55TH GLOBAL CONGRESS ON MIGS

BOSTON, MASSACHUSETTS
NOVEMBER 13-16, 2026

Syllabus

Surgical Tutorial 430

Artificial Intelligence and Image-Guided Surgery for Intraoperative Safety in Gynaecological Minimally Invasive Surgery

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Charles H. Koh, MD

SCIENTIFIC PROGRAM CHAIR
Nash S. Moawad, MD

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Surgical Tutorial 430
Artificial Intelligence and Image-Guided Surgery for Intraoperative Safety in Gynaecological Minimally Invasive Surgery

Chair: Nicolas Bourdel
Faculty: Nicolas Bourdel, Helder Ferreira Sr., Juan Gilabert Estelles

Course Description

Intraoperative complications in gynecological minimally invasive surgery (MIS) are frequently related to difficulties in anatomical recognition, loss of spatial orientation, and limited real-time decision support in complex surgical environments. Recent advances in artificial intelligence (AI) and image-guided surgery now offer new opportunities to improve intraoperative safety through enhanced visualization, anatomical mapping, and surgical navigation. This Surgical Tutorial will provide a practical and clinically oriented overview of how AI-assisted technologies and image-guided systems can be integrated into daily surgical practice to enhance intraoperative safety. The course will focus on real-time anatomical recognition, ureteral and vascular mapping, fluorescence-guided surgery, and augmented visualization techniques during complex pelvic procedures. Using high-quality narrated surgical videos and structured step-by-step analysis, participants will learn how these technologies can be applied during advanced hysterectomy, endometriosis surgery, and difficult pelvic dissections to reduce the risk of ureteral, vascular, and nerve injury. Emphasis will be placed on practical workflow integration, evidence-based application, and limitations of current systems.

Learning Objectives: *At the end of this course, the participant will be able to:* 1) Describe the principles of artificial intelligence and image-guided technologies applied to gynecological minimally invasive surgery; 2) Recognize critical pelvic anatomical structures using AI-assisted and fluorescence-based imaging techniques; 3) Apply image-guided strategies to enhance ureteral, vascular, and nerve safety during complex pelvic surgery; 4) Integrate AI-supported intraoperative guidance into surgical workflows for endometriosis surgery and advanced hysterectomy; and 5) Identify current limitations, regulatory considerations, and future perspectives of artificial intelligence in intraoperative surgical safety.

Course Outline

11:00 am	Welcome, Introduction and Course Overview	N. Bourdel
11:05 am	From Data to Decision: Integrating AI and Fluorescence Imaging into Real-Time Surgical Workflow	H. Ferreira
11:20 am	Artificial Intelligence–Assisted Anatomical Recognition and Surgical Navigation in Gynaecological MIS	N. Bourdel
11:35 am	Image-Guided Strategies for Ureteral, Vascular, and Nerve Safety in Complex Pelvic Surgery	J. Gilabert Estelles
11:50 am	Discussion Questions & Answers	All faculty
12:00 pm	Adjourn	

ADA Statement: In accordance with the Americans with Disabilities Act (ADA), please contact CMEsupport@aagl.org should you require any special assistance.

Disclosure of Relevant Financial Relationships

As an ACCME-accredited provider, AAGL is responsible for ensuring that accredited education is fair, balanced, free of commercial bias, and supports safe, effective patient care. AAGL maintains control over all aspects of educational planning, content, faculty selection, delivery, and evaluation.

All individuals in a position to control educational content are required to disclose financial relationships with ACCME-defined ineligible companies within the past 24 months. AAGL identifies and mitigates all relevant financial relationships before individuals assume their respective roles. Educational content is also subject to independent peer review by individuals without relevant financial relationships.

Disclosure information and acknowledgment of any commercial support are provided to learners before the activity to promote transparency and maintain the independence and integrity of the education.

Asterisk (*) denotes no financial relationships with ACCME-defined ineligible companies to disclose.

PLANNER DISCLOSURES

The following members of AAGL have been involved in the educational planning and/or review of this course (listed in alphabetical order by last name).

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COURSE CHAIR DISCLOSURE

Nicolas Bourdel, MD, PhD – Employed Relationship and Stockholder: SurgAR

FACULTY DISCLOSURES

The following faculty have agreed to support their presentations and clinical recommendations with the best available evidence from the medical literature (in alphabetical order by last name).

Nicolas Bourdel, MD, PhD – Employed Relationship and Stockholder: SurgAR
Helder Ferreira Sr., MD, PhD, MBA*
Juan Gilabert Estelles, MD*

MITIGATION OF RELEVANT FINANCIAL RELATIONSHIPS

All relevant financial relationships have been mitigated.

Drs. Lee, Lemos, Mikhail, and Chaudhari's planning decisions, as part of the Scientific Program Committee (SPC), were peer reviewed by other planners on the SPC who had disclosed no financial relationships with ineligible companies, and found to be fair, balanced, and free of commercial bias. Dr. Moawad's financial relationships ended 12/2024, thus mitigating them. For most of his AAGL Professional Education Committee service, Dr. Mourad had no financial relationships to disclose. He recently disclosed a new relationship as a Proctor for Intuitive Surgical. Since then, he has not participated in activities involving control or influence over accredited educational content; therefore, no additional mitigation was necessary.

Dr. Nicolas Bourdel, Course Chair and Faculty, disclosed employment and stock ownership relationships with SurgAR. Based on the information provided, SurgAR does not currently meet ACCME's definition of an ineligible company, as it has not initiated the FDA premarket approval process. Nevertheless, Dr. Bourdel's presentation underwent independent peer review and was determined to be fair, balanced, and free of commercial bias.

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From Data to Decision

Integrating AI and fluorescence imaging into the real-time surgical workflow

Hélder Ferreira, MD, PhD, MBA
Full Professor, Head of Minimally Invasive Surgery Unit, CMIN – ULS Santo António, Porto · ICBAS – University of Porto
15 November 2026 · Room 304

1

DISCLOSURES

Financial relationships

Nothing to disclose

Commercial systems shown are examples, not endorsements. ICG use for ureteral and perfusion imaging may be off-label in some jurisdictions.

2

THE PROBLEM

Most injuries are not failures of skill. They are failures of perception.

86%
of bile duct transections caused by misidentifying the duct

70%
not recognised during the operation

"Seeing what you believe" believe"
Cue ambiguity, visual misperception, plan continuation

Dekker & Hugh, ANZ J Surg 2008;78:1109–14 · 49 bile duct transections analysed 3

3

THE FRAMEWORK

From data to decision: five steps in every operation

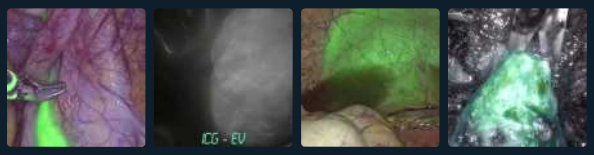
Sense — White light + near-infrared
→ **Interpret** — AI recognises, quantifies
→ **Decide** — The surgeon, at checkpoints
→ **Document** — Video, images, report
→ **Learn** — Audit; data trains models

Fluorescence improves what we see. AI improves how we read it. Neither replaces who decides.

4

SENSE · FLUORESCENCE

One dye, four questions answered in real time



Where is it?
Intraureteral ICG — the ureter in a frozen pelvis

Is it alive?
Intravenous ICG — bowel, ureter, ovary, cuff

Is it intact?
Intraluminal ICG — bladder and rectal wall

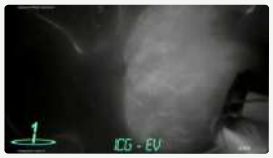
Is it disease?
Intravenous ICG — nodule vs bowel wall

Videos: CMIN Porto · Reviews: Mallick, FVV 2025 · Raffone, Medicina 2022 5

5

EVIDENCE · PERFUSION

Perfusion imaging is now level-one evidence — in colorectal surgery



IV ICG before transection — CMIN Porto

9 RCTS · 4,754 PATIENTS
RR 0.66 · NNT 24
LAR: **NNT 13** · high certainty · Ryan 2026

BOWEL ENDOMETRIOSIS · 1,090 PATIENTS
1.0% vs 0.8%
Fistula with vs without ICG · Barretto 2026

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EVIDENCE · URETER

Ureteral mapping: consistent signal, weaker evidence

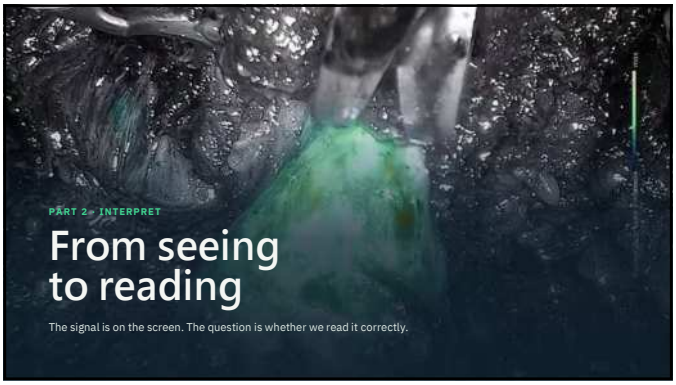


1.7 vs 22.7%	Complications with vs without ICG; 555 hysterectomies · Mrugala 2024
299 · 0	Patients, ureteral injuries; very low certainty · Zhang 2026
Jr = Sr	Juniors match seniors with ICG mapping, 92 cases · Radilla 2025
1–2 mm	Of fibrosis can hide the signal — dissection rules · Kashiwabara 2026

Images: CMIN Porto · AAGL 2026 · From data to decision

7

7



PART 2 — INTERPRET

From seeing to reading

The signal is on the screen. The question is whether we read it correctly.

