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Single Incision flexible endoscopic peritoneoscopy for staging of peritoneal carcinomatosis : translational research in surgery

From 2012 to 2020

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Instituts thématiques

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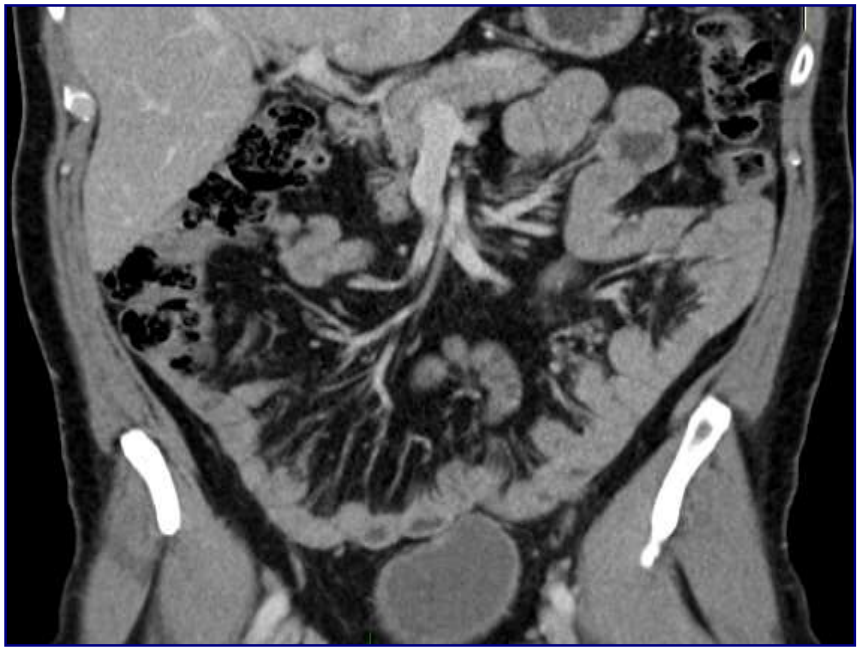
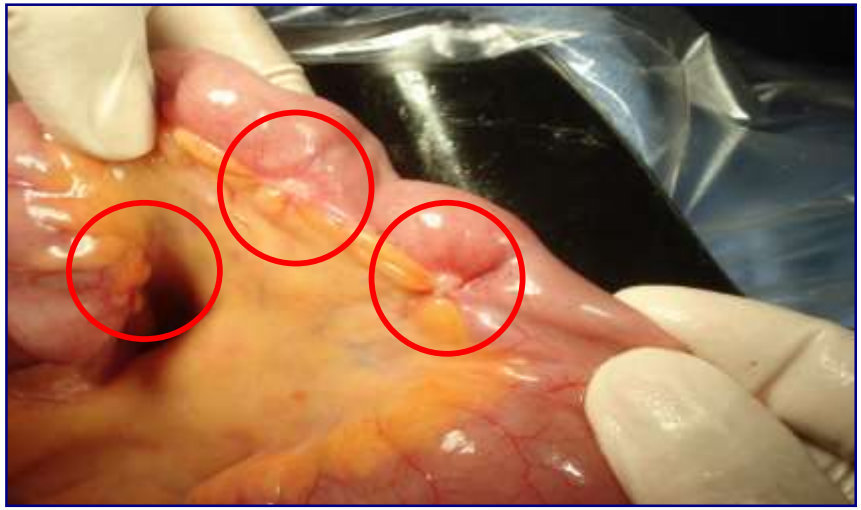
Diagnosis and staging of peritoneal carcinomatosis (PC)

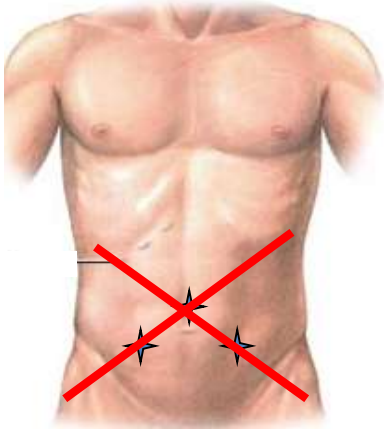
PC undiagnosed preoperatively



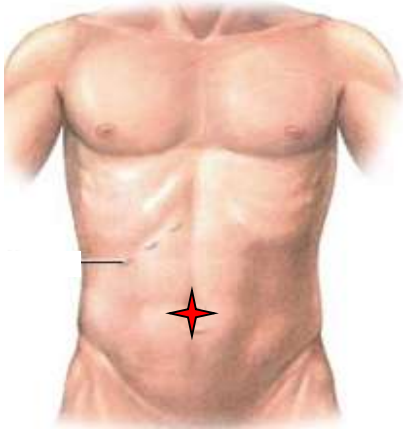


Not resectable!

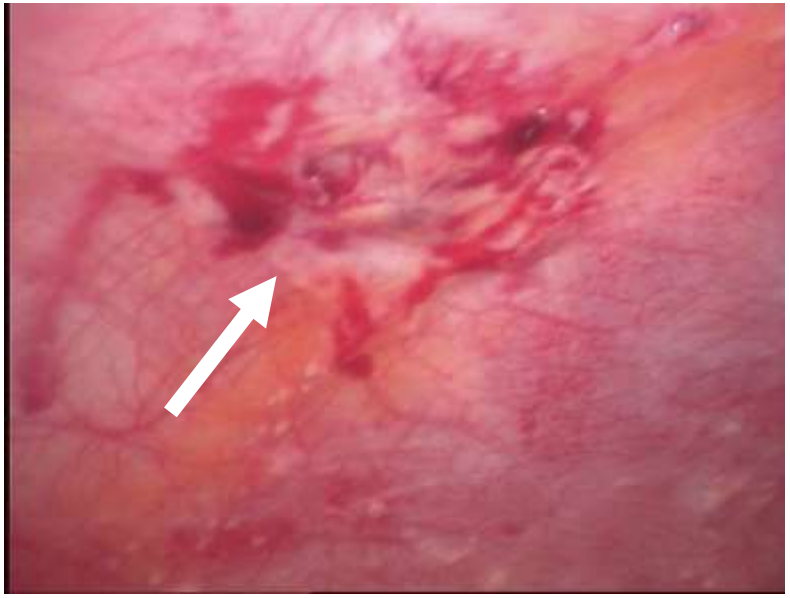
Diagnosis and staging of peritoneal carcinomatosis

