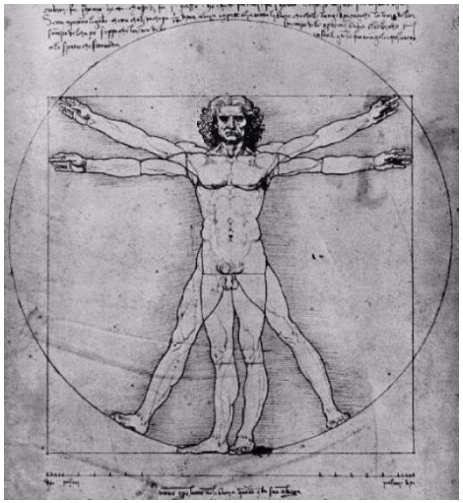
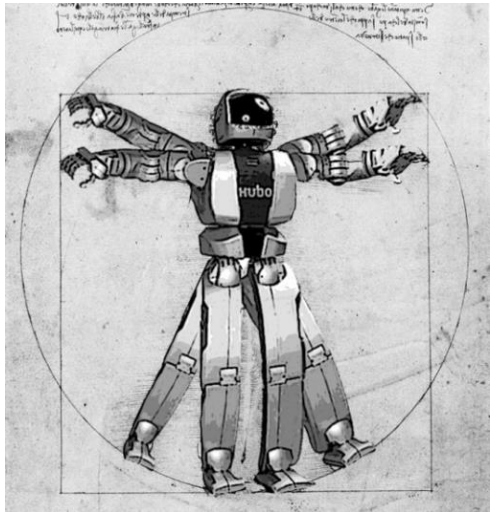
Robotic surgery:
Is it becoming a reality in GI cancer?



