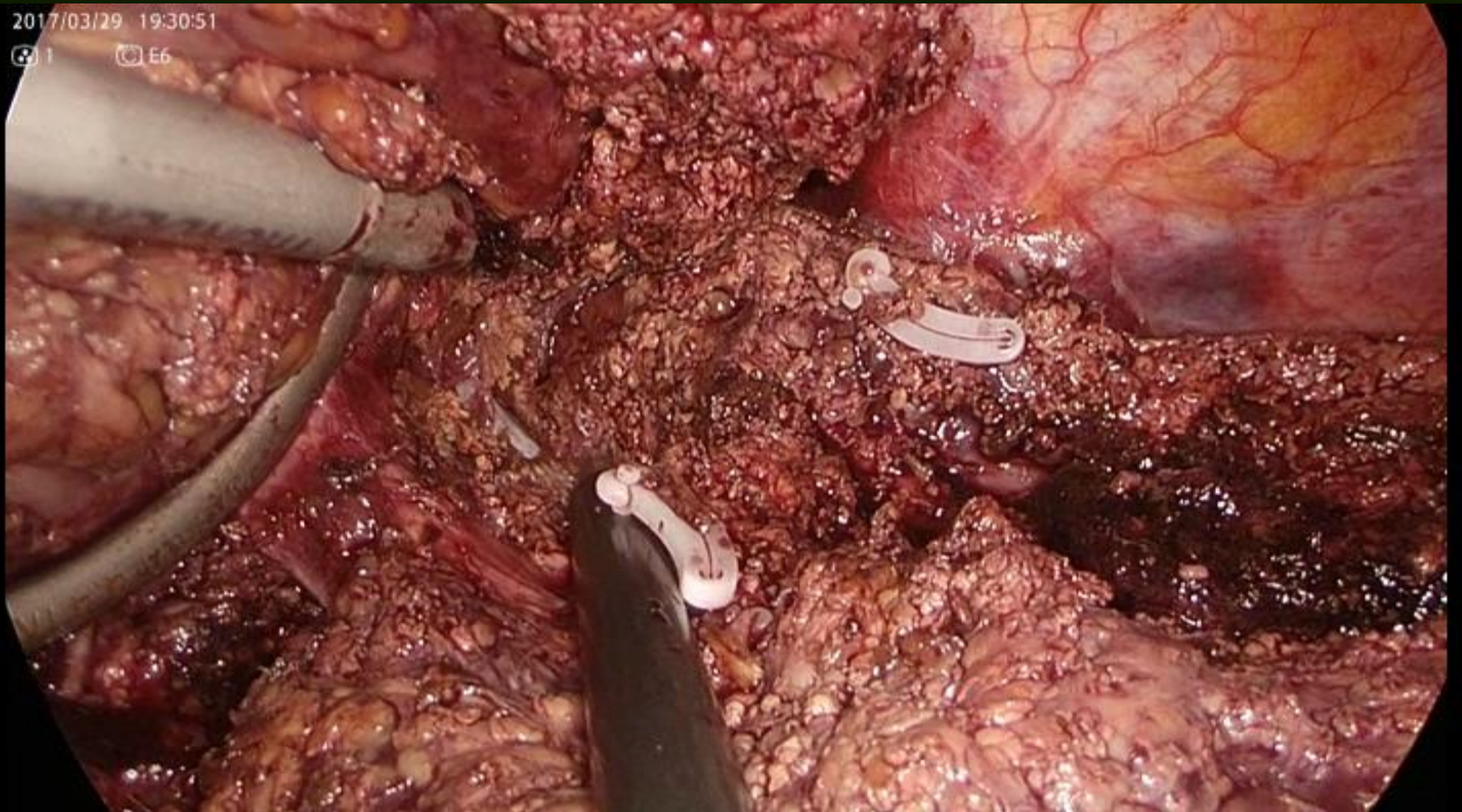
2017/03/29 18:18:57

1

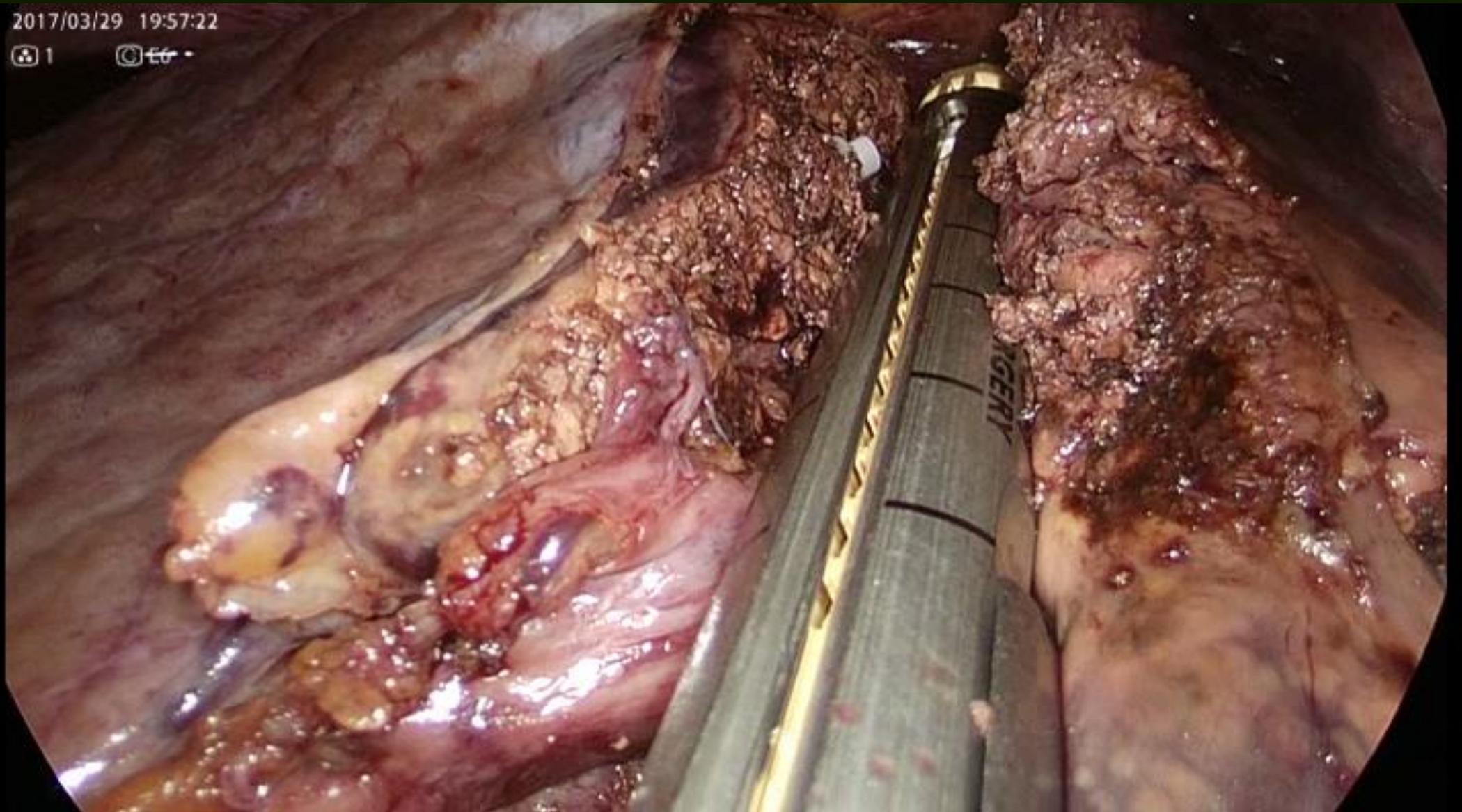
E6



Lap-H (resection of S3 for HCC)