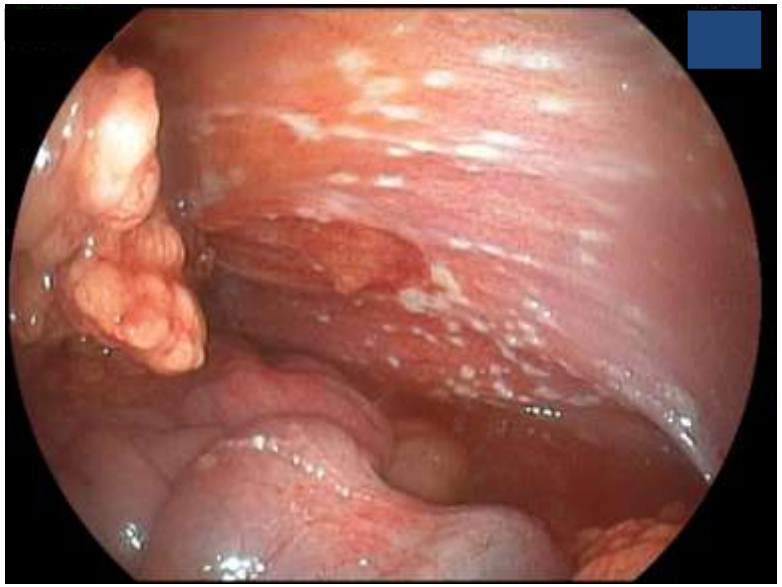


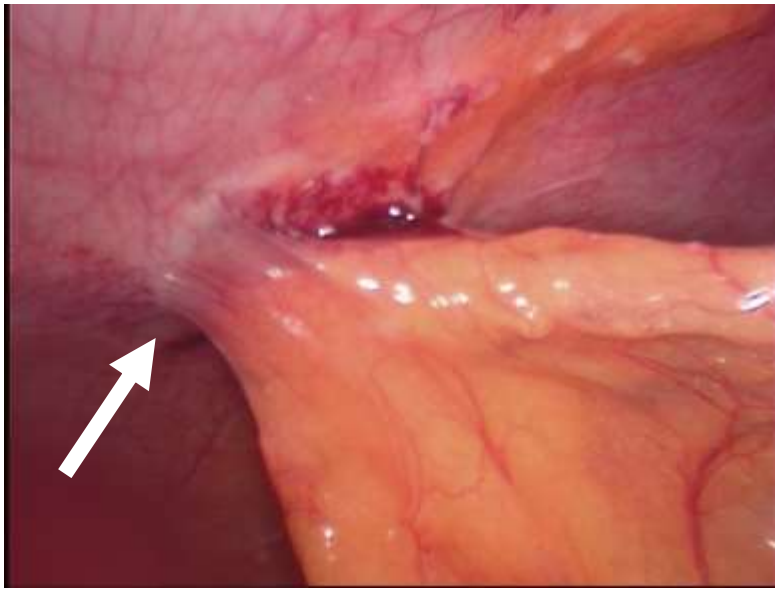
Traditional laparoscopy



Mono trocart







If you are a luky surgeon,
trocart orifice could be tumor free,
but if not: you had to resect a very extended part of the abdominal wall

Did we have another solution?

- Exploration of the abdomen using **NOTES** technology
- Natural Orifice Trans Endoscopic Surgery
  - Seriously ???

- Ok but using a comparison with laparoscopy
- Imagine an animal model mimicking a clinical situation :

Comparison of the 2 techniques :
NOTES (trans-gastric endoscopy)
and rigid trans-ombilical endoscopy