Philippe Rouanet

ICM Val d'Aurelle

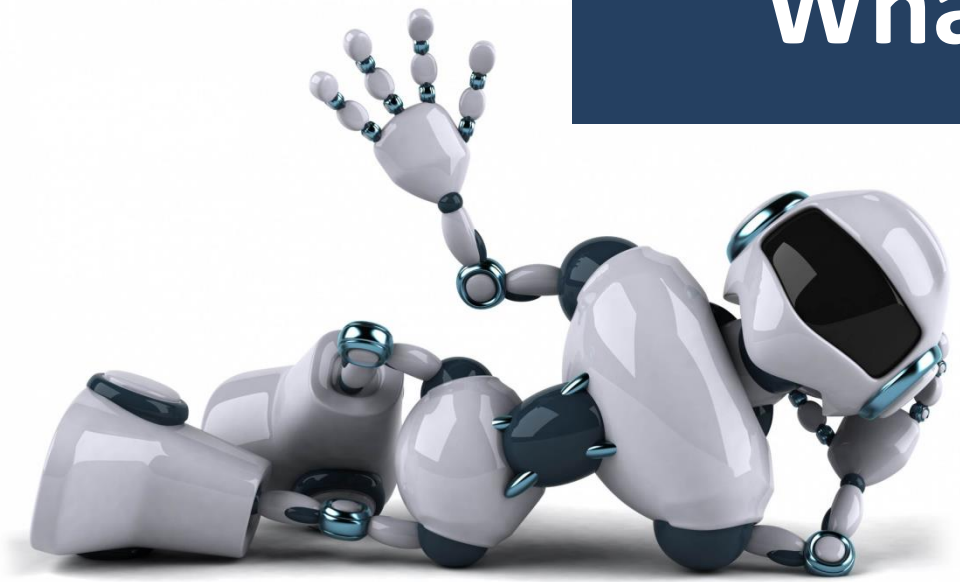
Montpellier

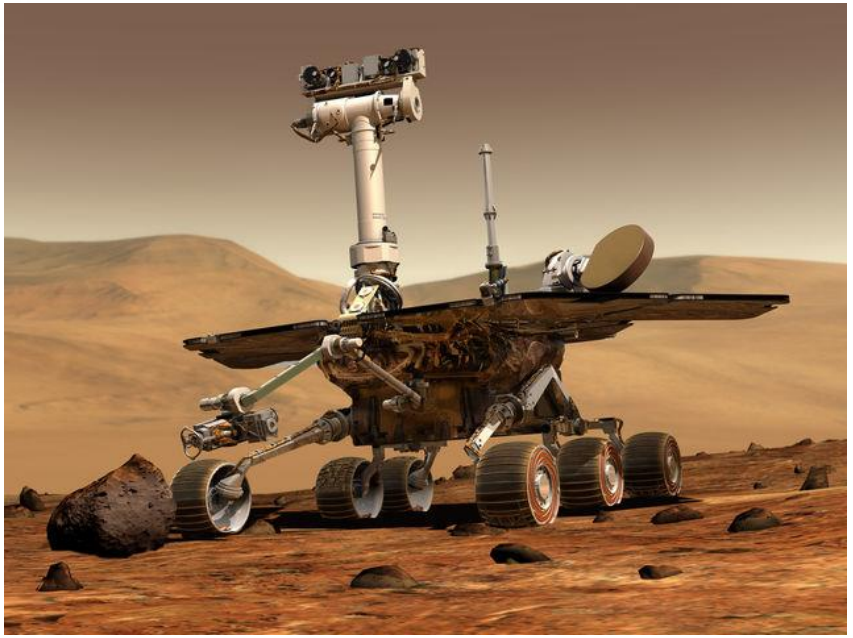


Disclosure

P Rouanet is a proctor for Intuitive

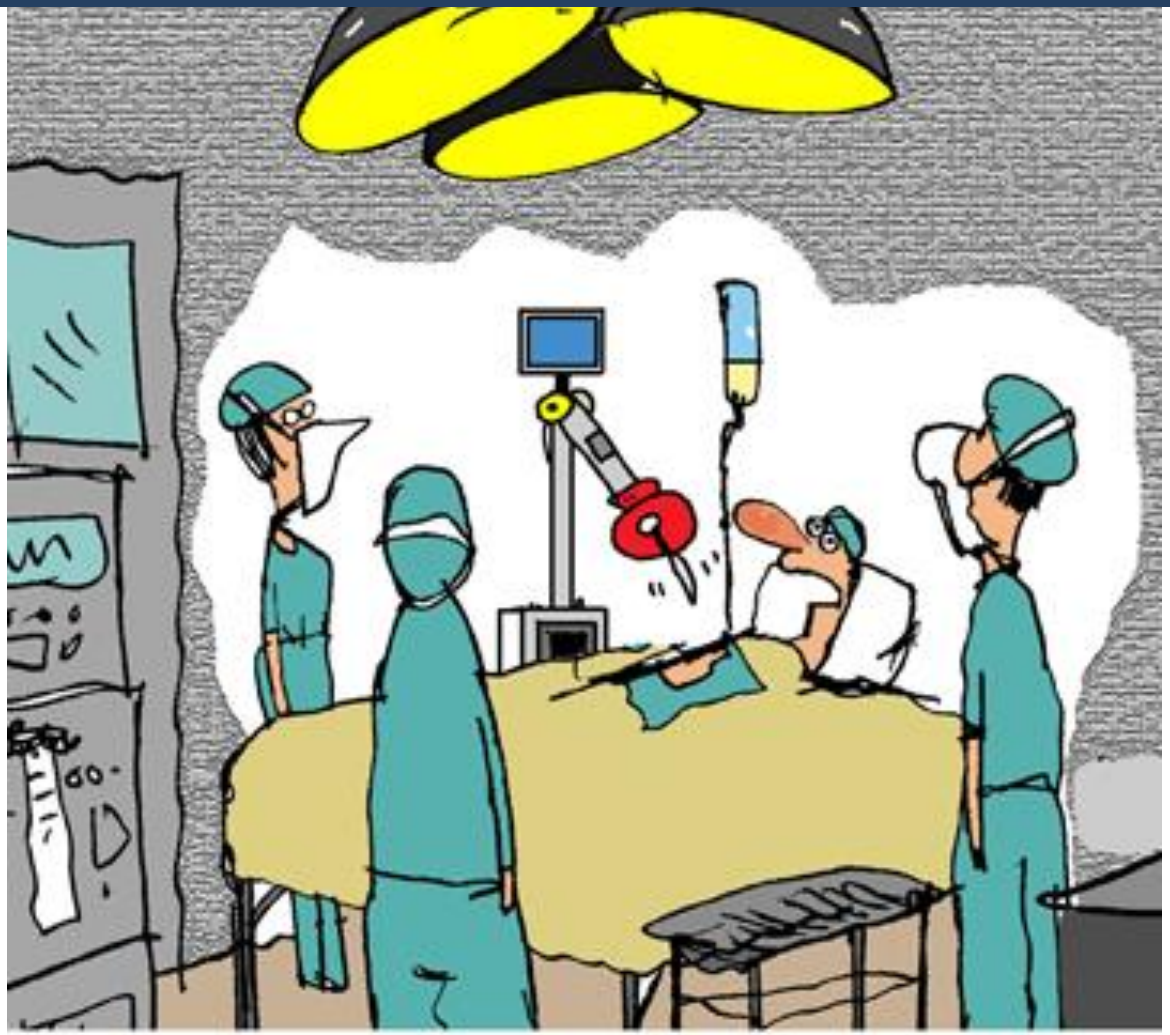
What is a robot ?



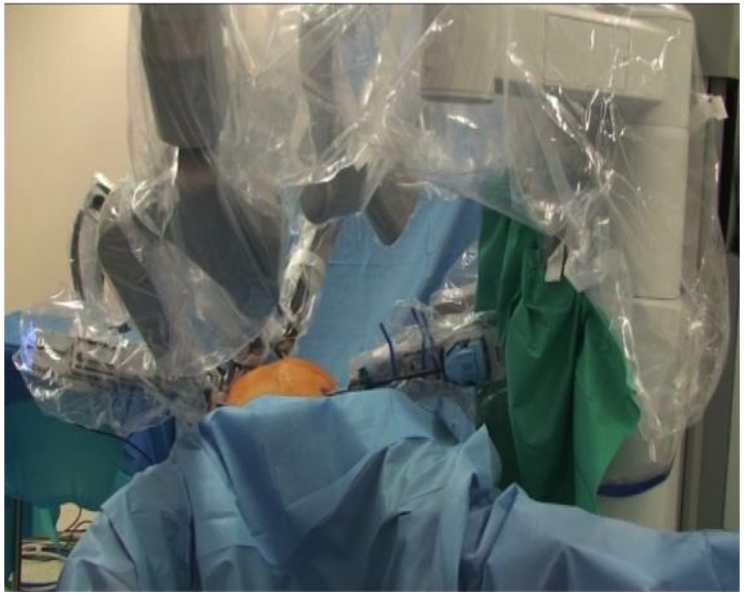


There are two robotic geologists on Mars

What is a robot ?

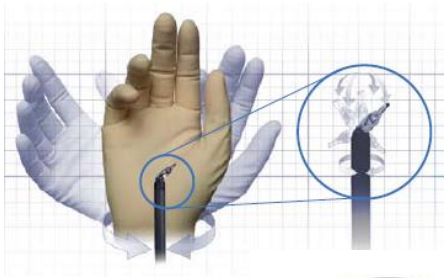


"Sir, please calm down. Our automated surgeon does not respond well under stressing loads."



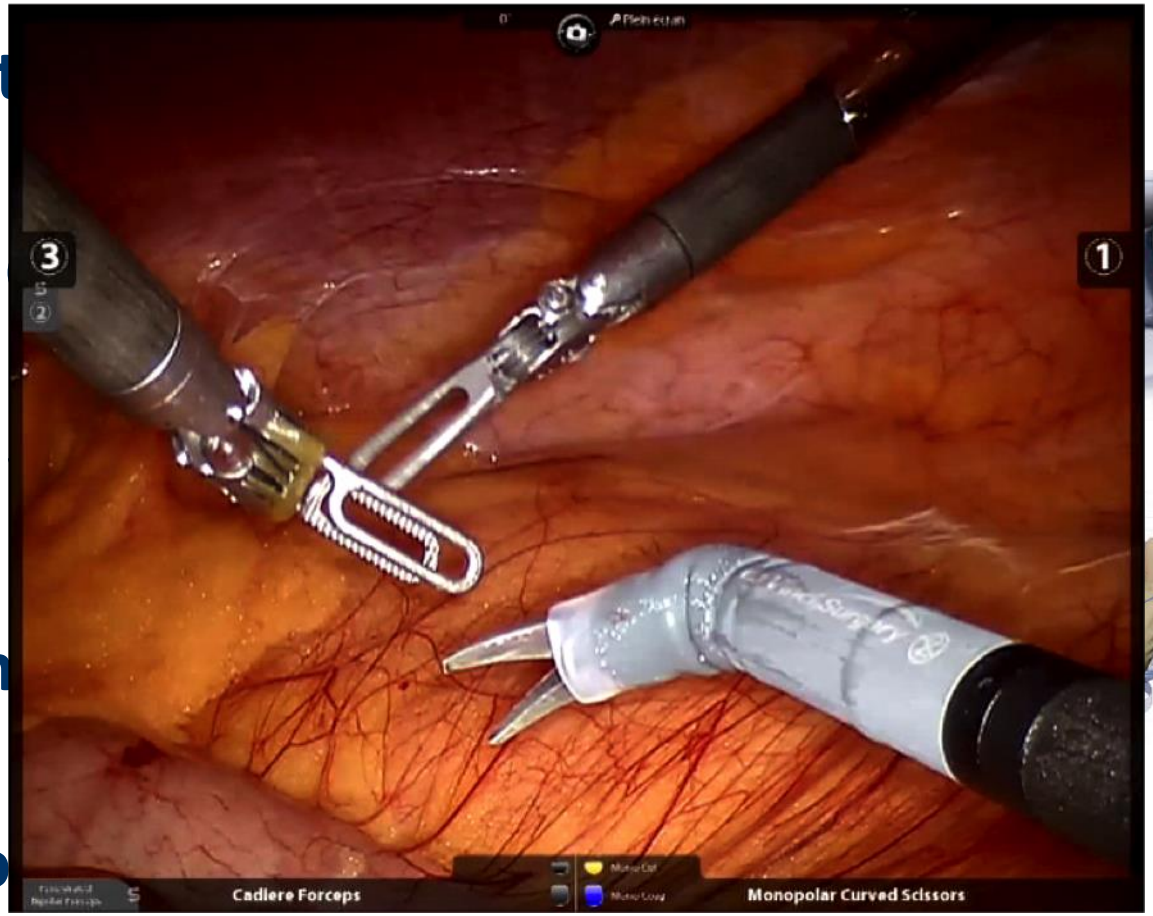
Robotic Surgery

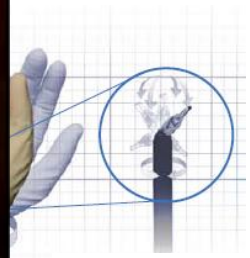
- « Intuitive » ambidextrous ability
- Stable Camera
- 3D HD view
- Instrumentation « EndoWrist® »
- Ergonomics for the surgeon