Lap-H (resection of S3 for HCC)



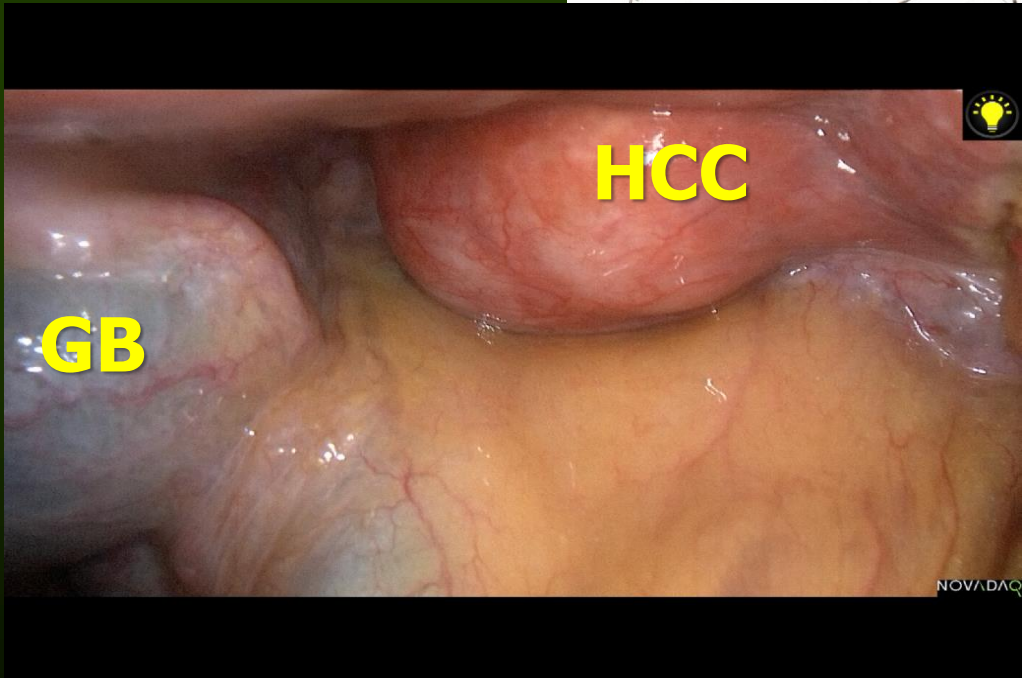
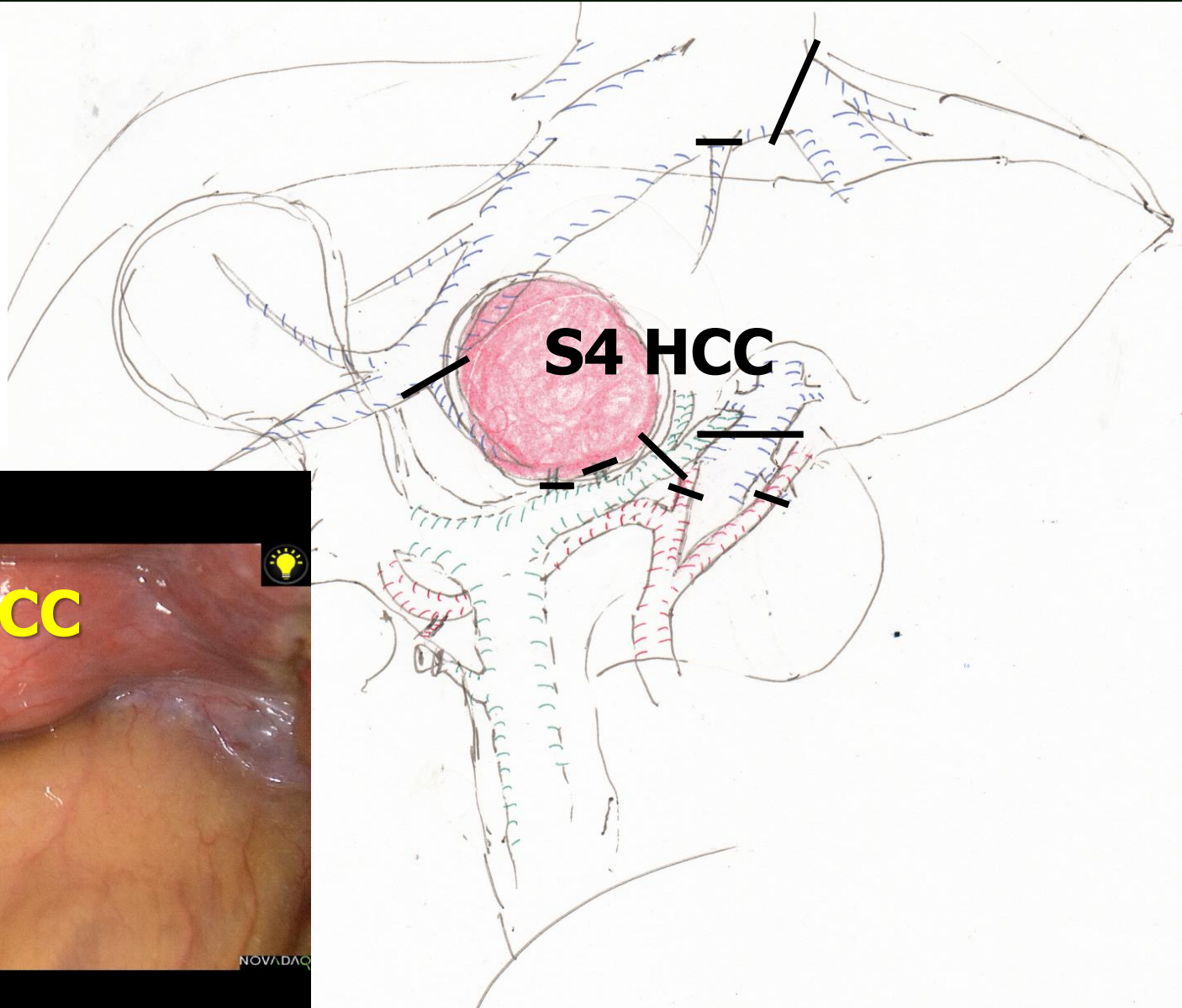
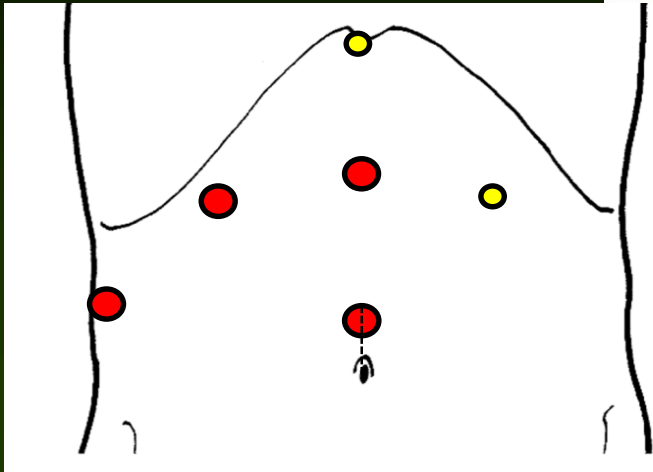