8

INTERPRET · THE WEAK LINK

The camera sees the signal. The eye misreads it.

SURGEON'S VISUAL READING

Wide inter-observer variation variation

Time to visibility, peak and wash-out: no difference between patients who leaked and those who did not

QUANTITATIVE PIXEL ANALYSIS

Slope 0.08 vs 0.13

Fluorescence curve was flatter in patients who later leaked (p = 0.04)

This is the gap AI is built to close: turning images into numbers, and numbers into thresholds.

Larsen et al., Surg Endosc 2023;37:3602–9 · 55 robotic low anterior resections

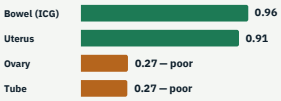
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INTERPRET · AI IN GYNAECOLOGICAL LAPAROSCOPY

What AI can already read — and what it cannot

Segmentation accuracy (Dice) by structure, U-Net



Hernández, J Pers Med 2022 · Lee, J Imaging Inform Med 2025

16 deep-learning studies

Anatomy classification · anatomy segmentation · instrument tracking · surgical action recognition

Large, stable organs: good.
Small, mobile, low-contrast structures — exactly the ones we injure: not yet.

Gkrozou, Medicina 2025

AAGL 2026 · From data to decision · Recognition and navigation in depth: N. Bourdel, 11:20

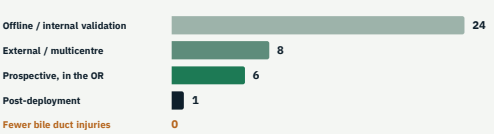
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REALITY CHECK

Even the most mature field has not yet shown patient benefit

AI for anatomy recognition in laparoscopic cholecystectomy · 39 model reports by readiness stage



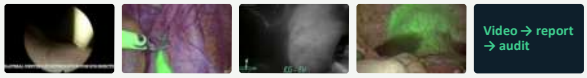
Cosma et al., Medicina 2026 · narrative review, searched to August 2026

11

11

DECIDE · IN THE WORKFLOW

Every signal tied to a checkpoint



1 · SET-UP	2 · BEFORE DISSECTION	3 · BEFORE TRANSECTION TRANSECTION	4 · AFTER REPAIR	5 · AFTER SURGERY
Which signals? Ureteral ICG if lateral disease; recording on	**Ureter mapped?** No signal: dissect, don't trust	**Perfused?** IV ICG sets the level of division	**Intact and alive?** Accept, reinforce or redo	**Learn.** Teaching, quality, data for AI

Our work: automated surgical report generation from laparoscopic video — CMIN Porto with U. Minho (FCT-funded)

Proposed workflow · Images: CMIN Porto

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LIMITS

Four things that can still go wrong

Optics
Shallow penetration; fibrosis and fat hide the signal. No standard dose, timing or threshold.

Data
Small single-centre datasets; models fail on new cameras, centres and difficult anatomy.

Human factors
Automation bias, alert fatigue, and loss of anatomical skill if we stop dissecting.

Regulation and liability
AI in devices is high-risk under the EU AI Act; FDA clearance; video privacy; who answers for an AI-guided error?

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TAKE-HOME MESSAGES

Better images are not enough. Better decisions are the goal.

1 Intraoperative injuries are mostly **perception errors** — that is what these tools target.
2 ICG perfusion is evidence-based today; ureteral mapping is a useful adjunct with **optical limits**.
3 AI's first real value is to **quantify** what the eye reads poorly — not to decide.
4 Tie every signal to a **checkpoint**, record everything, and audit the outcome.

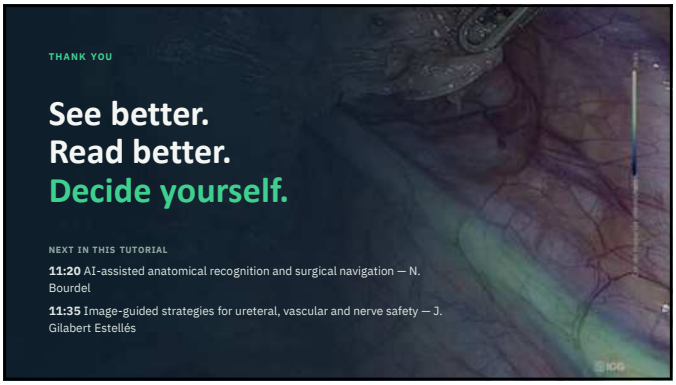
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Zhang, et al. ICG for intraoperative ureteral identification in gynecologic surgery. Int J Gynaecol Obstet 2026;175:67–76.
Kashiwabara, et al. Is identifying the ureter using ICG in severe DE always useful? J Minim Invasive Gynecol 2026;33:861.
Hernández A, et al. Deep learning to measure ICG intensity in endometriosis bowel resection. J Pers Med 2022;12:982.
Ekrozou F, et al. Deep learning models in laparoscopy for gynecology. Medicina 2025;61:1460.
Mallick R, et al. The case for ICG in benign gynaecology. Facts Views Vis Obgyn 2025;17:192–203.

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THANK YOU

See better.
Read better.
Decide yourself.

NEXT IN THIS TUTORIAL

11:20 AI-assisted anatomical recognition and surgical navigation — N. Bourdel

11:35 Image-guided strategies for ureteral, vascular and nerve safety — J. Gilabert Estellés

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Artificial Intelligence and Augmented Reality for in Gynaecological Surgery

Nicolas Bourdel, MD, PhD,Prof · Clermont Ferrand, France

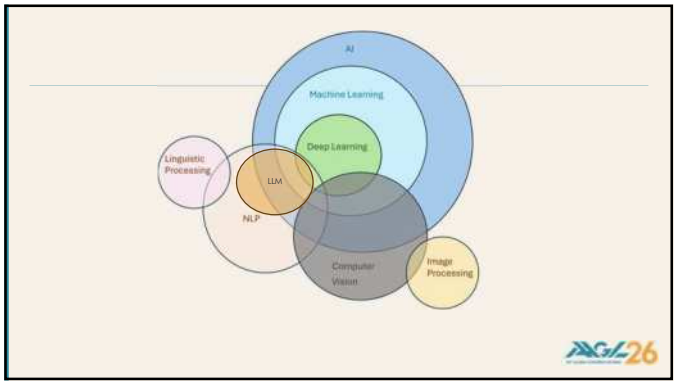
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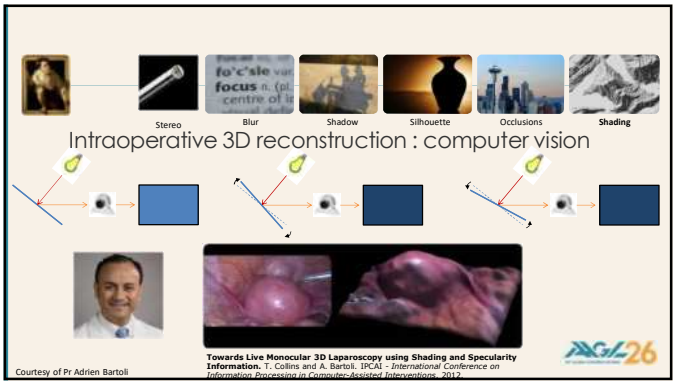
Disclosure

- Founder and CMO : SurgAR

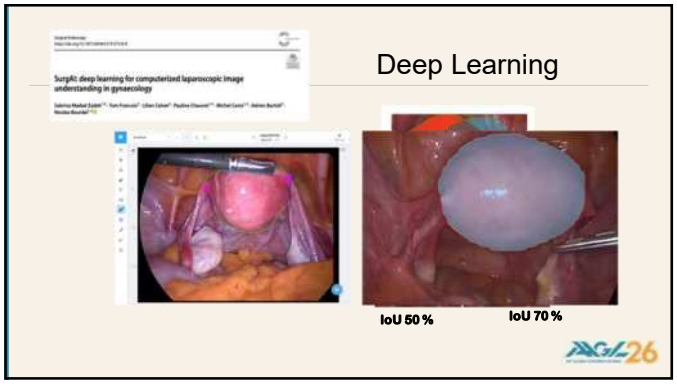
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4



5

Back to basics ....

Artificial intelligence :
- Computer vision : replicate the human vision
- Machine Learning, Deep learning : replicate the human brain
- Tools for Augmented reality !