Robotic Surgery

- « Intuit
- Stable
- 3D HD
- Instrun
- Ergono



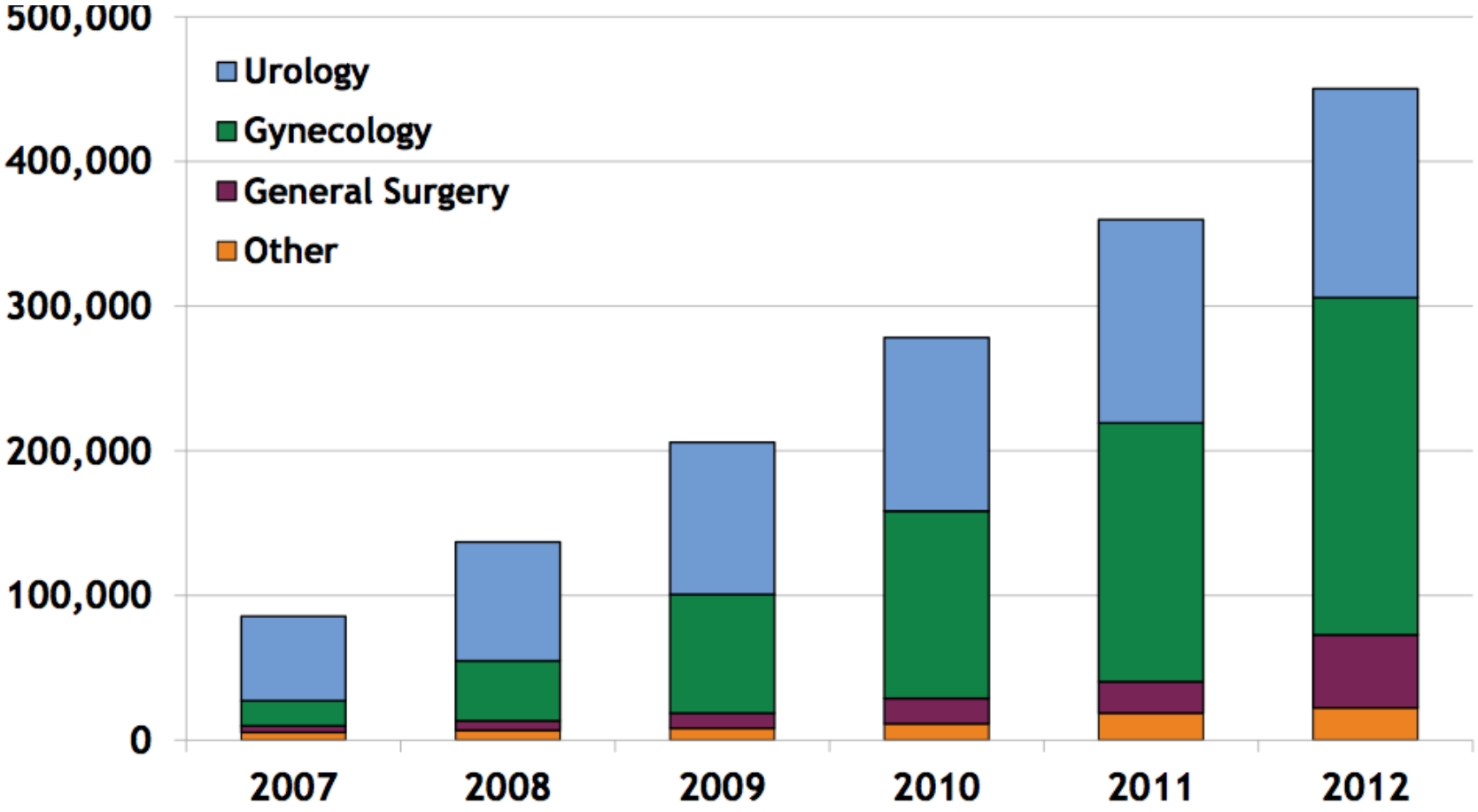


Robot and GI surgery ?
MIS and GI surgery ?

- **Less surgical aggressivity**
- **Better recovery**
- **Easiness for adjuvant treatment**

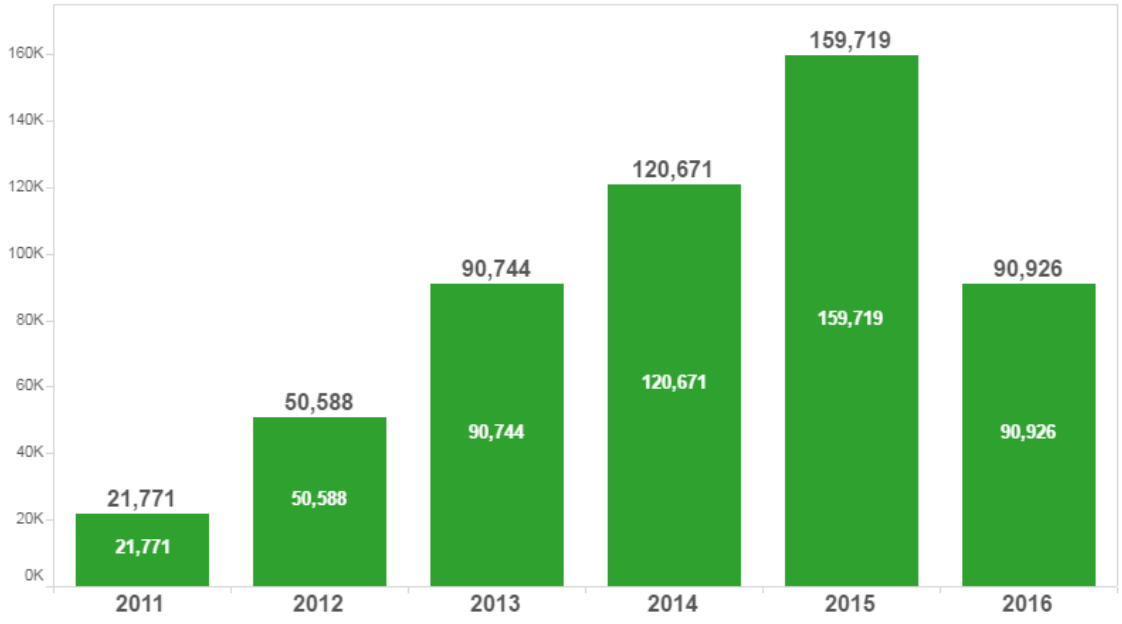
- **Better resecability: margin**
- **Surgical indication**
- **Oncologic prognosis**