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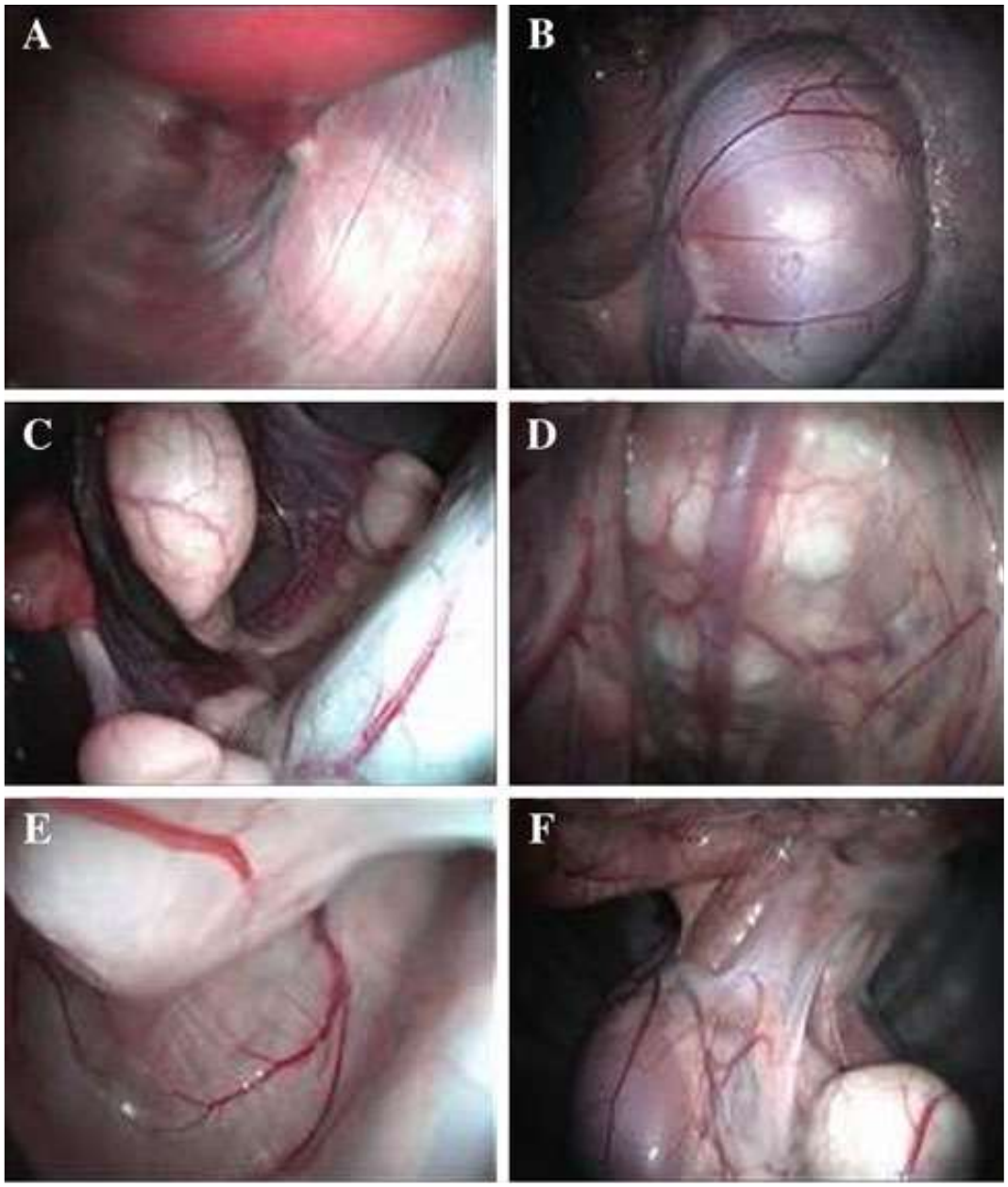
DOI 10.1007/s00464-012-2251-2

SURGICAL ENDOSCOPY and Other Interventional

DYNAMIC MANUSCRIPTS

No-incision (NOTES) versus single-incision (single-port) surgery for access to sites of peritoneal carcinomatosis: a back-to-back animal study

Yamina Ladjici · Marc Pocard · Philippe Marteau · Patrice Valleur · Xavier Dray



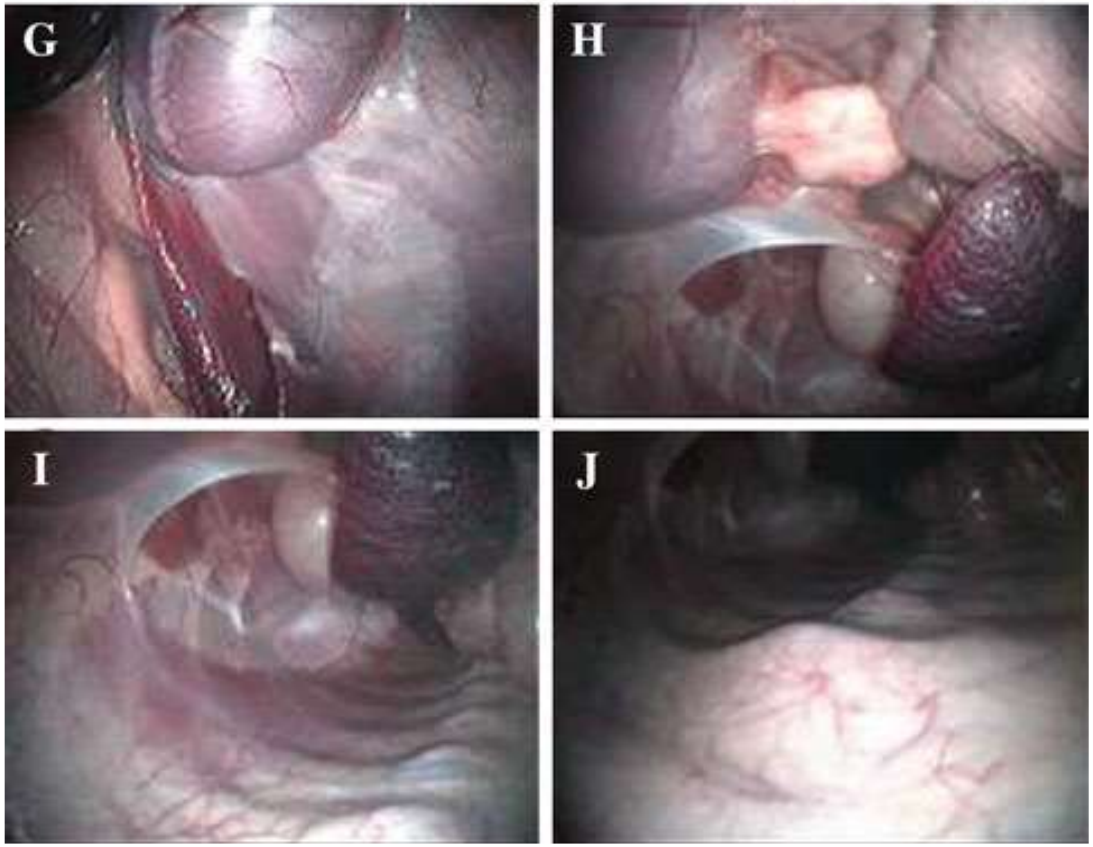


Fig. 3 Endoscopic view of the elective sites of peritoneal carcinomatosis with transgastric natural orifice transluminal endoscopic surgery. **A** Right diaphragmatic dome with suprahepatic inferior vena cava and diaphragmatic veins. **B** Right paracolic gutter and kidney. **C** Rectum, uterus, and right salpinx. **D** Sacrum. **E** Cul-de-sac of Douglas. **F** Root of the mesentery. **G** Right kidney, suprarenal inferior vena cava, and pancreatic head. **H** Spleen, pancreatic tail, and left kidney. **I** Left diaphragmatic dome. **J** Left paracolic gutter