Augmented reality :
- Using preoperative information (digital twin)
  - fusion between reality (laparoscopic view) and digital twin
- Adding real time interpretation of the laparoscopic field
  - Deep learning approach
- Tools for Autonomous surgery !

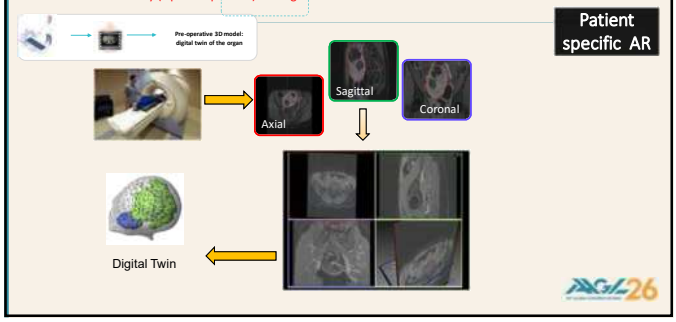


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Augmented reality :

- Using preoperative information (mainly anatomy : MRI / CT / US : digital twin)
  - fusion between reality (laparoscopic view) and digital twin

Patient specific AR

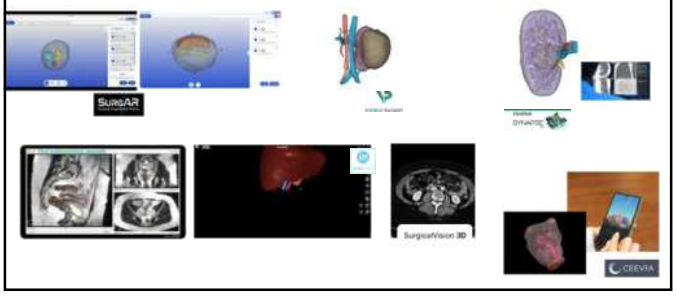


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Digital Twin

Presurgical planning

Patient specific AR

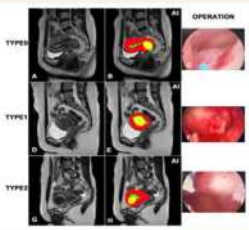


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Digital Twin

Patient specific AR

Revolutionizing hysteroscopy outcomes: AI-powered uterine myoma diagnosis algorithm shortens operation time and reduces blood loss

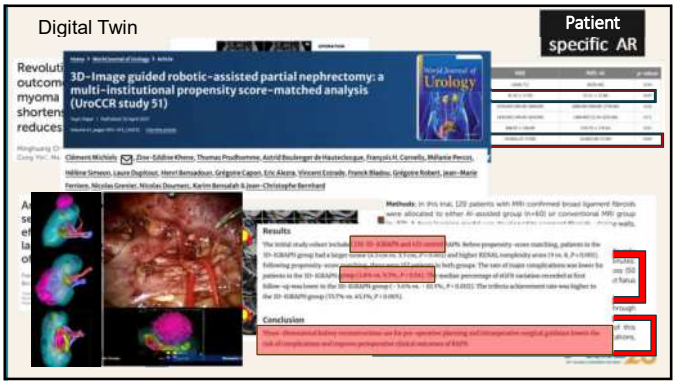


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Digital Twin

Patient specific AR

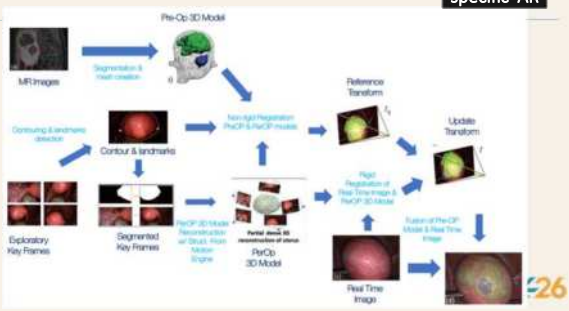
3D-Image guided robotic-assisted partial nephrectomy: a multi-institutional propensity score-matched analysis (UroCCR study 51)



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From Digital Twin to AR

Patient specific AR

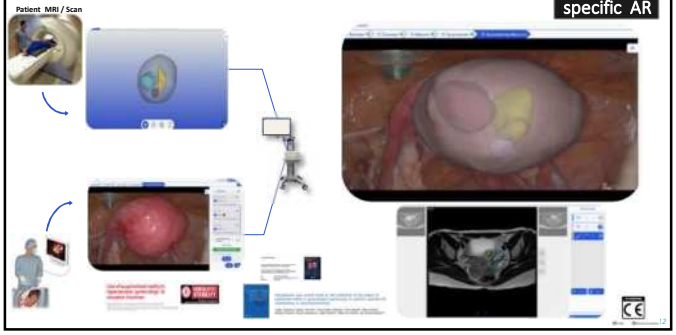


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Augmented reality : Using preoperative information

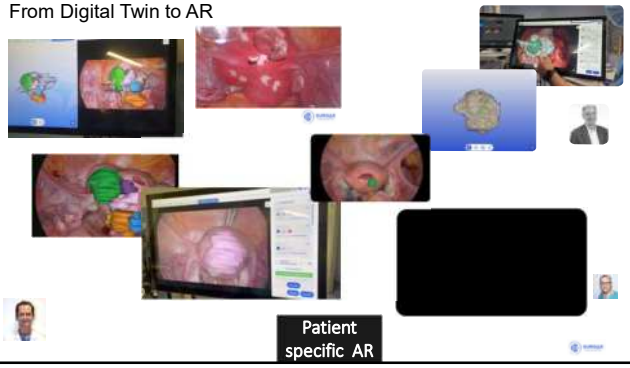
fusion between reality (laparoscopic view) and digital twin

Patient specific AR

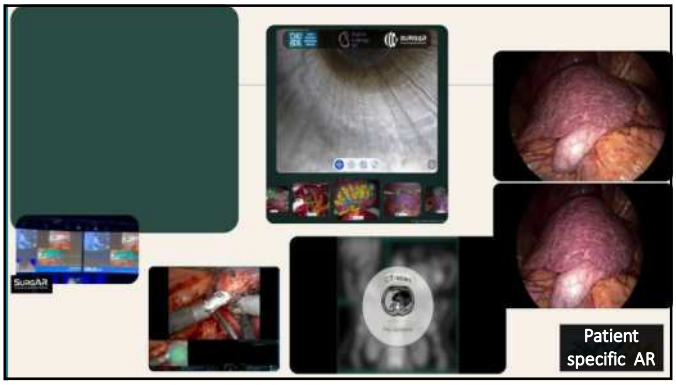


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From Digital Twin to AR



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Disease
specific AR

AI and endometriosis



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Augmented reality :
Adding real time interpretation of the laparoscopic field with
Deep learning approach

Disease
specific AR

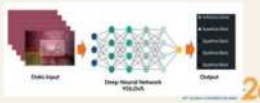
Data collection *Data anonymization* *Storage* *Dataset* *Segmentation*



FEMaLe

Neural network creation





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Disease
specific AR

Back to the basics… alphabet

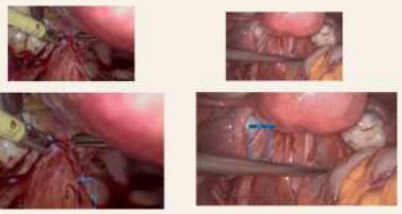




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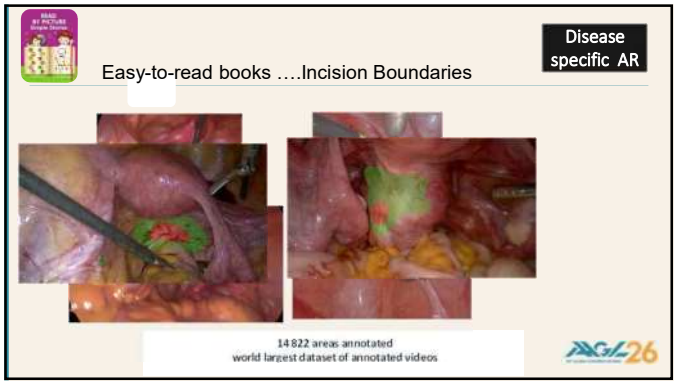
words

Disease
specific AR

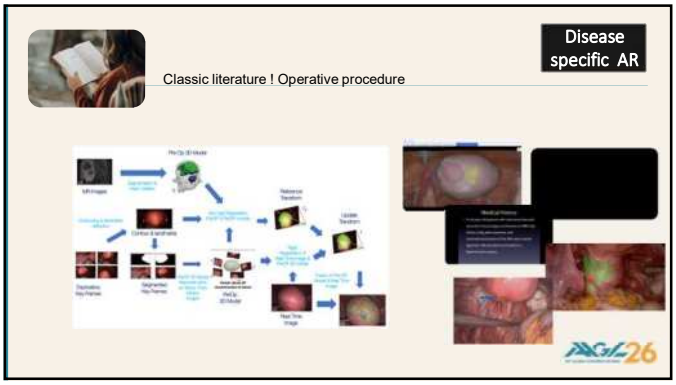


19 000 frames annotated
61791 annotations
world largest dataset of annotated image