dV Procedures Worldwide by Specialty

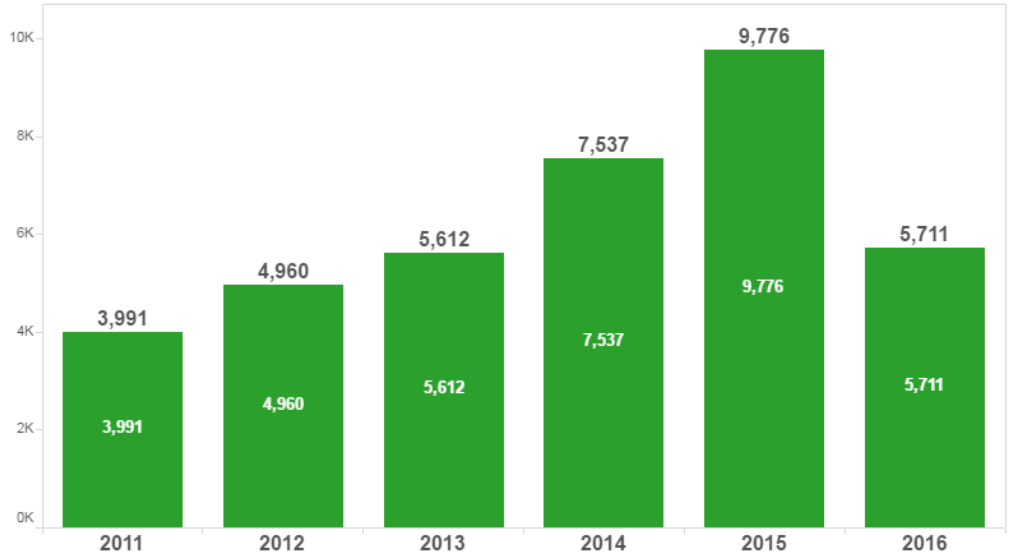


INTUITIVE SURGICAL®

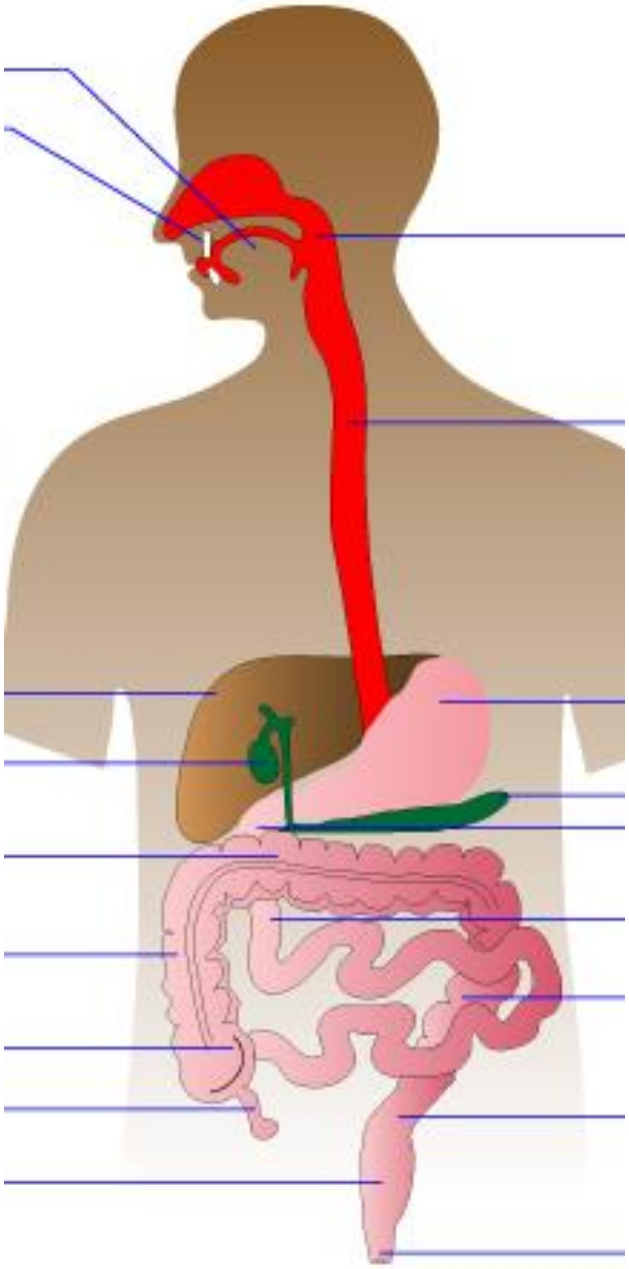
GI robotic procedures



World Wide



Europe



Upper GI cancer

- Oesophageal cancer
- Gastric cancer

Liver

Pancreas

Colo-Rectal cancer

Minimally invasive surgery for upper gastrointestinal cancer: Our experience and review of the literature.

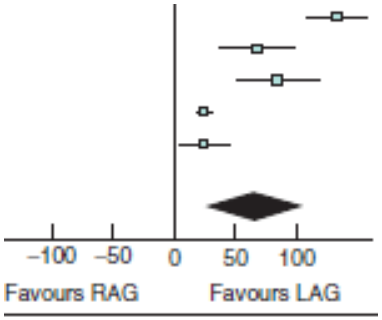
Suda K &al. WJG 2016

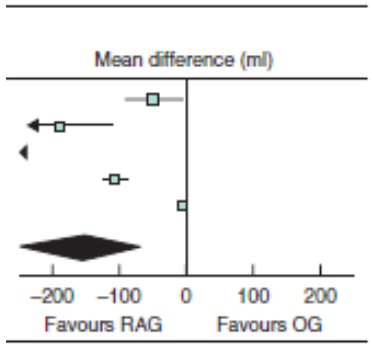
OG LG	trial	n	morbidity	mortality	OS
JCOG 0703	Ph II - St I	176	5%	0	-
JCOG 0912	Ph III – St I	923	NS	NS	-
KLASS 01	Ph III - St I	1416	13%/20%	0.3%/0.6%	-
JLSSG0901	Ph III – St II	500			RFS3
KLASS 02	Ph III – St II	1050			RFS3
CLASS 01	Ph III-St II	1056			RFS3

Systematic review and meta-analysis of robotic surgery compared with conventional laparoscopic and open resections for gastric carcinoma. Hyun MF & al. BJS 2013

Meta analysis, 9 studies , 7200 patients

	RAG // LAG / OG
Operat time	+ 61 / + 65 min
HLN	NS / NS
Blood loss	-6 / -154 ml
Hosp day	- 0.6 / -2.18 d
Post op complications	1.1 / 1.3

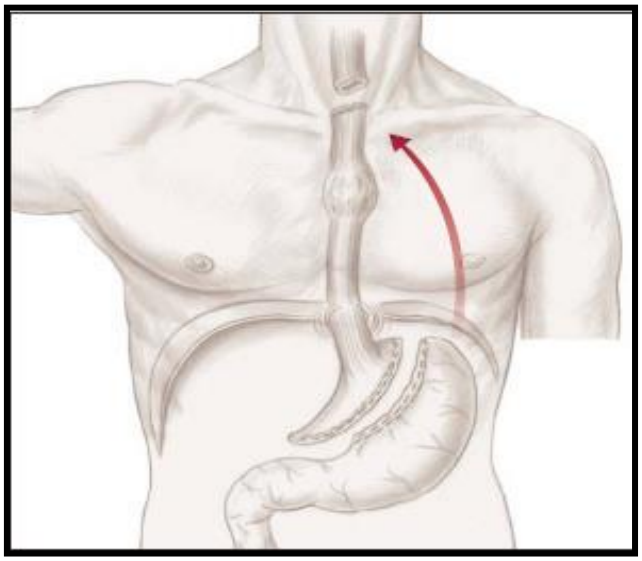




Conclusion: Short-term oncological outcomes of RAG were comparable with those of the other approaches. LAG was a shorter procedure and less expensive than RAG.