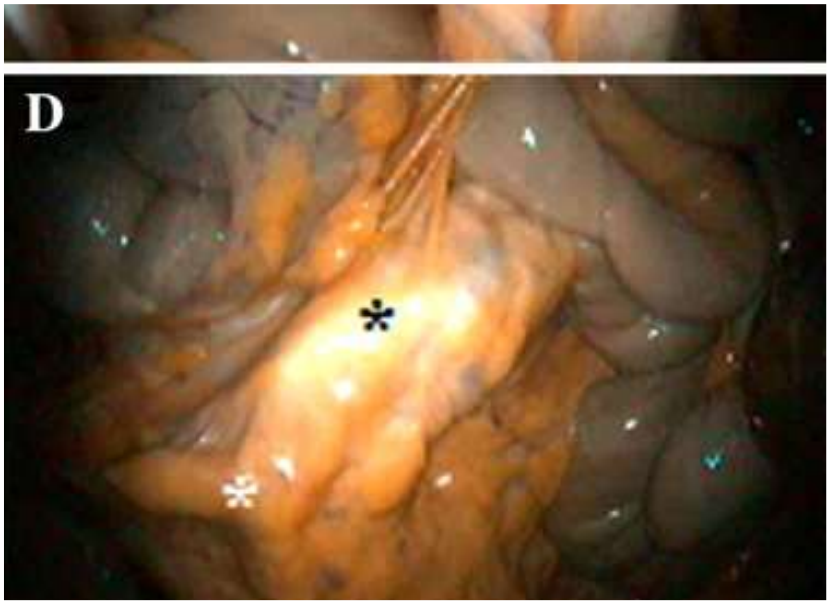
Results Access to the targets was successful in 89 % with NOTES and 80 % with SPLS ($p = 0.27$). NOTES and SPLS achieved a 100 % access rate to the diaphragmatic domes and paracolic gutters, to the splenic area, to the pelvic floor, and to the trigonal bladder ($p > 0.99$). Access rates of NOTES versus SPLS to other elective sites of PC were the following: mesentery root (94 % vs. 0 %, $p < 0.001$), inferior mesenteric vein origin (88 % vs. 0 %, $p < 0.001$), inferior vena cava (88 % vs. 75 %, $p = 0.85$), and hepatic pedicle (8 % vs. 100 %, $p < 0.001$).

Conclusions Both transgastric NOTES and SPLS provided quick and easy access to most elective sites of PC, except for the mesenteric vessel root (better achieved by NOTES) and the hepatic pedicle (better achieved by SPLS). Both techniques could be improved or combined to overcome their specific drawbacks.

Surg Endosc (2012) 26:2651–2657
DOI 10.1007/s00464-012-2218-3

Flexible versus rigid single-port peritoneoscopy: a randomized controlled trial in a live porcine model followed by initial experience in human cadavers

Y. Ladjici · X. Dray · P. Marteau · P. Valleur · M. Pocard



Flexib endoscope or rigid endoscope using a trans-ombilcal approach

95 sites under 110
87 %

108 sites under 110
98 %

Single Incision flexible endoscopic peritoneoscopy

- Is it possible on human .
- We test accessibility using 4 cadavers
- All the regions of interest were touch on cadaver

- Infectious risk ?
- Disinfection less than 10^{-4} bacteria
- Or Sterilisation less than 10^{-5} bacteria

Translational research process

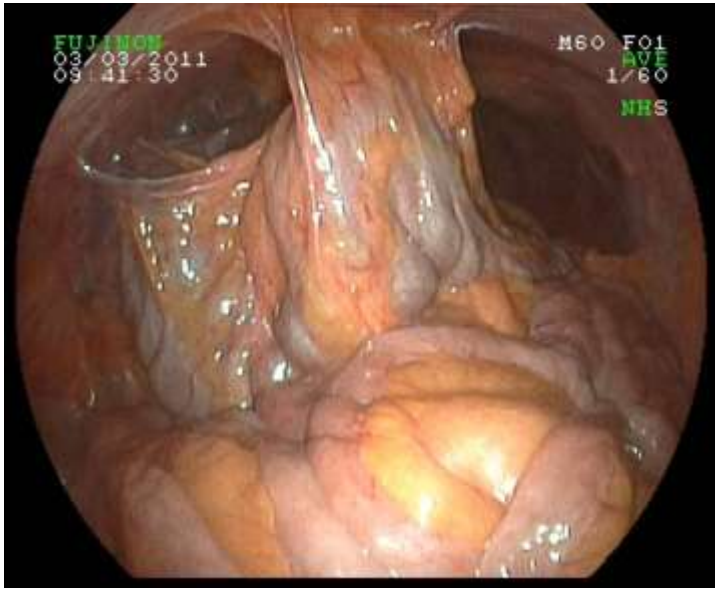
Preliminary studies

Clinical experience

ADVANTAGES

- to get around peritoneal adhesions
- to gain access to areas that can not be explored using a rigid camera

Flexible Endoscope



Single Port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Rigid laparoscopy - Flexible peritoneoscopy

then

2009 - 2012 n = 45

Endpoints :

- feasibility
- diagnostic impact
- therapeutic impact

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Patients Characteristics

	n = 45
Colorectal adenocarcinoma	21
Gastric adenocarcinoma	14
Ovarian cancer	3
Pseudomyxoma	4
Mesothelioma	1

Mean age: 52 years

28 Men

29 Past History of Surgery

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Results

Inclusion N = 45

Endoscopic Peritoneoscopy
Success
N = 42 (94%)

Failure N = 3 (6%)