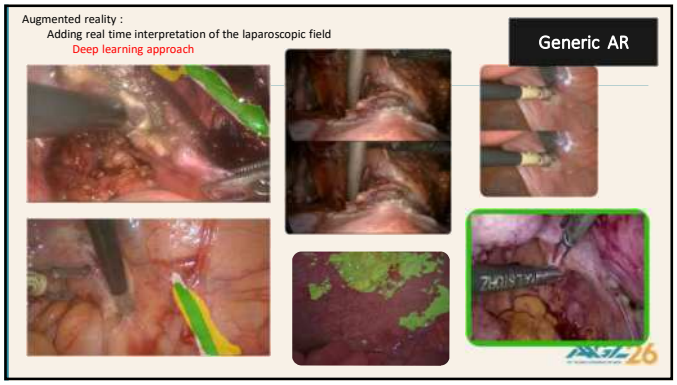
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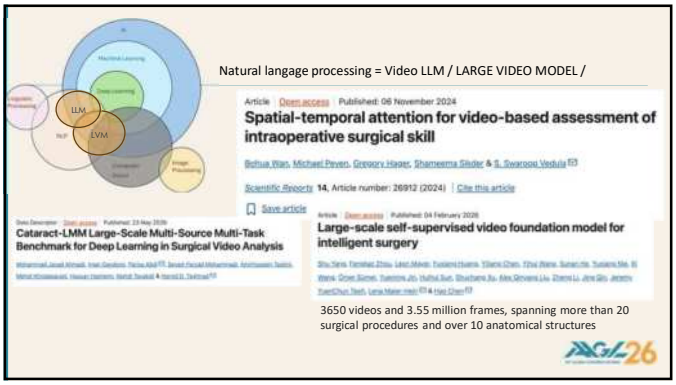
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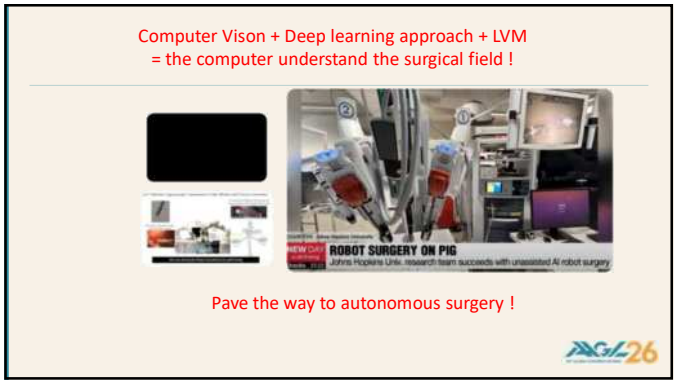
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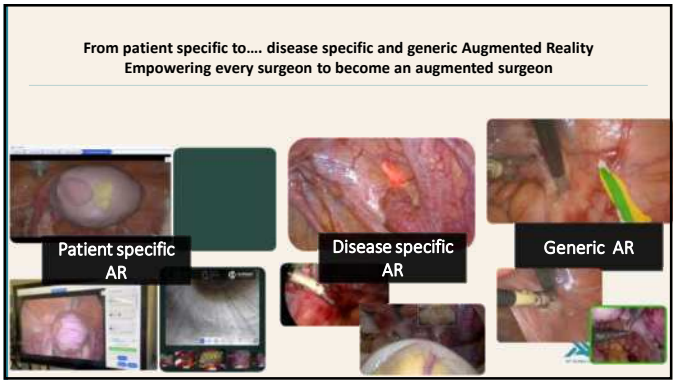
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SESSION TITLE: 430: Artificial Intelligence and Image-Guided Surgery for Intraoperative Safety in Gynaecological Minimally Invasive Surgery

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1

Image-guided Strategies for Ureteral, Vascular and Nerve Safety in Complex Pelvic Surgery

Juan Gilabert Estellés, MD, PhD · University of Valencia (Spain). Hospital General Universitario de Valencia (Spain)

NOVEMBER 13-16, 2026 · BOSTON · #AAGL26

2

Disclosure

"I have no financial relationships to disclose."

3

Objectives

- Describe anatomical landmarks in complex gynecological surgery
- Identify the best tracer for image guided surgery
- Illustrate the surgical technique to prevent damage of ureter, nerves and vessels
- Analyse the different tools for preoperative diagnosis
- Discuss on the role of artificial intelligence in the management of complex gynecological surgery

BLOOM'S TAXONOMY VERBS LIST · COGNITIVE DOMAIN

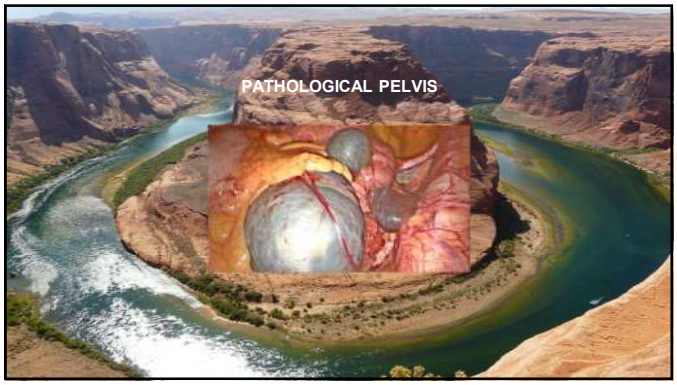
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5



6


PATHOLOGICAL PELVIS

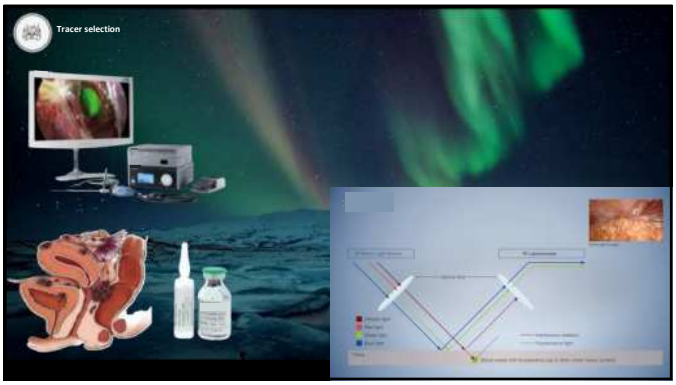
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Tracer selection
Artificial intelligence
Image guided surgery
Anatomical landmarks
Surgical planning
Pero-Intraoperative imaging

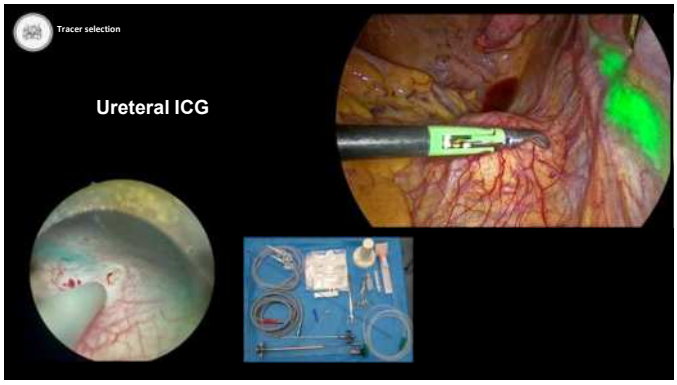
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Tracer selection
Tc-99m
Isosulfan blue
Indocyanine Green
Blue Patent

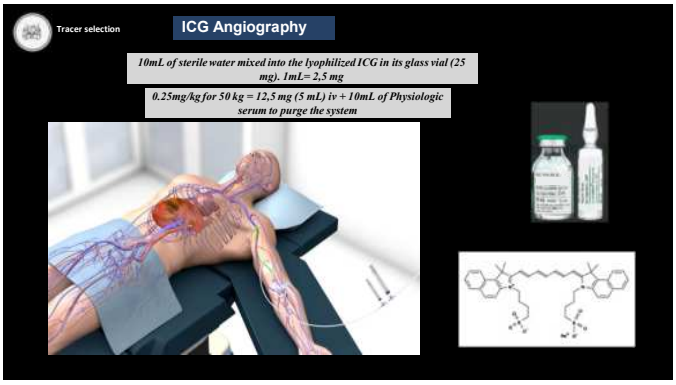
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Tracer selection

10


Tracer selection
Ureteral ICG

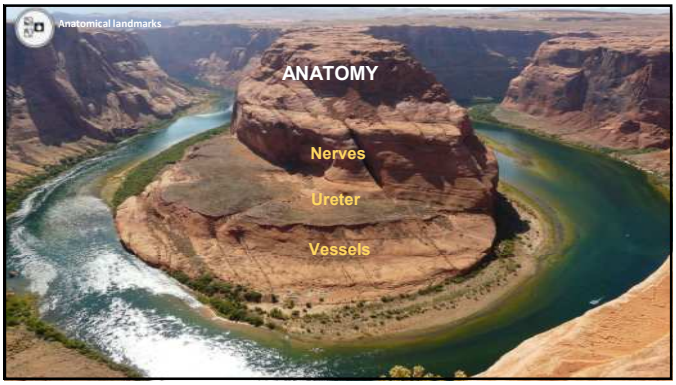
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Tracer selection
ICG Angiography
10mL of sterile water mixed into the lyophilized ICG in its glass vial (25 mg). 1mL= 2,5 mg
0.25mg/kg for 50 kg = 12,5 mg (5 mL) iv + 10mL of Physiologic serum to purge the system