Oesophagectomy

- **For many years, esophageal surgery has been recognized as very challenging for surgeons and risky for patients**
- **MIS and pulmonary complications**



Minimally invasive esophagectomy: results of a prospective phase II multicenter trial-the eastern cooperative oncology group (E2202) study. **Luketich JD & al. Ann Surg 2015**

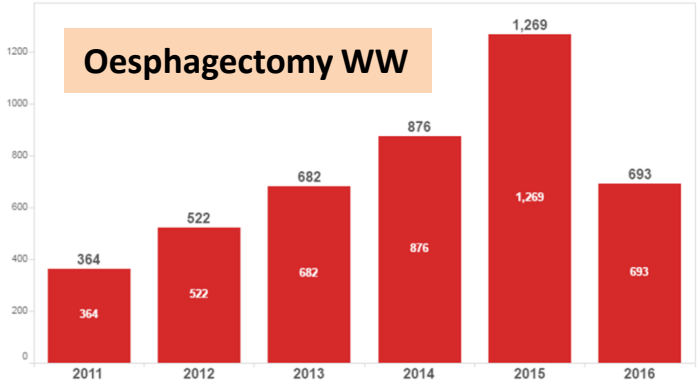
- Ph II, multicentric, prospective (17 sites)
- 30-D mortality: 2%
- Anastomotic leak: 8.6%
- ARDS: 6%
- OS3: 58.4%
- LR: 7%

CONCLUSIONS:

This prospective multicenter study demonstrated that MIE is feasible and safe with low perioperative morbidity and mortality and good oncological results.

Worldwide trends in surgical techniques in the treatment of esophageal and gastroesophageal junction cancer
Haverkamp L & al. Dis Oeso 2016

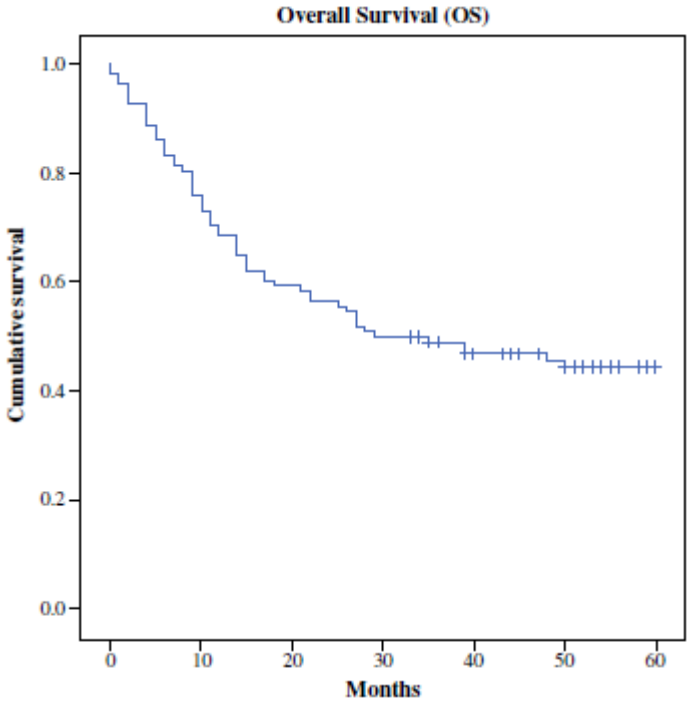
- Surgical techniques for esophageal cancer, Study from 2016 comparing to survey from 2007
- 48 responses for 1142 (42%) – 49 different countries
- High volume surgeon (>21/year): 45% to 54%
- MIS: 14% to 43%
- Cervical anastomosis: 87% to 54%

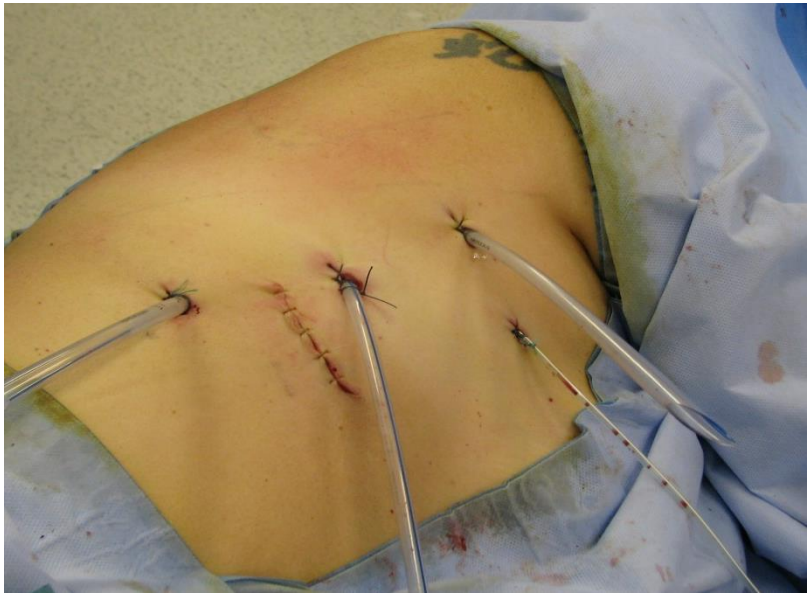


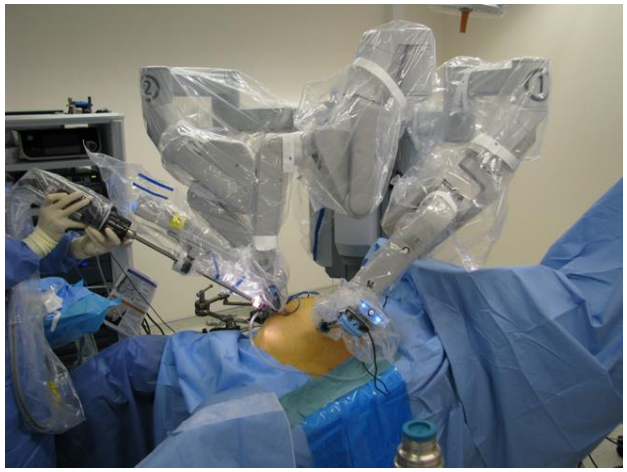
- Preferred approach
  - Siewert I : oesophagectomy 93%
  - Siewert II: gastrectomy 66% - oesophagectomy 27%
  - Siewert III: gastrectomy 95%