Op. time: 347 min
Blood loss: 330 mL

A photograph of a field of iris flowers. In the foreground and middle ground, there are several large, vibrant purple iris flowers with yellow centers. In the background, there are also white iris flowers with purple markings. The flowers are surrounded by long, green, sword-shaped leaves. A semi-transparent dark grey rectangular box is overlaid in the upper center of the image, containing white text.

Lap-left hepatectomy for HCC

Laparoscopic left hepatectomy for HCC



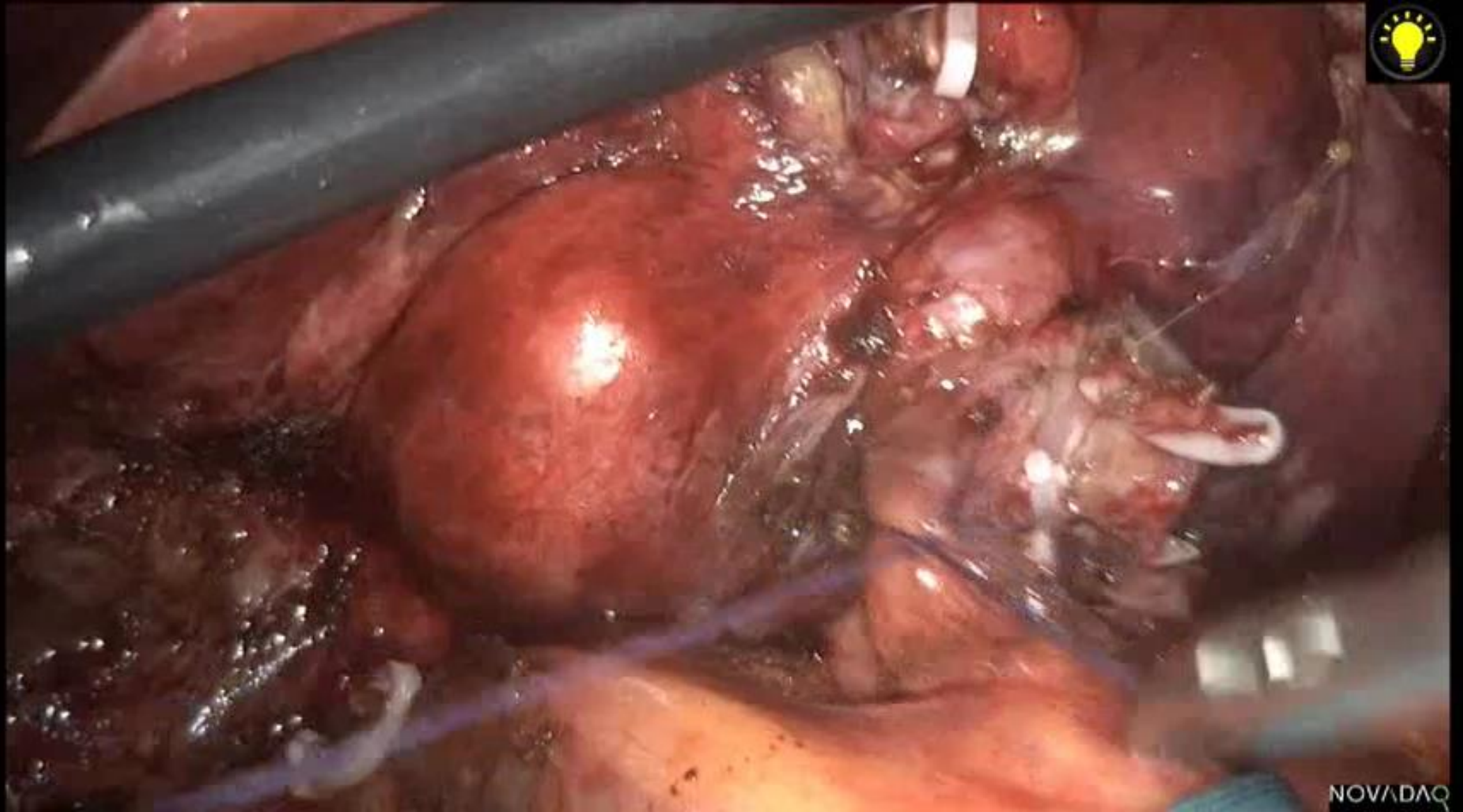
Laparoscopic left hepatectomy for HCC



Laparoscopic left hepatectomy for HCC



Laparoscopic left hepatectomy for HCC



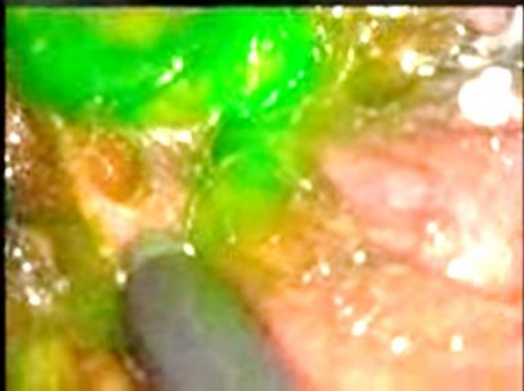
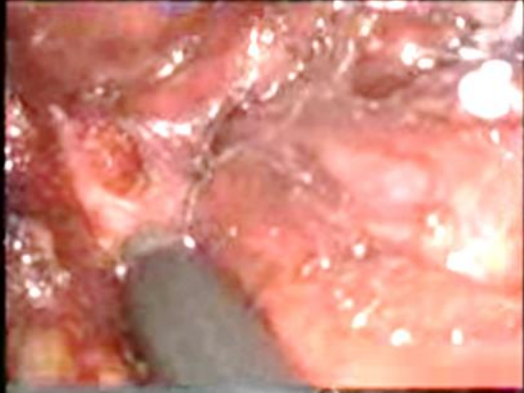
Laparoscopic left hepatectomy for HCC



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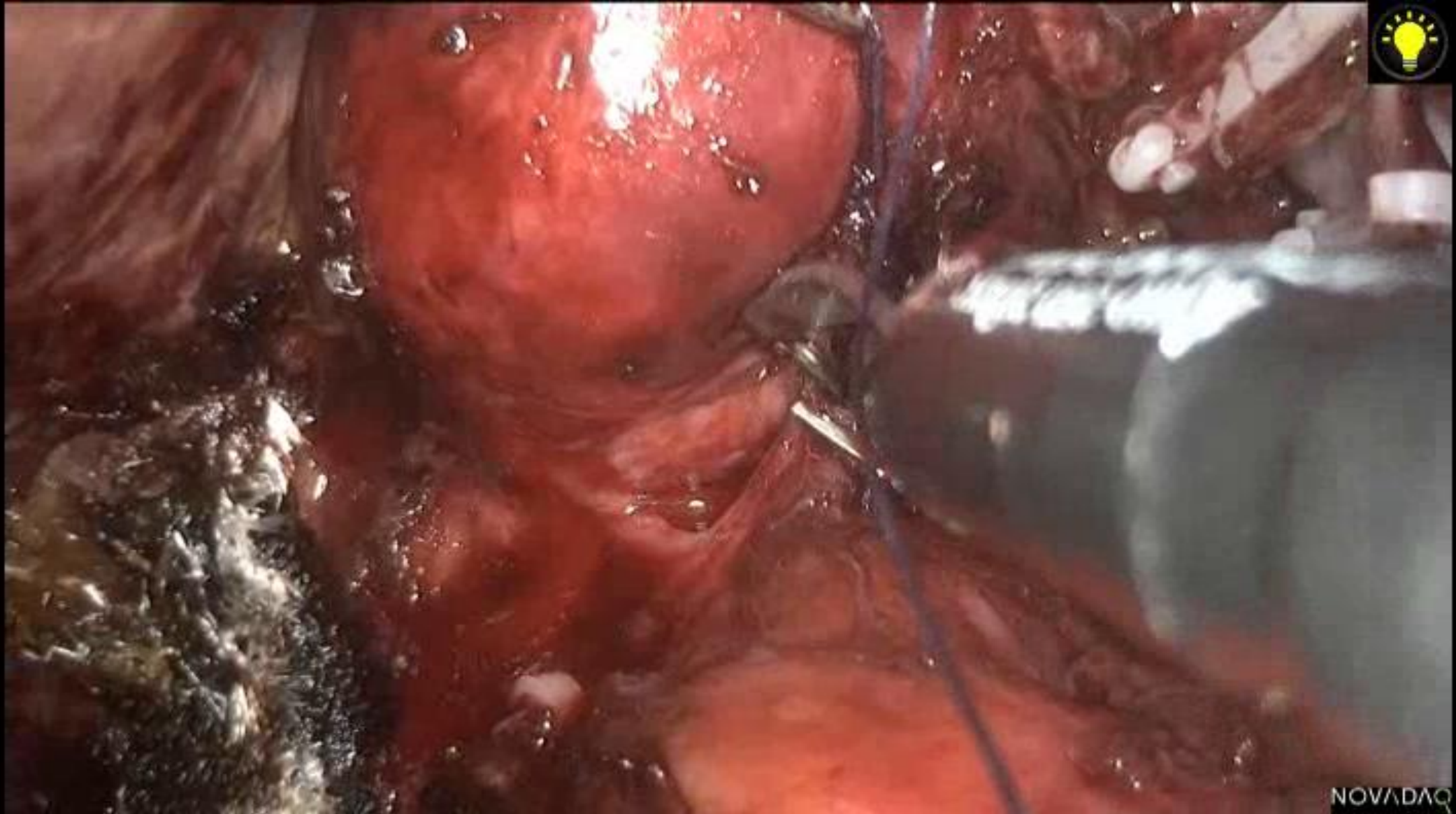