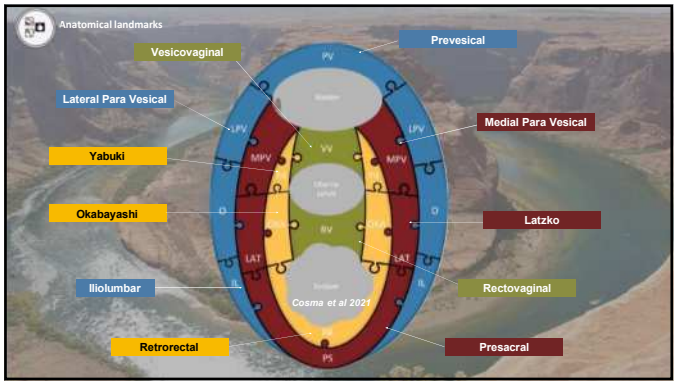
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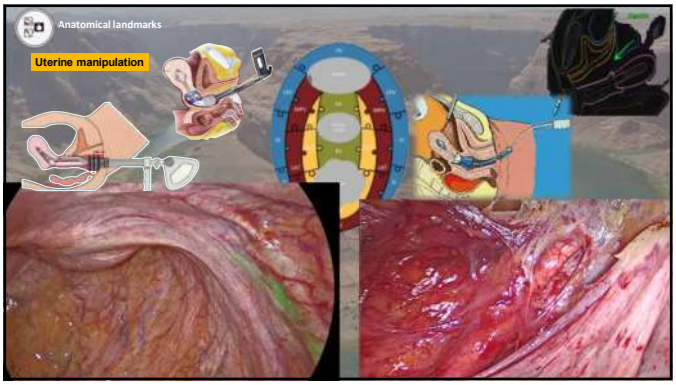
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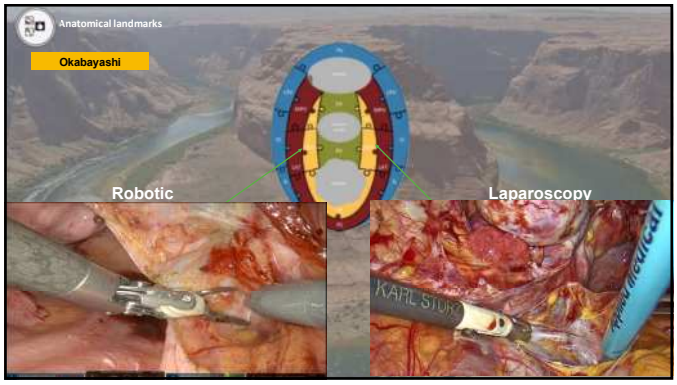
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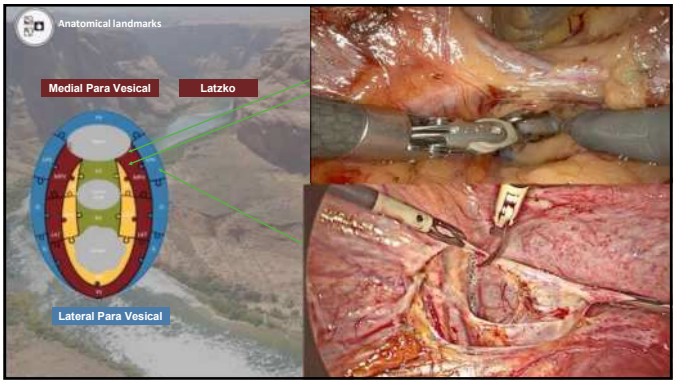
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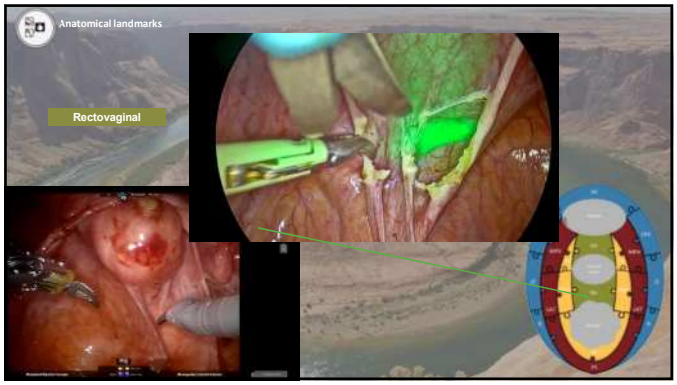
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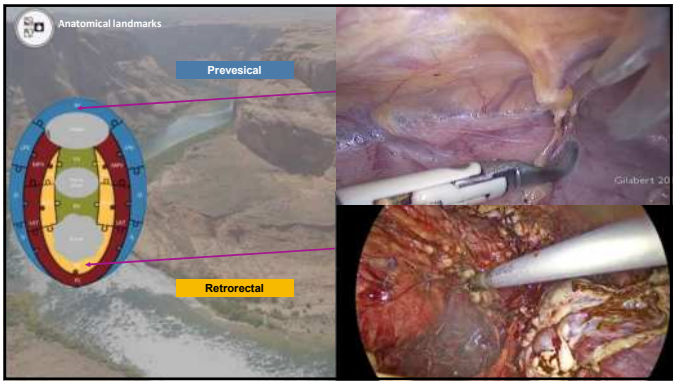
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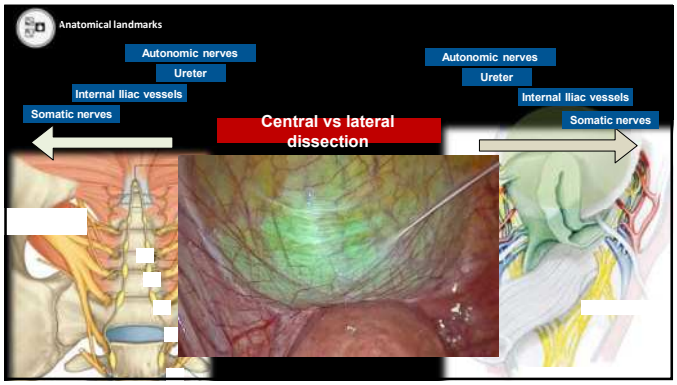
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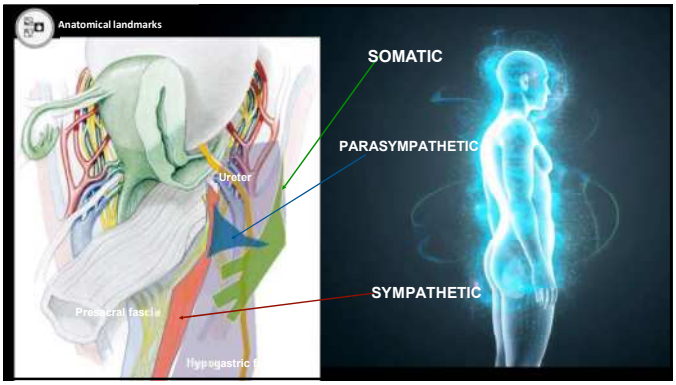
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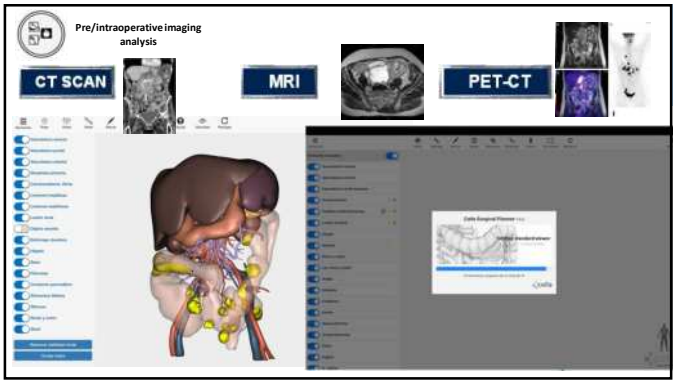
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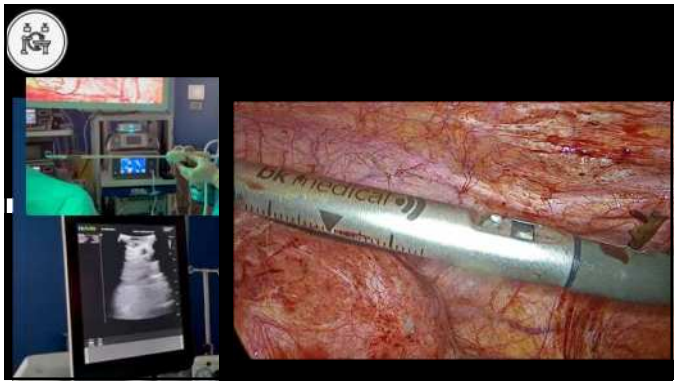
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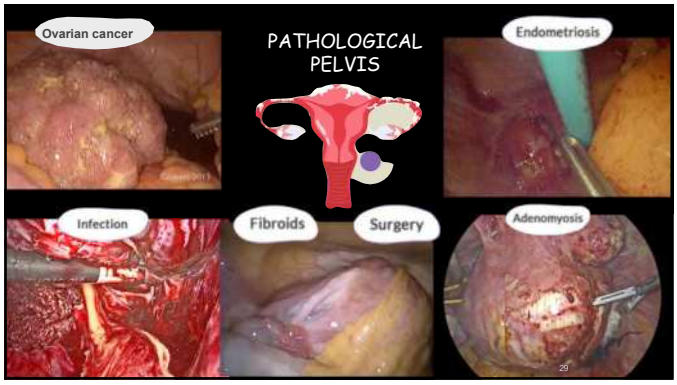
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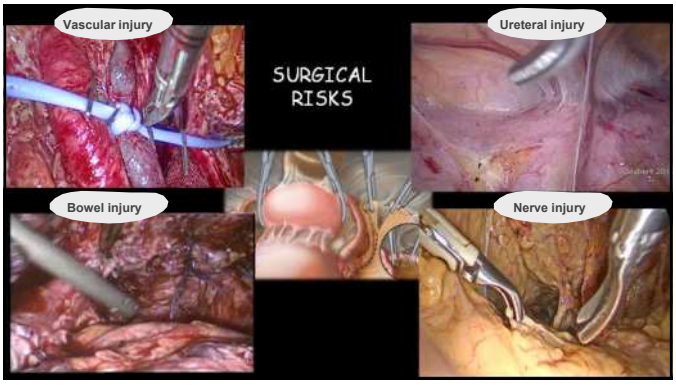
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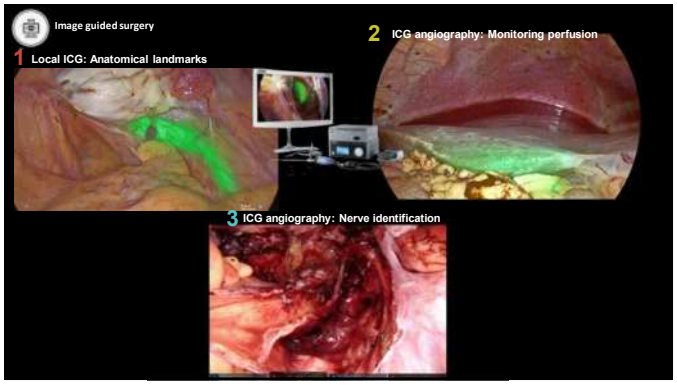