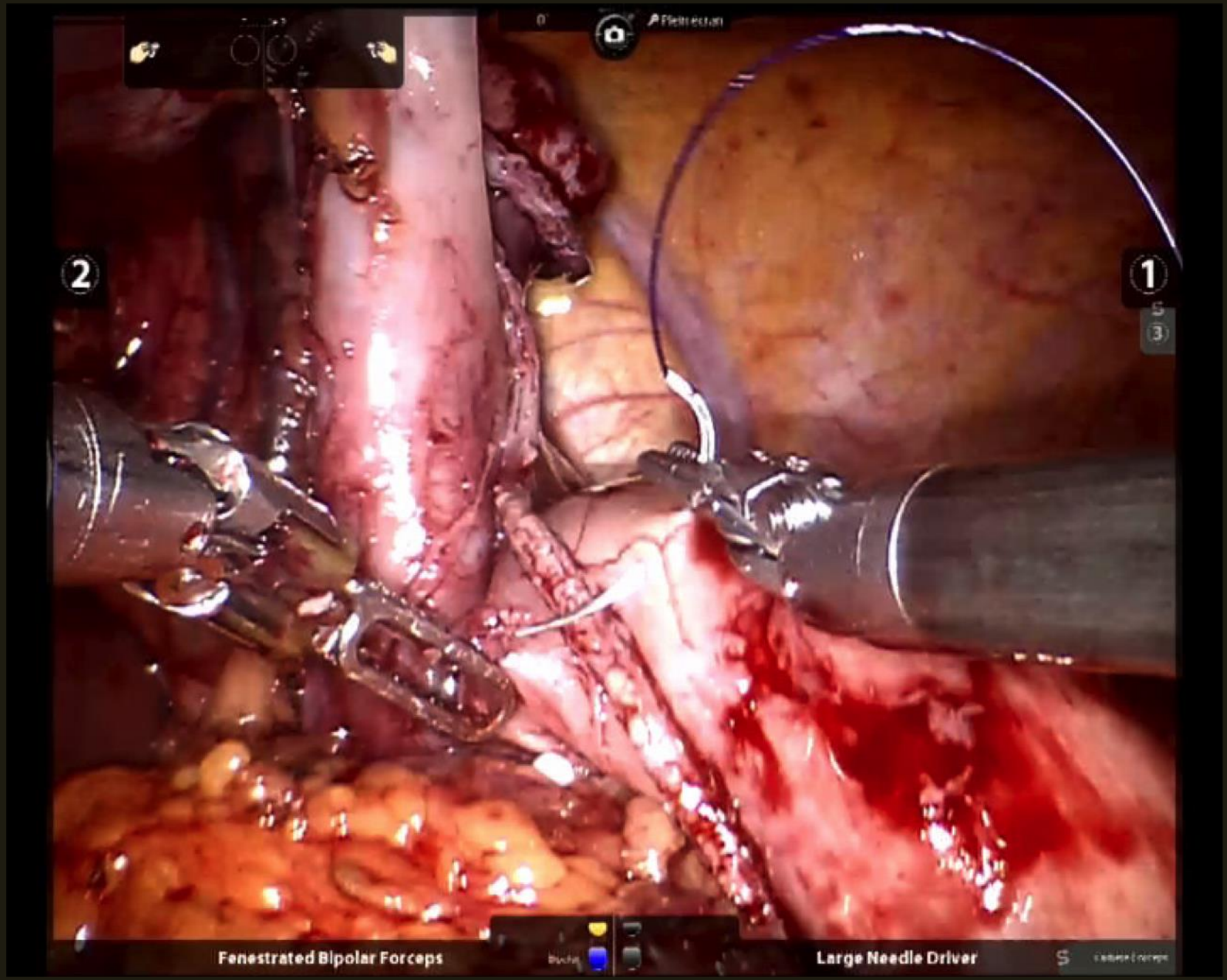
Oncologic Long-Term Results of Robot-Assisted Minimally Invasive Thoraco-Laparoscopic Esophagectomy with Two-Field Lymphadenectomy for Esophageal Cancer. Van der Sluis PC & al. ASO 2015

- **2007-2011 ; 108 RAMIE (robot-assisted MI eosophagectomy)**
- **Mc keown oesophagectomy (total, cervical anastomosis)**
- **Pulmonary complications: 33%**
- **Median ICU stay: 1 day**
- **Median hospital stay: 16 days**
- **Mortality: 5%**
- **NA Chemotherapy: 65%**
- **R0 resection 95%**
- **Median LNH: 26**
- **OS5: 42%**
- **Median DFS: 21 months**
- **LR: 20% (6% isolated / 14% combined)**





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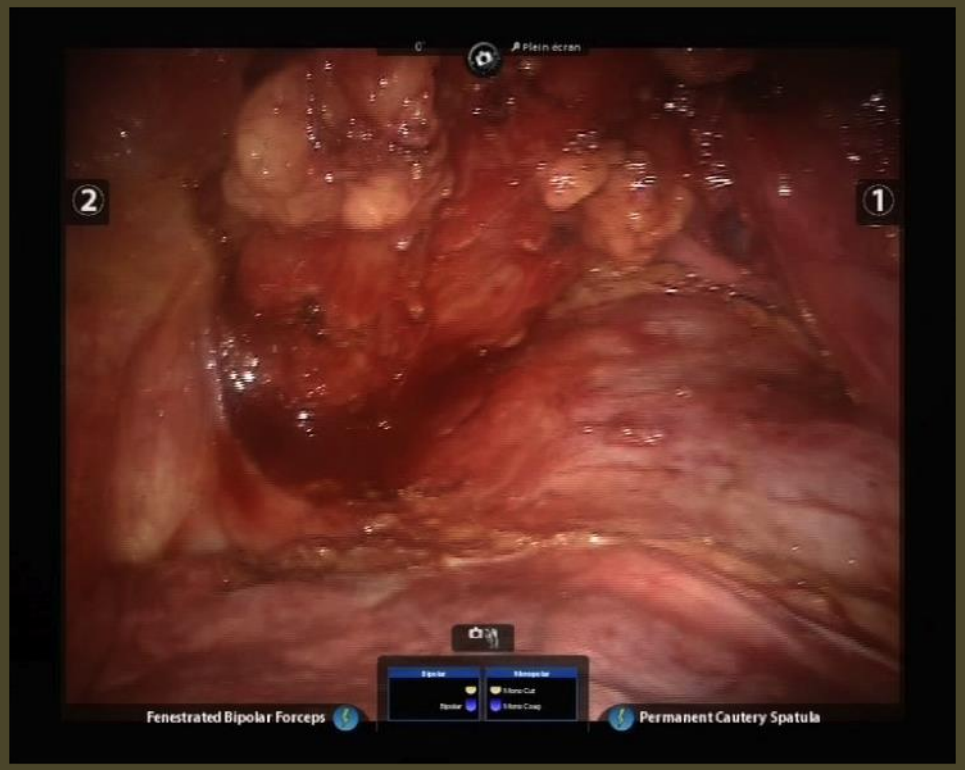
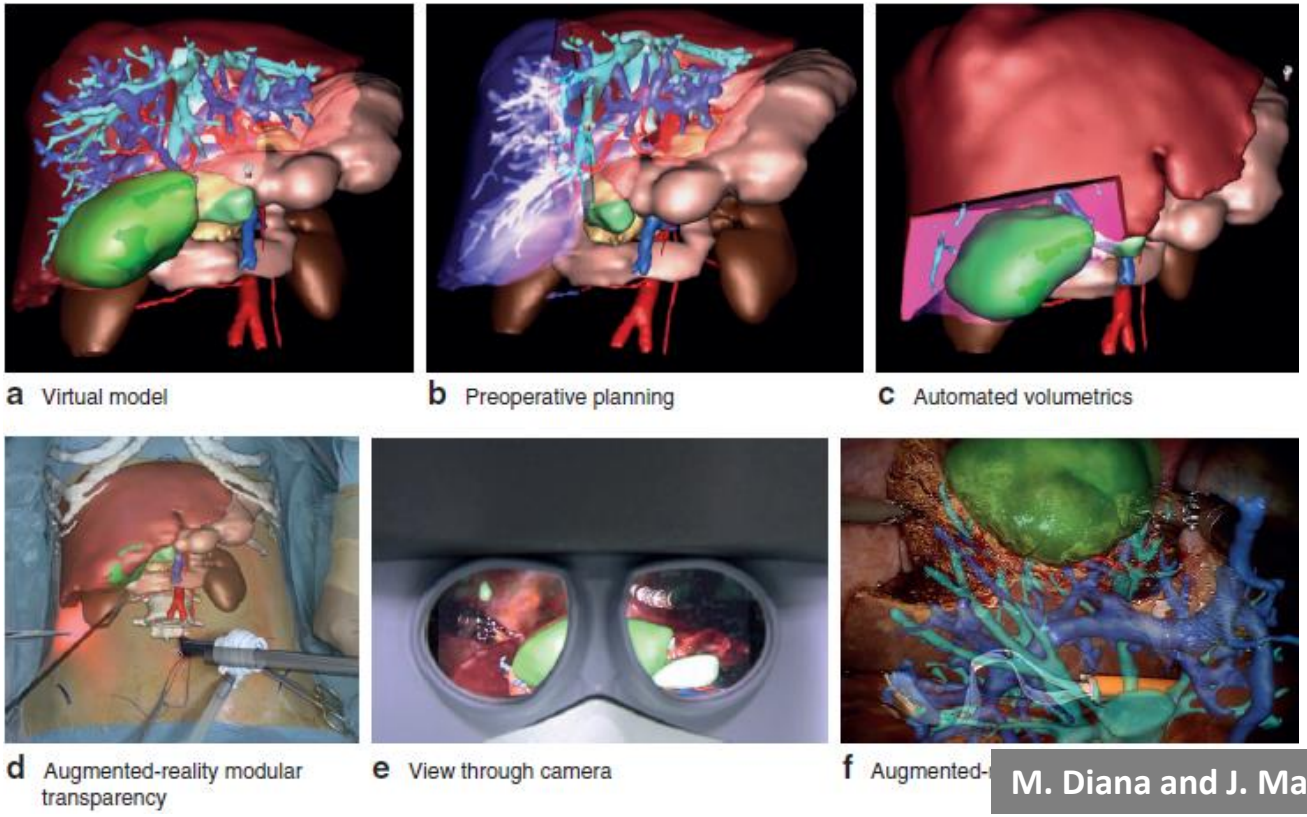
Fenestrated Bipolar Forceps
Large Needle Driver