NOVA/DAQ

Laparoscopic left hepatectomy for HCC



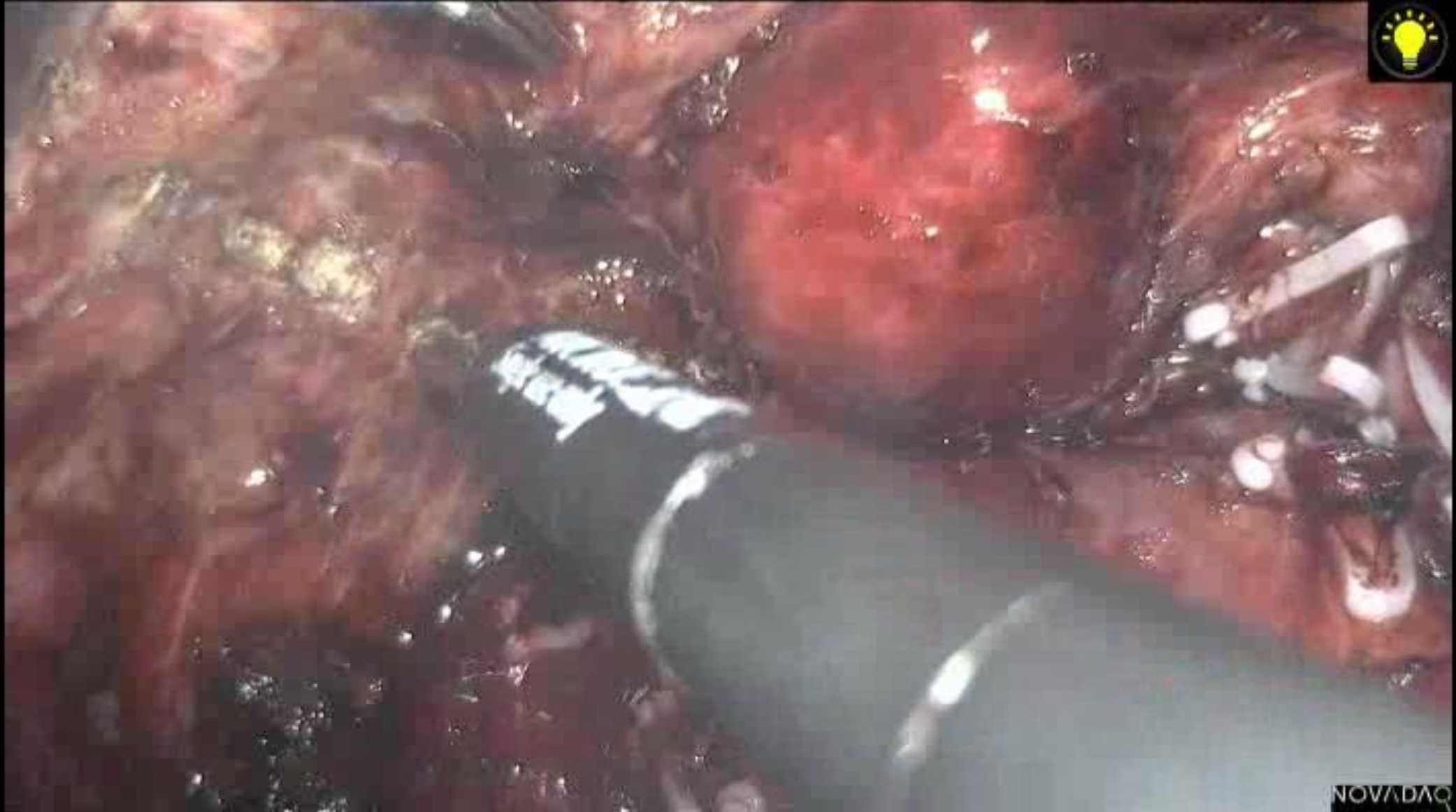
Laparoscopic left hepatectomy for HCC



Laparoscopic left hepatectomy for HCC



Laparoscopic left hepatectomy for HCC



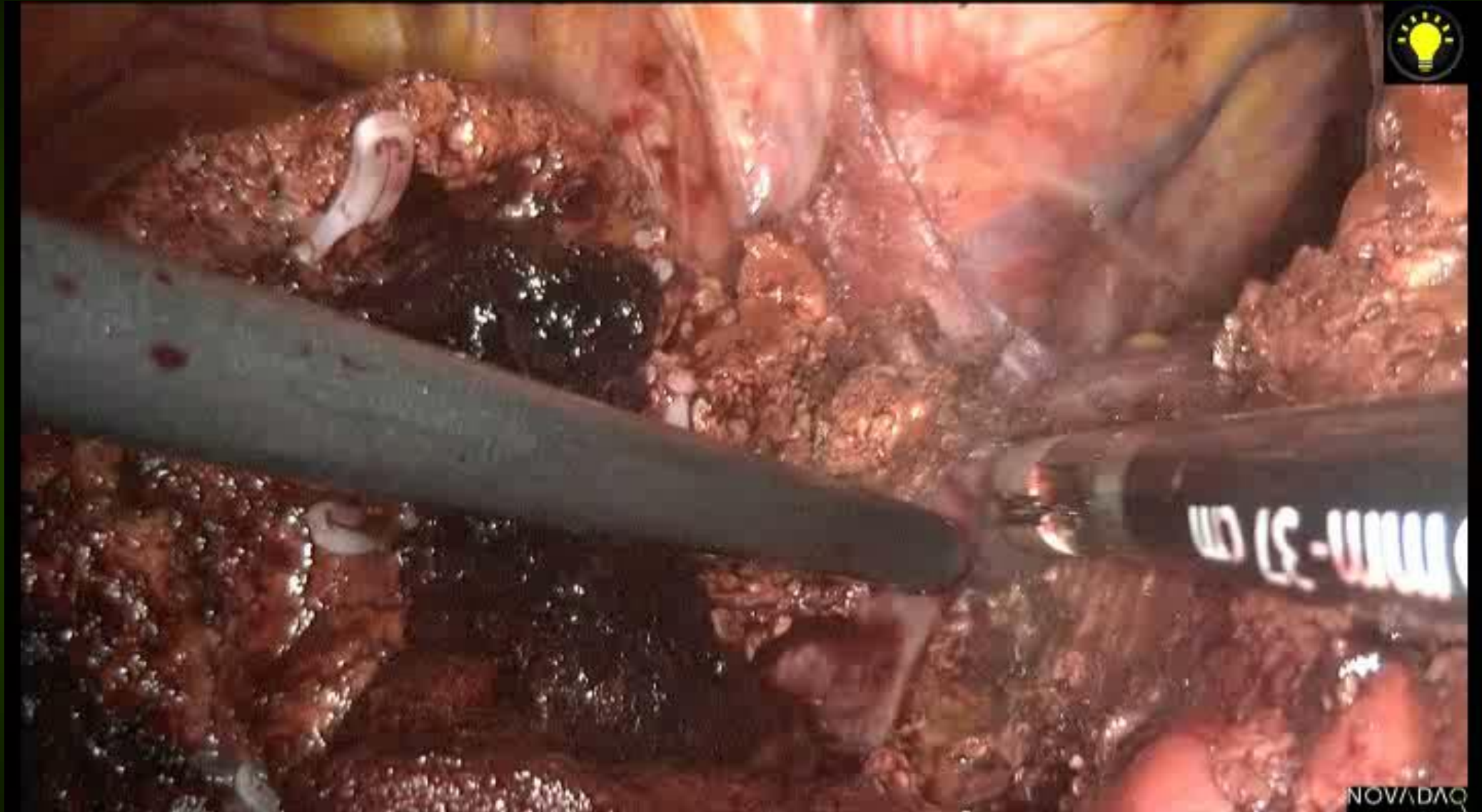
Laparoscopic left hepatectomy for HCC