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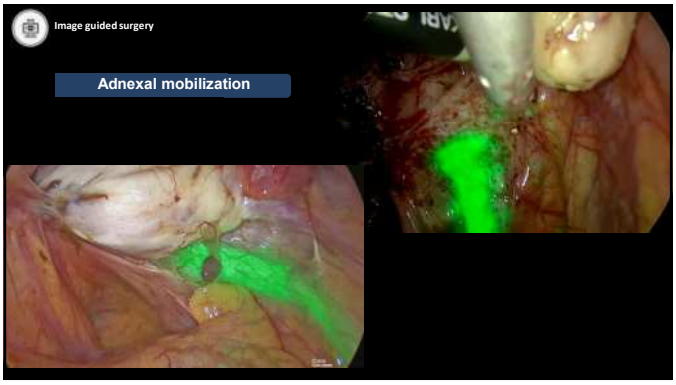
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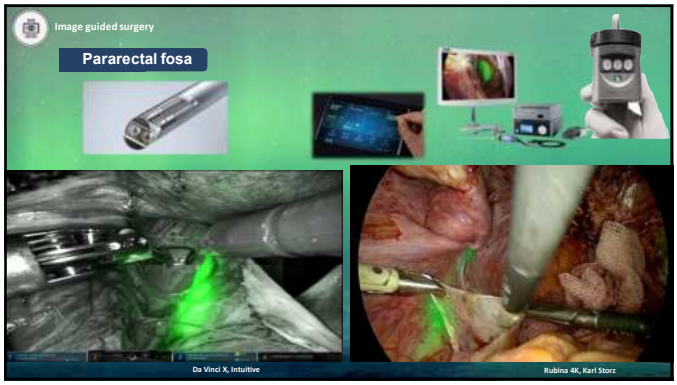
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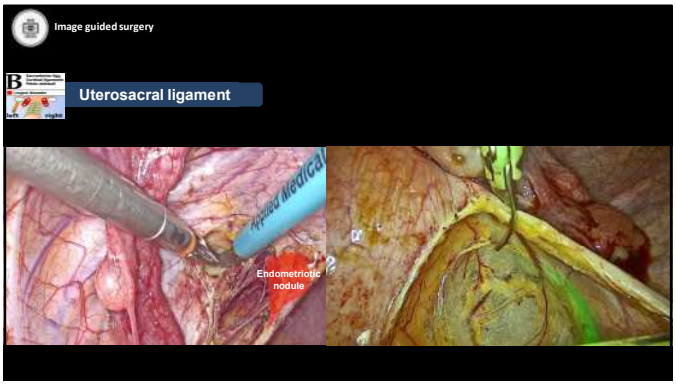
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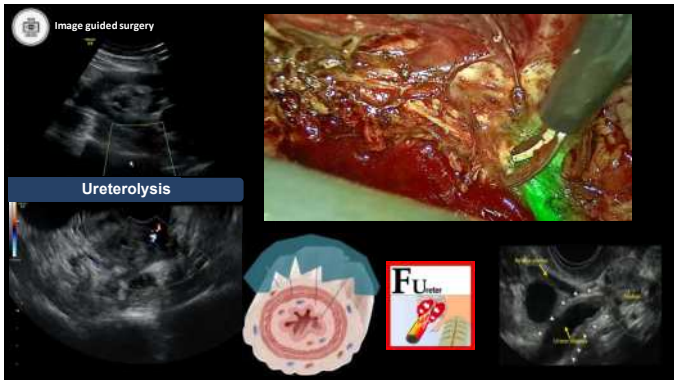
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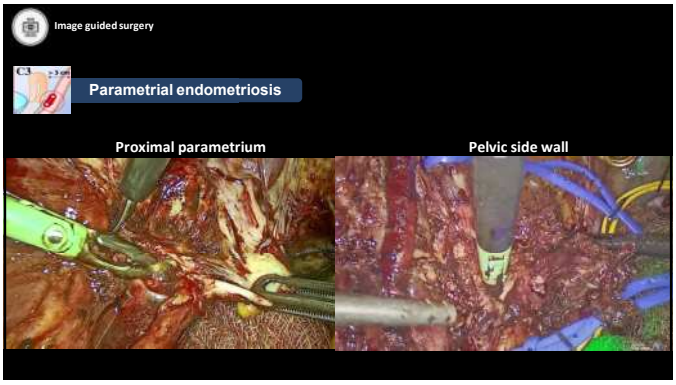
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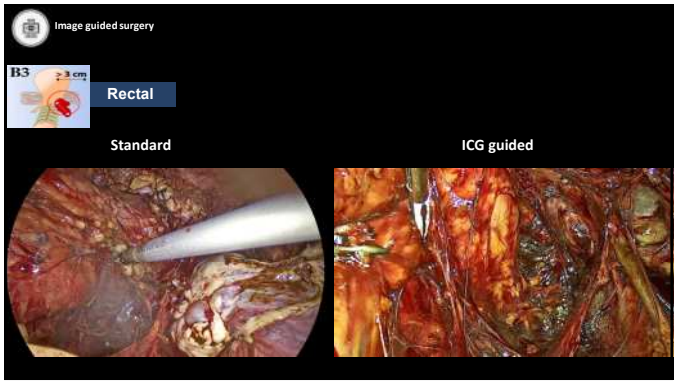
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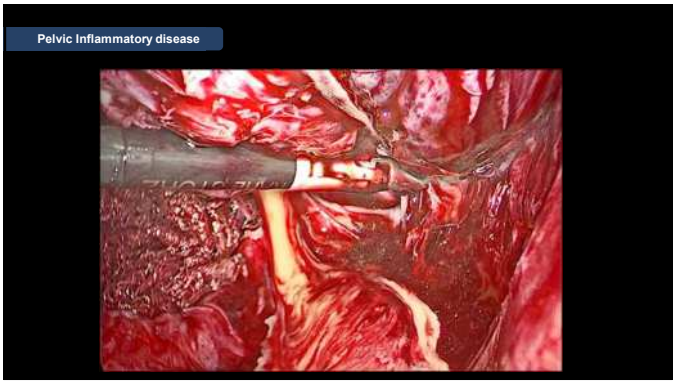
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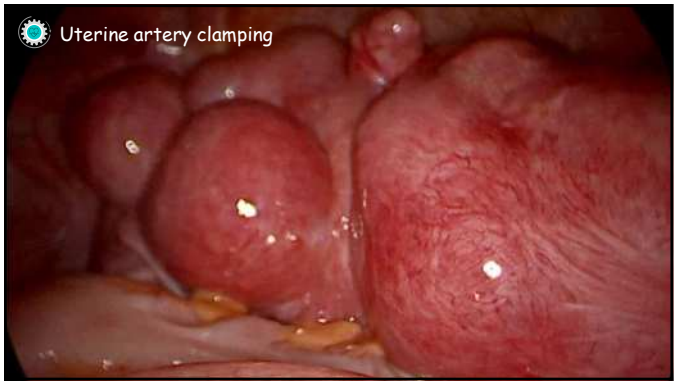
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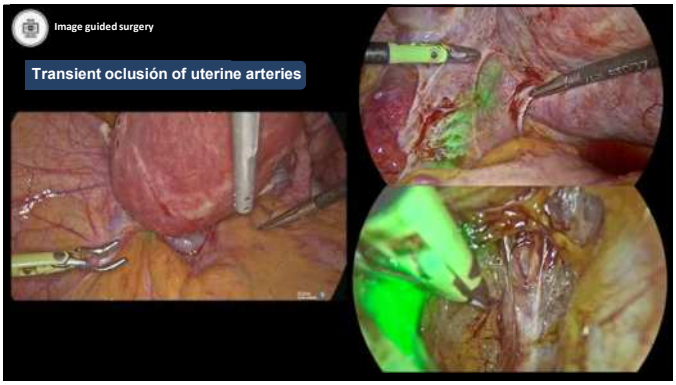
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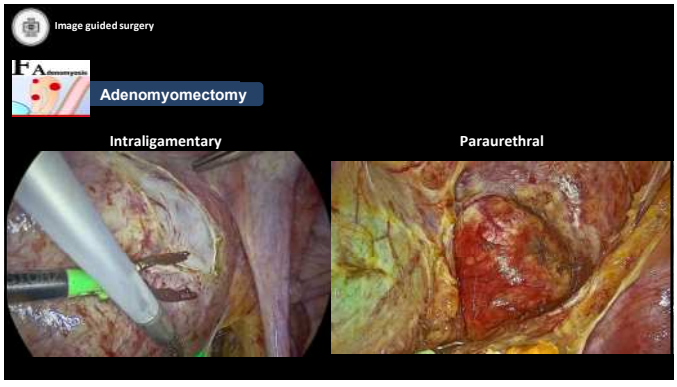
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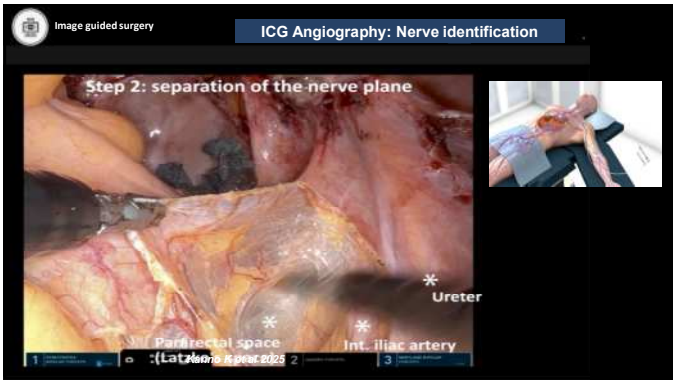
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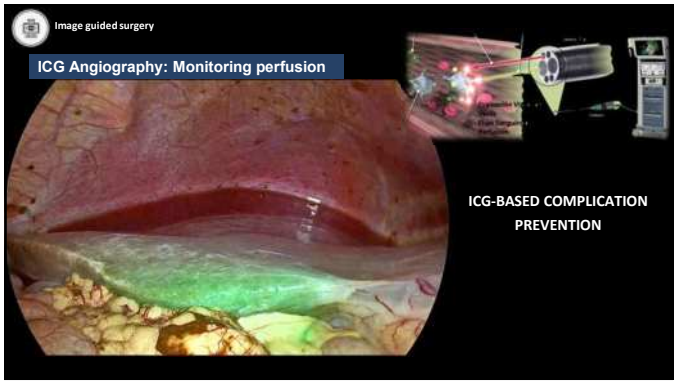
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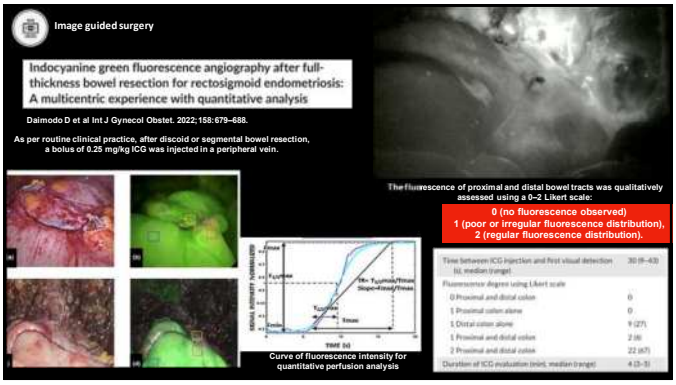