Robotic Oesophagectomy



Robotic hepatectomies: advances and perspectives. Dehlawi &al. Minerva Chir 2016

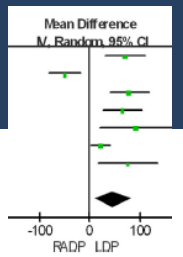
Robotic Liver Resection and laparoscopic liver resection were comparable in terms of safety, feasibility, and outcome for hepatectomies. However, RLR is more expensive than LLR.



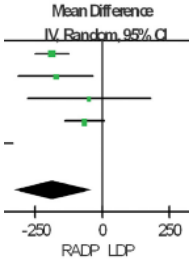
M. Diana and J. Marescaux *BJS* 2015

Robotic versus Laparoscopic Distal Pancreatectomy: A Meta-Analysis of ShortTerm Outcomes.

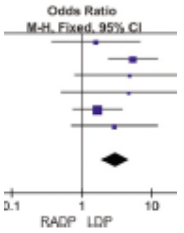
Zhou JY & al. Plos one 2016



- **7 non randomized trials / 568 patients**

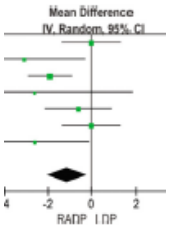


- **RADP was associated with**
  - **longer operating time,**
  - **lower estimated blood loss,**
  - **higher spleen-preservation rate,**
  - **shorter hospital stay.**



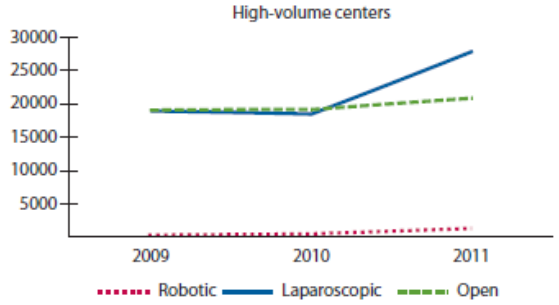
- **NS: Transfusion, Conversion, R0, LNH, Morbidity total cost, ICU stays**

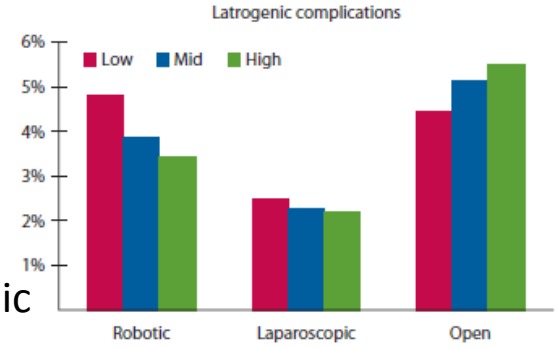
RADP is a safe and feasible alternative to LDP with regard to short-term outcomes.



Comparison of Open, Laparoscopic, and Robotic Colectomies Using a Large National Database: Outcomes and Trends Related to Surgery Center Volume. Yeo HL & al. DCR june 2016

- National inpatient sample, 2009-2012,
- 509029 Colectomies, 36% for cancer
- Distribution: 266263: Open (52%)
  235080: Laparoscopy (46%)
  7685: robotic (1,5%)