N = 12 (27%)
No additional information

N = 30 (67%)
Identification of lesions undetected by rigid peritoneoscopy

N = 8 (17 %)
Treatment regimen changed

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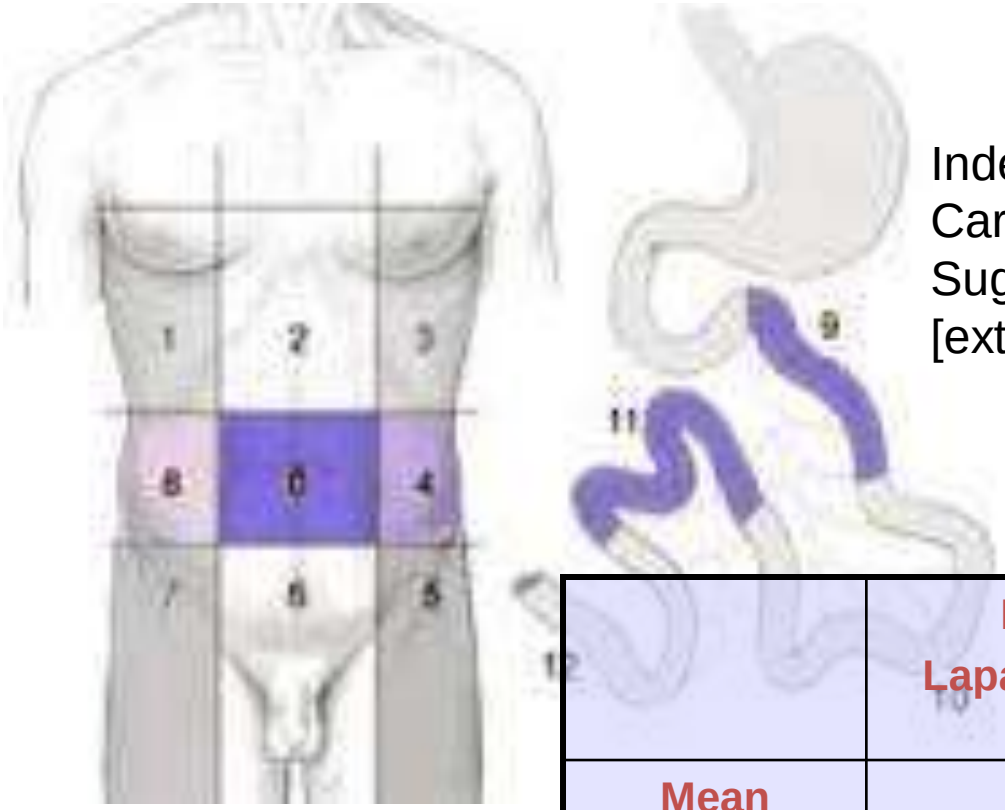
Results



Index of Peritoneal Carcinomatosis (IPC) Sugarbaker
[extremes 0 – 39]

	Rigid Laparoscopy	Flexible Peritoneoscopy	Gain
Mean IPC Score	13	17	+23%
Mean # of regions accessed	6	9	+30%

Conclusions

- Single-port flexible endoscopic peritoneoscopy was feasible in **94%** of cases.

- It demonstrated higher staging capabilities than rigid instruments in **67%** of cases, and therefore impacted on therapeutic decision in **17%** of cases.