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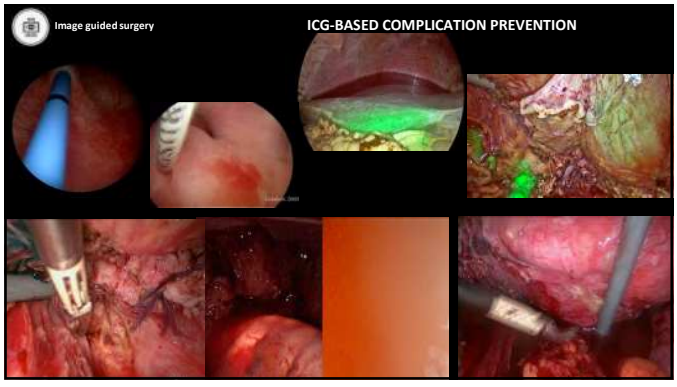
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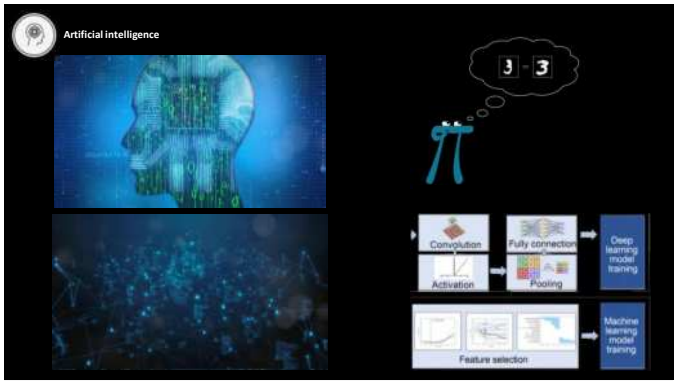
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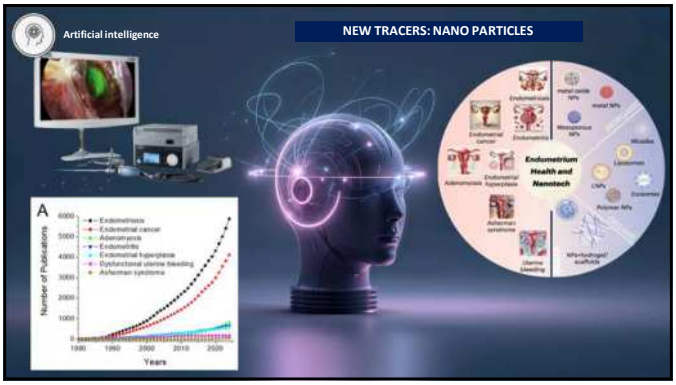
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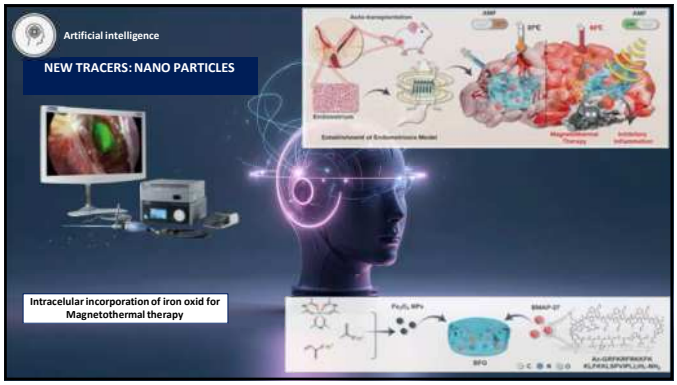
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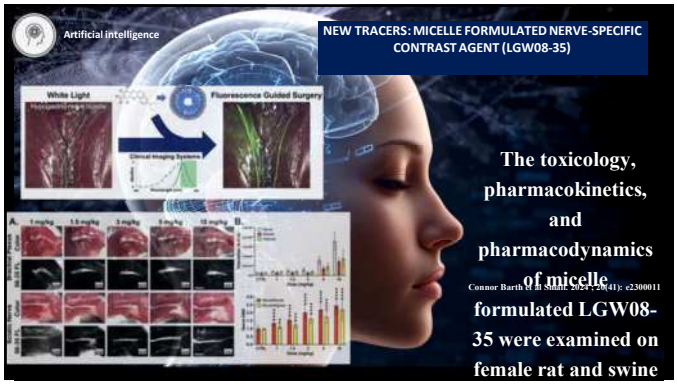
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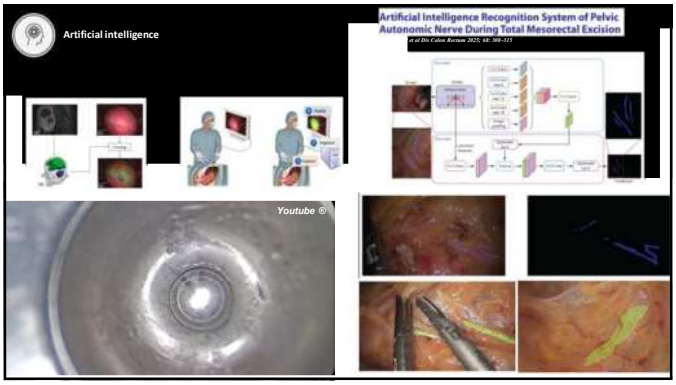
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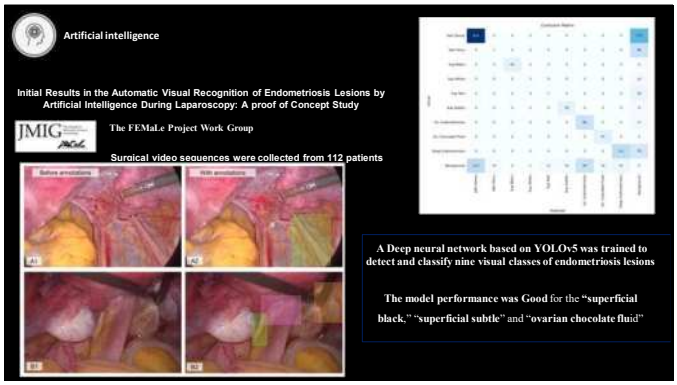
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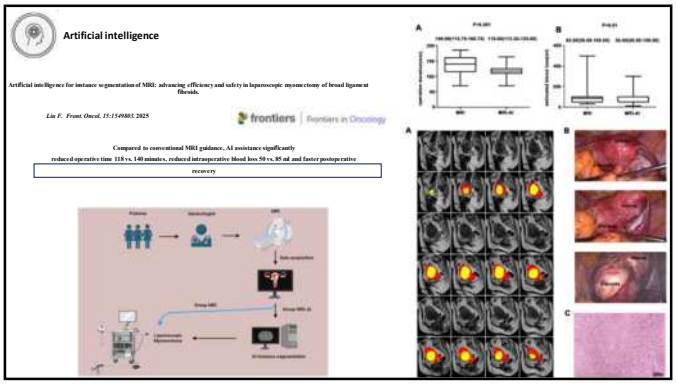
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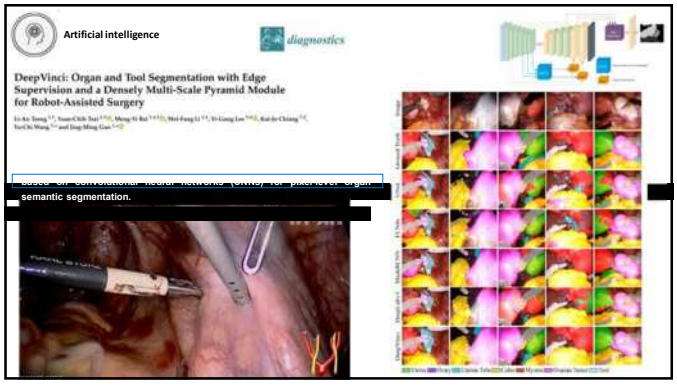
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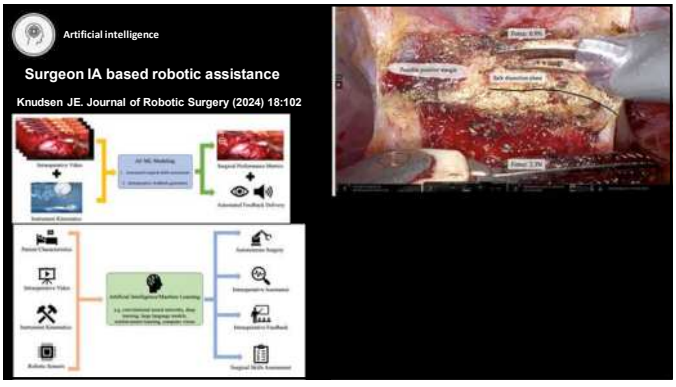
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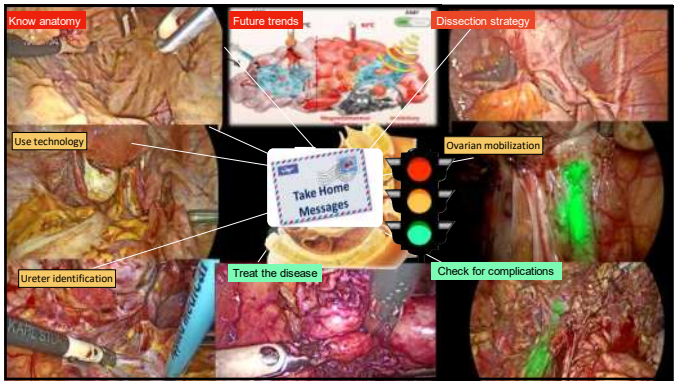
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Artificial intelligence
Robotics
Robot autónomo
2025