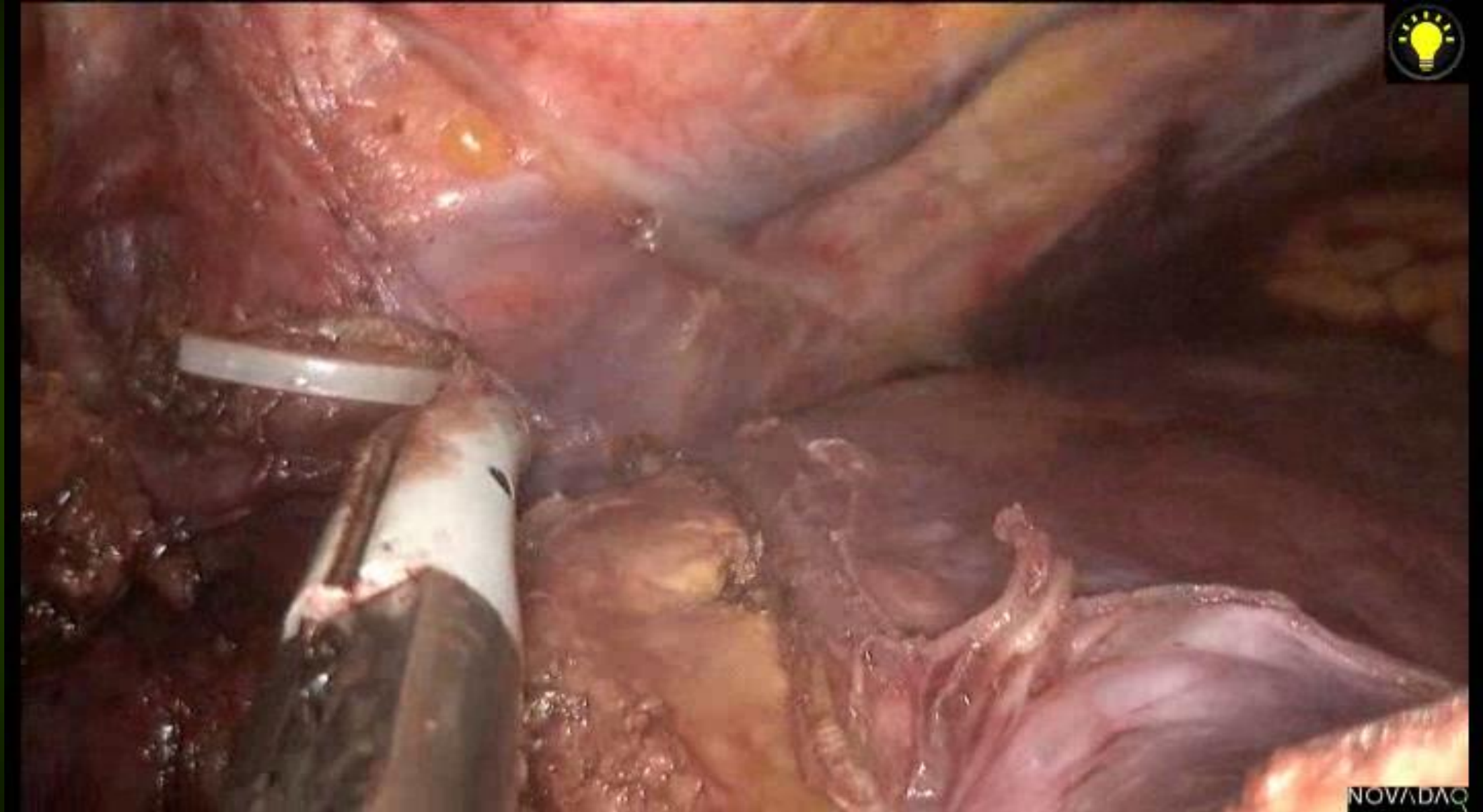
Laparoscopic left hepatectomy for HCC



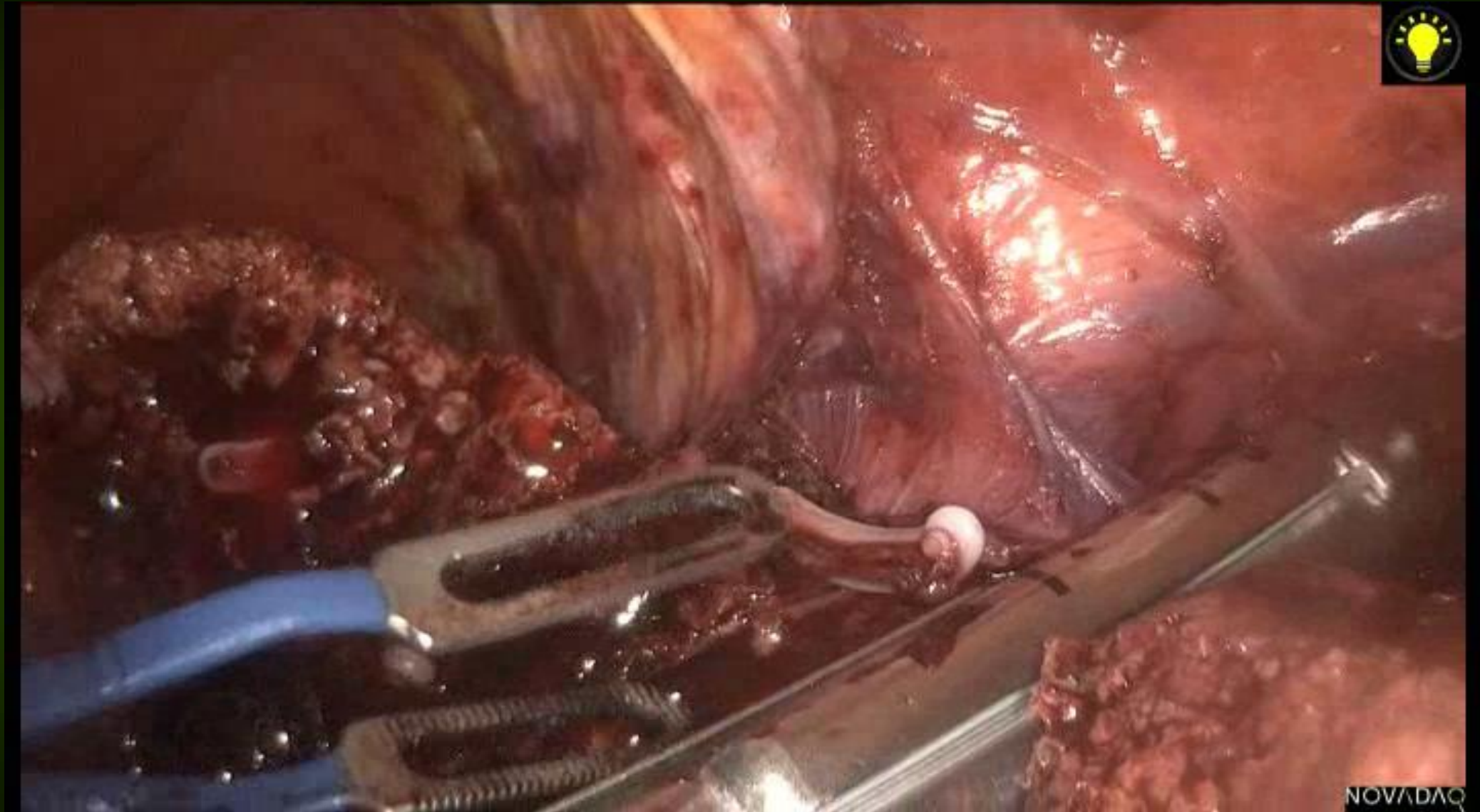
Laparoscopic left hepatectomy for HCC



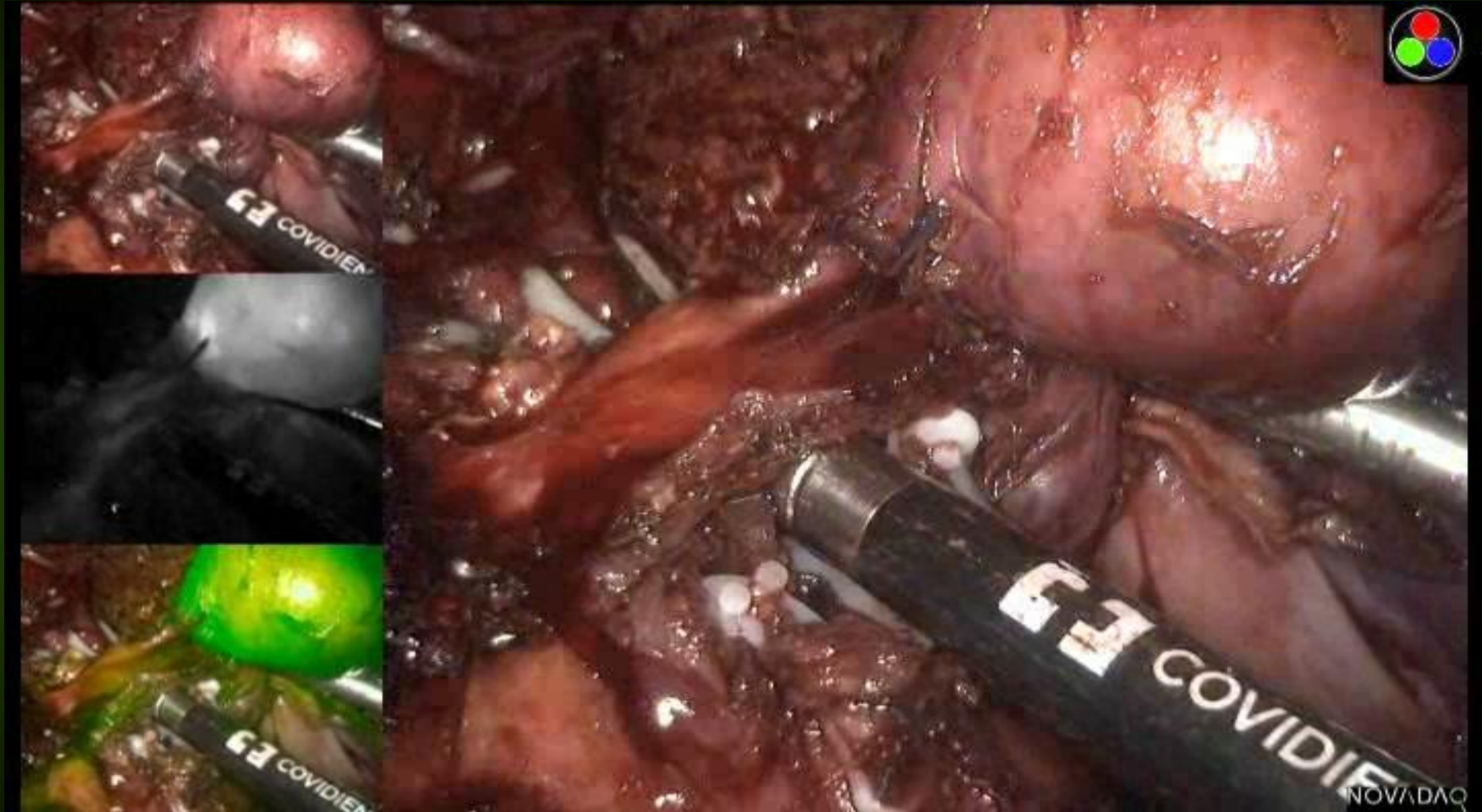
Laparoscopic left hepatectomy for HCC



Laparoscopic left hepatectomy for HCC