In our institution,

this technique has become a standard for PC staging

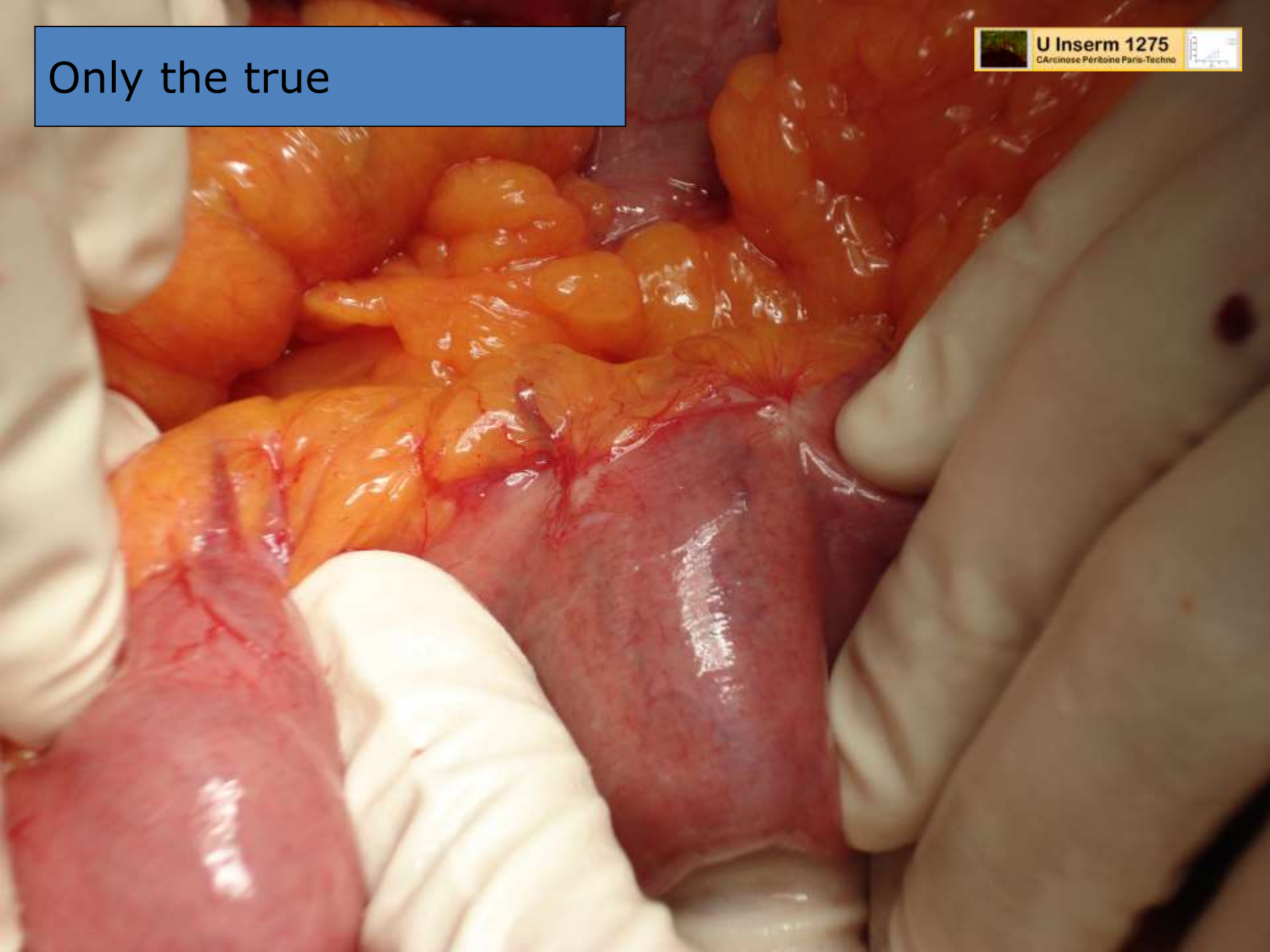
when HIPEC is considered

or in case of suspected limited carcinomatosis

Laparoscopy is not the gold standard

- Some times, even a laparoscopy is performed, carcinomatosis is avoided by an experimented surgeon.
- Did you believe me ?

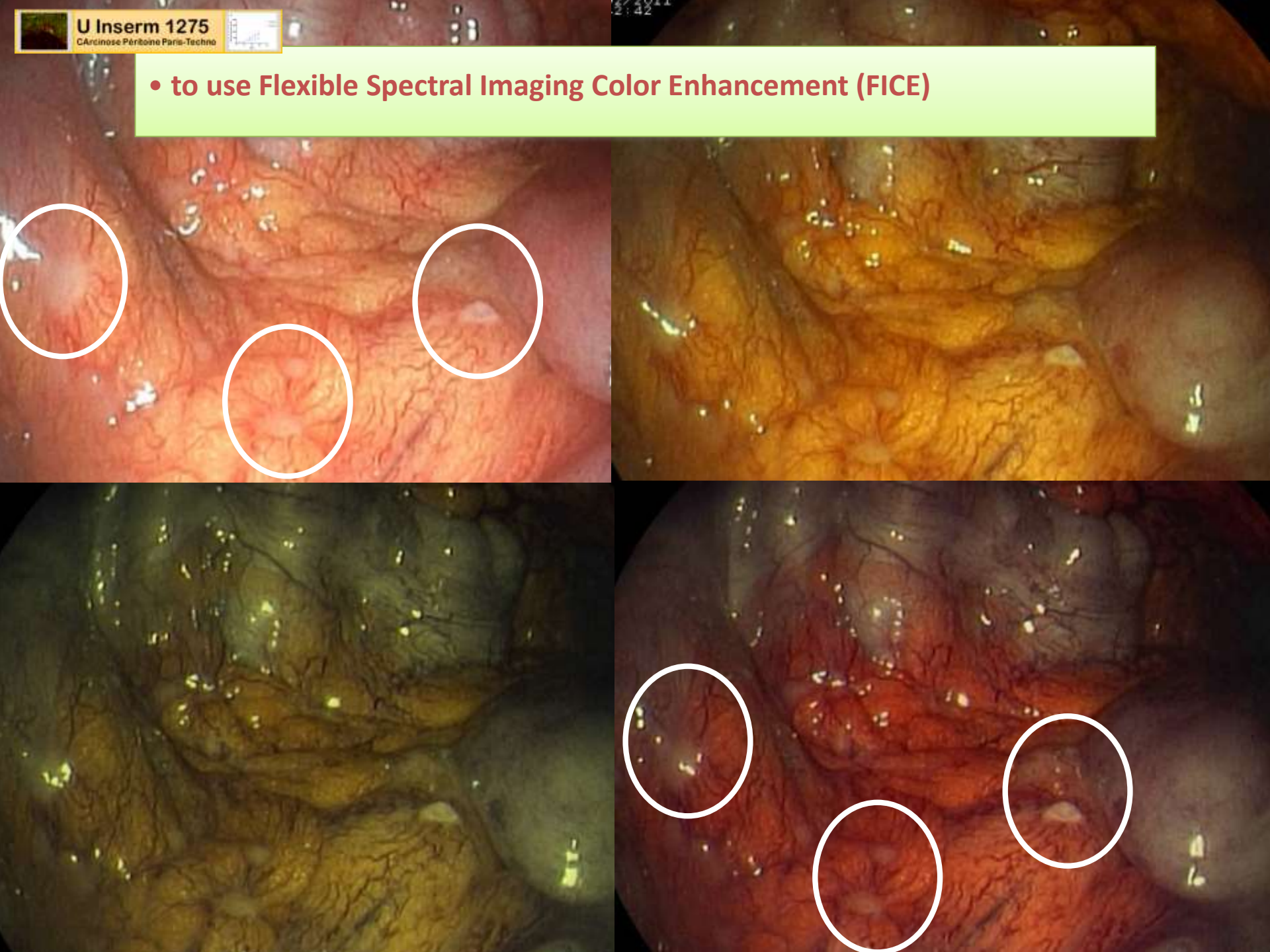
Only the true



Laparoscopy is not the gold standard

- Some times, even a laparoscopy was performed, carcinomatosis is avoided by an experimented surgeon.
- Did you believe me ?