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Take Home Messages
DOC
JAN

62


Know anatomy
Future trends
Dissection strategy
Use technology
Ovarian mobilization
Take Home Messages
Ureter identification
Treat the disease
Check for complications

63


Thank you very much for your attention

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CULTURAL AND LINGUISTIC COMPETENCY & IMPLICIT BIAS

The California Medical Association (CMA) outlines standards for Cultural Linguistic Competency and Implicit Bias in CME. The goal of the standards is to support the role of accredited CME in advancing diversity, health equity, and inclusion in healthcare. These standards are relevant to ACCME-accredited, CMA-accredited, and jointly accredited providers located in California. AAGL is ACCME-accredited and headquartered in California.

CMA developed the standards in response to California legislation (Business and Professions (B&P) Code Section 2190.1), which directs CMA to draft a set of standards for the inclusion of cultural and linguistic competency (CLC) and implicit bias (IB) in accredited CME.

The standards are intended to support CME providers in meeting the expectations of the legislation. CME provider organizations physically located in California and accredited by CMA CME or ACCME, as well as jointly accredited providers whose target audience includes physicians, are expected to meet these expectations which began on January 1, 2022. AAGL has been proactively adopting processes that meet and often exceed the required expectations of the legislation.

CMA CME offers a variety of resources and tools to help providers meet the standards and successfully incorporate CLC & IB into their CME activities, including FAQ, definitions, a planning worksheet, and best practices. These resources are available on the CLC and IB standards page on the CMA website.

Important Definitions:

Cultural and Linguistic Competency (CLC) – The ability and readiness of health care providers and organizations to humbly and respectfully demonstrate, effectively communicate, and tailor delivery of care to patients with diverse values, beliefs, identities and behaviors, in order to meet social, cultural and linguistic needs as they relate to patient health.

Implicit Bias (IB) – The attitudes, stereotypes and feelings, either positive or negative, that affect our understanding, actions and decisions without conscious knowledge or control. Implicit bias is a universal phenomenon. When negative, implicit bias often contributes to unequal treatment and disparities in diagnosis, treatment decisions, levels of care and health care outcomes of people based on race, ethnicity, gender identity, sexual orientation, age, disability and other characteristics.

Diversity – Having many different forms, types or ideas; showing variety. Demographic diversity can mean a group composed of people of different genders, races/ethnicities, cultures, religions, physical abilities, sexual orientations or preferences, ages, etc.

Direct links to AB1195 (CLC), AB241 (IB), and the B&P Code 2190.1:

Bill Text – AB-1195 Continuing education: cultural and linguistic competency.
Bill Text – AB-241 Implicit bias: continuing education: requirements.
Business and Professions (B&P) Code Section 2190.1

CLC & IB Online Resources:

Diversity-Wheel-as-used-at-Johns-Hopkins-University-12.png (850×839) (researchgate.net)
Implicit Bias, Microaggressions, and Stereotypes Resources | NEA
Act, Communicating, Implicit Bias (racialequitytools.org)
https://www.contemporaryobgyn.net/view/overcoming-racism-and-unconscious-bias-in-ob-gyn
https://pubmed.ncbi.nlm.nih.gov/34016820/
https://hr.ucdavis.edu/departments/learning/certificate/implicit-bias
https://pmc.ncbi.nlm.nih.gov/articles/PMC7011228/