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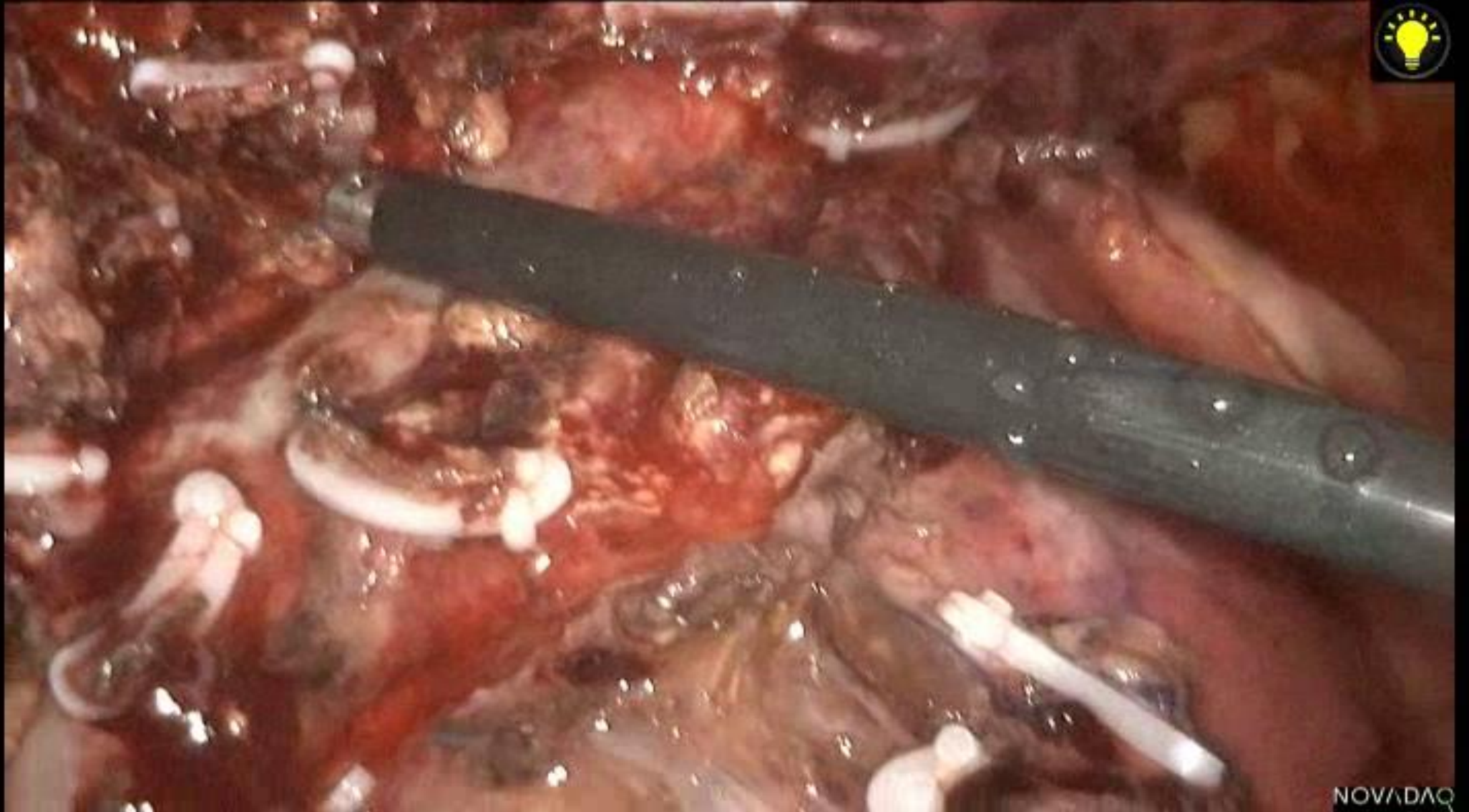
Laparoscopic left hepatectomy for HCC



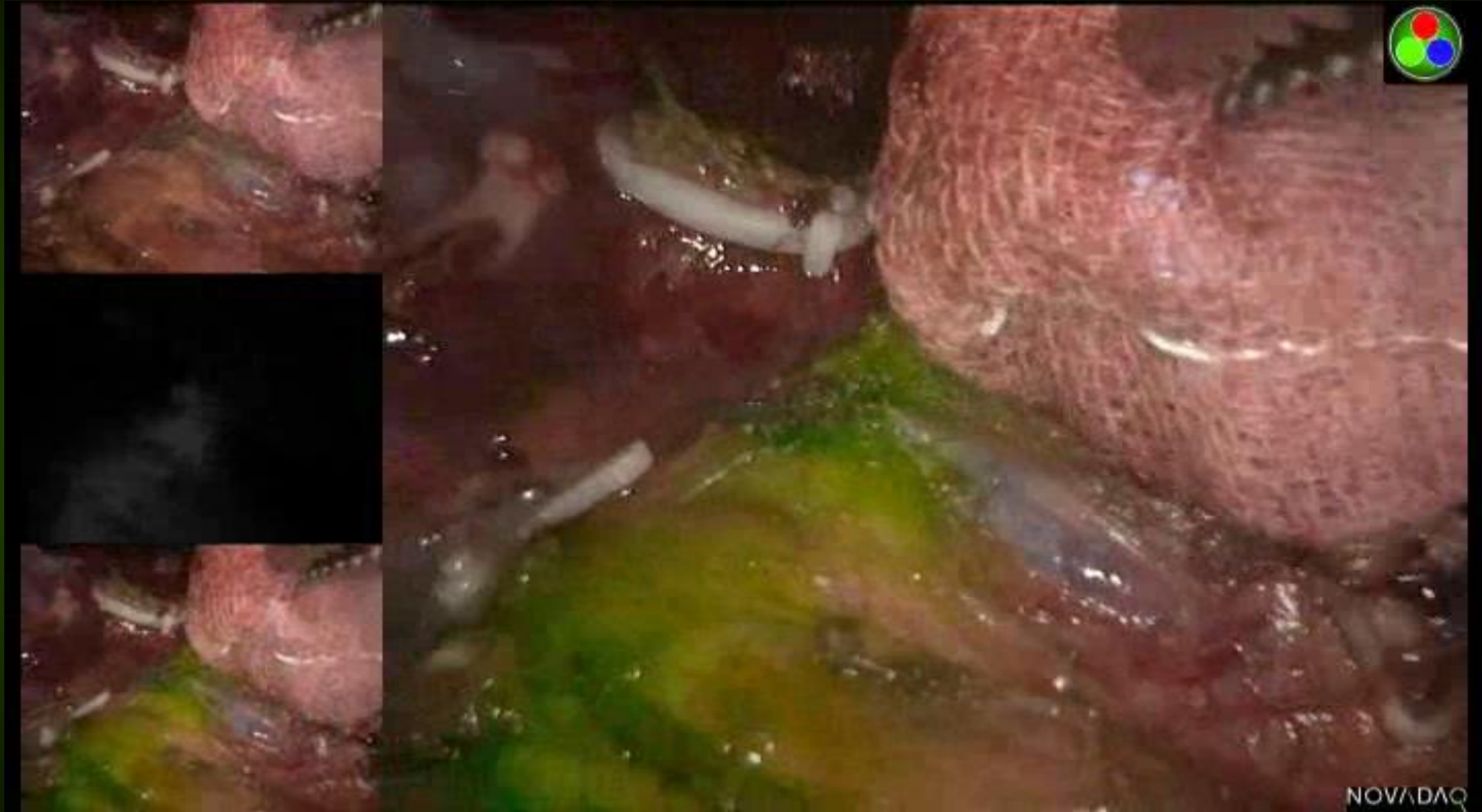
Laparoscopic left hepatectomy for HCC



Laparoscopic left hepatectomy for HCC



Laparoscopic left hepatectomy for HCC



Conclusions

- ICG-fluorescence imaging is a simple and easy intraoperative navigation tool enabling visualization of the bile ducts, hepatic tumors and segmentary boundaries during laparoscopic hepatectomy.

Thank you for your attention!

Takeaki ISHIZAWA, take1438@gmail.com