Increase the possibility of detection in case of peritoneum suspected metastasis ?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• to use Flexible Spectral Imaging Color Enhancement (FICE)

Single Incision flexible endoscopic peritoneoscopy

- A standard of care in the Unit with near 100 procedures
- Not a gold standard
- Needs to be improved

- We start a new surgical research programme using spectral imaging – including animal and human study

- **Take Home message :** Surgeon had to be implicated in cancer research – biology is not the only way to progress – but surgical research had to be done using the same process as any others biological research

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DYNAMIC MANUSCRIPTS

No-incision (NOTES) versus single-incision (single-port) surgery for access to sites of peritoneal carcinomatosis: a back-to-back animal study

Yamina Ladjici · Marc Pocard · Philippe Marteau · Patrice Valleur · Xavier Dray

Abstract

Background Preoperative radiological diagnosis and evaluation of limited peritoneal carcinomatosis (PC) is suboptimal. Triangle laparoscopy is considered a noncarcinologic option due to the risk of tumoral spreading through the lateral ports into the abdominal wall muscles. Open surgery is therefore often needed to characterize PC. A minimally invasive approach would be progress.

Methods We aimed to compare access rates to elective sites of PC using natural orifice transluminal endoscopic surgery (NOTES) with those using single-port laparoscopic surgery (SPLS). Sixteen acute experiments were performed in a live porcine model. Back-to-back NOTES and SPLS standardized peritoneoscopy were conducted in a crossover design. Access rates to 11 elective sites of PC were considered as end points based on operators' consensus and necropsy verification.

Results Access to the targets was successful in 89 % with NOTES and 80 % with SPLS ($p = 0.27$). NOTES and SPLS achieved a 100 % access rate to the diaphragmatic domes and paracolic gutters, to the splenic area, to the pelvic floor, and to the trigonal bladder ($p > 0.99$). Access rates of NOTES versus SPLS to other elective sites of PC were the following: mesentery root (94 % vs. 0 %, $p < 0.001$), inferior mesenteric vein origin (88 % vs. 0 %, $p < 0.001$), inferior vena cava (88 % vs. 75 %, $p = 0.85$), and hepatic pedicle (8 % vs. 100 %, $p < 0.001$).

Conclusions Both transgastric NOTES and SPLS provided quick and easy access to most elective sites of PC, except for the mesenteric vessel root (better achieved by NOTES) and the hepatic pedicle (better achieved by SPLS). Both techniques could be improved or combined to overcome their specific drawbacks.

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First paper

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Flexible versus rigid single-port peritoneoscopy: a randomized controlled trial in a live porcine model followed by initial experience in human cadavers

Y. Ladjici · X. Dray · P. Marteau · P. Valleur · M. Pocard

Received: 27 July 2011 / Accepted: 26 November 2011 / Published online: 22 March 2012

Abstract

Introduction We compared single incision laparoscopic surgery with flexible endoscope ("flexible SILS") and with rigid optic ("rigid SILS") for access to 11 elective sites of peritoneal carcinomatosis.

Materials and methods Back-to-back flexible and rigid SILS peritoneoscopy were performed in ten live pigs. SILS peritoneoscopy was performed using a flexible endoscope or a rigid optic, in random order, together with two rigid 5-mm laparoscopic forceps. Primary endpoint was access success rate to 11 elective sites of peritoneal carcinomatosis. Findings for the most favorable option were then assessed in four human cadavers.

Results In the porcine model, the overall rate of access to targets was 98% with flexible SILS and 87% with rigid SILS ($p < 0.001$). Both flexible and rigid SILS allowed a 100% access rate to diaphragmatic domes, paracolic gutters, splenic and hepatic hilum, pelvic floor, and trigonal bladder. The rates of access to other sites by flexible versus rigid SILS, respectively, were: root of the mesentery (90 *vs.* 50%), origin of the inferior mesenteric vein (90 *vs.* 50%), inferior vena cava (100 *vs.* 90%), and cul-de-sac of Douglas (100 *vs.* 50%). No complications were observed. Procedures were performed in mean time of 26 and 24 min, respectively. These findings were confirmed for flexible SILS in four human cadavers.

Conclusions Flexible SILS is superior to rigid SILS to evaluate the peritoneal cavity in a timely manner. This suggests a need for flexible instrumentation or other technical solutions to perform thorough minimally invasive surgical evaluation of peritoneal carcinomatosis.

Keywords Laparoendoscopic single-site surgery · Minimally invasive surgery · Peritoneal carcinomatosis · Peritoneoscopy · Single-incision laparoscopic surgery

Abbreviations

NOTES	Natural orifice translumenal endoscopic surgery
SD	Standard deviation
SILS	Single incision laparoscopic surgery

Surg Endosc (2016) 30:3808–3815
DOI 10.1007/s00464-015-4682-z

Single-incision flexible endoscopy (SIFE) for detection and staging of peritoneal carcinomatosis

Haythem Najah[1,2] · Réa Lo Dico[1,2] · Marion Grienay[3] · Anthony Dohan[2,4] · Xavier Dray[5] · Marc Pocard[1,2]

Abstract

Objective To show the feasibility and the safety of peritoneal carcinomatosis (PC) evaluation by single-incision flexible endoscopy (SIFE) and to compare it to single-incision rigid endoscopy (SIRE).

Background Direct peritoneal visualization, either by laparotomy or laparoscopy, continues to be the gold standard in diagnosing PC. We reported, in animal study, that combining single-incision laparoscopic surgery and flexible endoscopy improved evaluation of the peritoneal cavity in a live porcine model and in four human cadavers.

Methods Patients, undergoing surgical exploration for diagnosis and staging of PC, were included in a prospective study. Using a superiority design a sample size of 47 patients was determined. Through a single incision, a standardized peritoneoscopy was conducted with rigid (SIRE) and with flexible endoscope (SIFE). Primary outcome was the access success rates for the 13 regions of the Peritoneal Carcinomatosis Index (PCI).

Results Overall access to the 13 regions of PCI was successful in 83 % of the cases with SIRE and in 91.1 % with SIFE ($p < 10^{-10}$). SIFE access rates were superior to SIREs' in the regions: R1 (87.2 vs. 61.7 %, $p = 0.002$), R2 (87.2 vs. 66 %, $p = 0.004$), R3 (85.1 vs. 59.6 %, $p = 0.001$) and R6 (80.9 vs. 61.7 %, $p = 0.008$). The mean PCI was higher ($p < 10^4$) with SIFE 12.77 (± 11.97) than with SIRE 11.77 (± 11.63).

Conclusion This prospective, comparative study shows that SIFE was significantly superior to SIRE in the exploration of some difficult-to-access peritoneal areas, located in regions 1, 2, 3 and 6. These two minimally invasive staging procedures are safe, feasible and have to be seen as complementary rather than competing.

Single-incision flexible endoscopy (SIFE) for detection and staging of peritoneal carcinomatosis

Haythem Najah[1,2] · Réa Lo Dico[1,2] · Marion Grienay[3] · Anthony Dohan[2,4] · Xavier Dray[5] · Marc Pocard[1,2]

Surg Endosc (2017) 31:743–751
DOI 10.1007/s00464-016-5028-1

A feasibility study of the use of computed virtual chromoendoscopy for laparoscopic evaluation of peritoneal metastases

Haythem Najah[1,2] · Réa Lo Dico[1,2] · Anthony Dohan[2,3] · Lucy Marry[4] · Clarisse Eveno[1,2] · Marc Pocard[1,2]

Received: 29 January 2016 / Accepted: 6 June 2016 / Published online: 20 June 2016

Abstract

Background Detection of an incipient peritoneal carcinomatosis (PC) is still challenging, and there is a crucial need for technological improvements in order to diagnose and to treat early this condition. Fujinon Intelligent Chromo Endoscopy (FICE) is a spectral image processing technology that enhances the contrast of the target tissue. The aim of this study is to investigate the usefulness of FICE system during peritoneal endoscopy and to establish the optimal FICE preset(s) for peritoneal exploration and PC detection.

Methods A total of 561 images corresponding to 51 different areas of PC nodules and normal peritoneum were recorded during peritoneal endoscopies (For each area, one white light endoscopy (WLE) image and 10 FICE images). Three groups of 5 evaluators each: senior surgeons, surgical residents and medical students assessed these images. In a first questionnaire, the evaluators gave a score ranging from 1 to 10 to each image, and the three best FICE channels were determined. In a second questionnaire, five criteria were studied specifically: contrast, brightness, vascular architecture, differentiation between organs and detection of PC. The evaluators ranked the WLE and the three best FICE channel images according to these criteria.

Results The three best FICE channels were channels 6, 2 and 9 with mean scores of 6.21 ± 1.59, 6.17 ± 1.48 and 6.06 ± 1.52, respectively. FICE Channel 2 was superior to WLE and other FICE channels, in terms of contrast ($p < 10^{-4}$), visualization of vascular architecture ($p < 10^{-4}$), differentiation between organs ($p < 10^{-4}$) and detection of PC ($p < 10^{-4}$); and ranked first in 38.8, 41.5, 31 and 46.9 % of the cases, respectively.

Conclusion FICE system provides adequate illumination of the abdominal cavity and a unique contrast that enhances the vascular architecture. FICE Channel 2 is the optimal channel for peritoneal exploration and could be a useful tool for the diagnosis of PC during peritoneal explorations.

Keywords Peritoneal carcinomatosis · Peritoneoscopy · Computed virtual chromoendoscopy · Fujinon intelligent chromoendoscopy · Video imaging · Wavelength

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Surgical Endoscopy
https://doi.org/10.1007/s00464-019-06984-8

The role of single-incision laparoscopic peritoneal exploration in the management of patients with peritoneal metastases

Haythem Najah[1,2] · Brice Malgras[1,2] · Anthony Dohan[2,3] · Caroline Gronnier[4] · Clarisse Eveno[1,2] · Marc Pocard[1,2]

Received: 20 November 2018 / Accepted: 15 July 2019

Abstract

Background The outcome of cytoreductive surgery and hyperthermic intraperitoneal chemotherapy (CRS/HIPEC) depends on the extent of peritoneal metastases (PM) and the completeness of cytoreduction (CCR). The role of preoperative assessment of PM is to identify potential candidates for CRS/HIPEC and to prevent unwarranted laparotomy for those who are not. Laparoscopy has been utilized for that purpose but with concerns related to technical difficulties and risk of trocar site metastases. Single-incision laparoscopic peritoneal exploration (SILPE) has not yet been evaluated in this setting.

Methods This single-center retrospective study examined patients from January 2011 to December 2015 who underwent SILPE for diagnosis and staging of PM. Preoperative, intraoperative, and postoperative data were collected. For the patients who underwent subsequent laparotomy, a comparison between SILPE and laparotomy findings was made.

Results A total of 183 SILPE were performed. Primary sites were mostly colorectal in 72 cases (39.3%) and gastric in 47 (25.7%). Overall, 157 patients (85.8%) had at least one prior abdominal surgery and 48 (26.2%) had 3 or more. SILPE was successfully achieved in 90.2% of the cases. Two (1.2%) intraoperative complications and five (3%) postoperative complications were observed. Eighty-one patients had laparotomy, with a median of 27 days between SILPE and laparotomy (4–162 days). The peritoneal carcinomatosis index PCI was 9.7 ± 7.5 at SILPE, and 13.5 ± 9.6 at laparotomy. The positive predictive value of SILPE to predict CCR was 79.5%. SILPE sensitivity was 75% and specificity 97%. The lowest sensitivity was in regions 9–12 ranging from 44 to 53%.

Conclusion SILPE can be safely incorporated in the management of patients with PM. It is a safe and feasible staging tool, allowing for preventing unwarranted laparotomy for patients not deemed candidate for CRS/HIPEC. Even though it may underestimate PCI, SILPE accurately predicts the possibility of CCR.