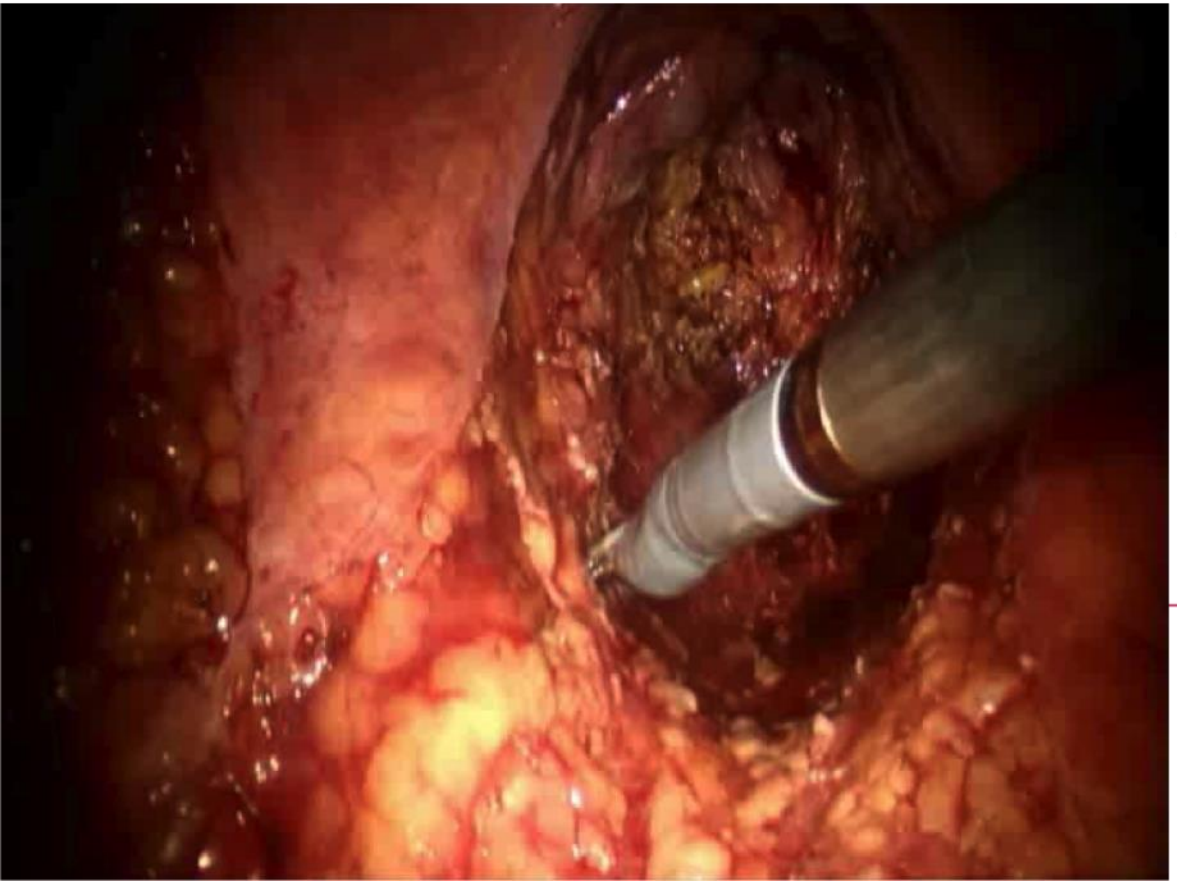


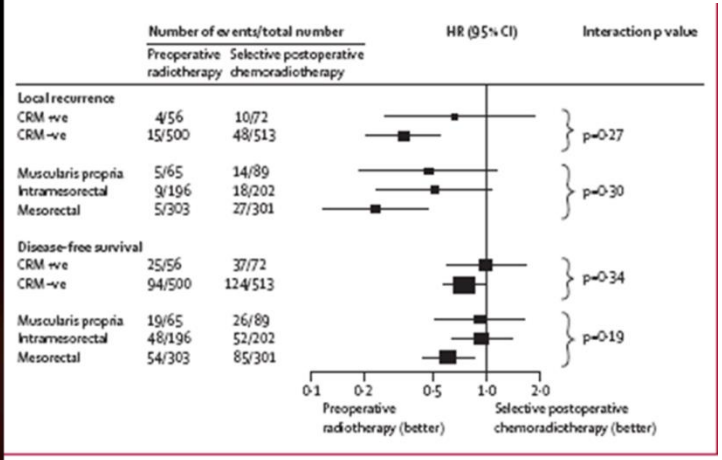


- **Robotic colectomy: 702 (2009) – 3390 (2012) x4**
  - Iatrogenic complications OR: 1,73
  - Median cost 15,649 $ vs 12,71 $ for laparoscopic

The role of robotics is still being defined, in light of higher cost, lack of clinical benefit, and increased iatrogenic complications, albeit comparable overall complications, as compared with laparoscopic colectomy.

Robotic Rectal Cancer





Effect of the plane of surgery achieved on local recurrence in patients with operable rectal cancer. MRC 07
P Quirke Lancet 09

Robotic Low Anterior Resection for Rectal Cancer: A National Perspective on Short-term Oncologic Outcomes.

Speicher PJ & al. Ann Surg. 2014

- **NCDB US: 1500 centers**
- **2010-2011: 6403 AR / 1912 L-TME (30%) / 956 R-TME (15%)**
- **R-TME: academic centers / preop RCT / higher T stage**

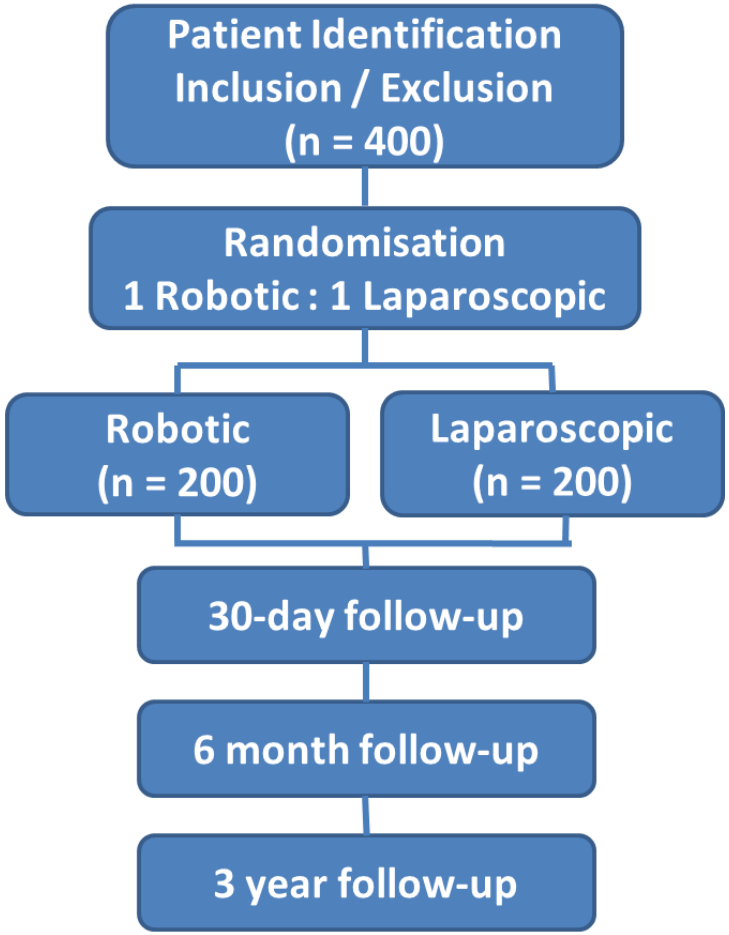
TABLE 4. Propensity-Adjusted Outcomes Following LLAR vs RLAR in the NCDB, 2010–2011

Endpoint	LLAR (n = 1912)	RLAR (n = 956)	*P*
Conversion to open	314 (16.4%)	91 (9.5%)	< 0.001
Nodes removed (IQR)	15 (11–21)	15 (11–20)	0.255
Positive margins	107 (6.6%)	60 (7.3%)	0.553
Surgical margins			0.634
Negative	1829 (96.3%)	922 (96.8%)	
Positive margin—microscopic	42 (2.2%)	16 (1.7%)	
Positive margin—macroscopic	29 (1.5%)	14 (1.5%)	
Circumferential margin within 1mm	76 (4.7%)	45 (5.5%)	0.437
Short-term outcomes			
30-day mortality	15 (0.8%)	6 (0.6%)	0.815
30-day readmission	120 (6.3%)	68 (7.1%)	0.454
Hospital LOS (IQR)	5 (4–7)	5 (4–7)	0.785
Adjuvant XRT	138 (7.3%)	92 (9.7%)	0.03
Adjuvant chemotherapy	608 (32.1%)	327 (34.6%)	0.206

ROLARR

RObotic versus LAparoscopic Resection for Rectal Cancer

Trial Results



This project is funded by the Efficacy and Mechanism Evaluation (EME) Programme, an MRC and NIHR partnership.

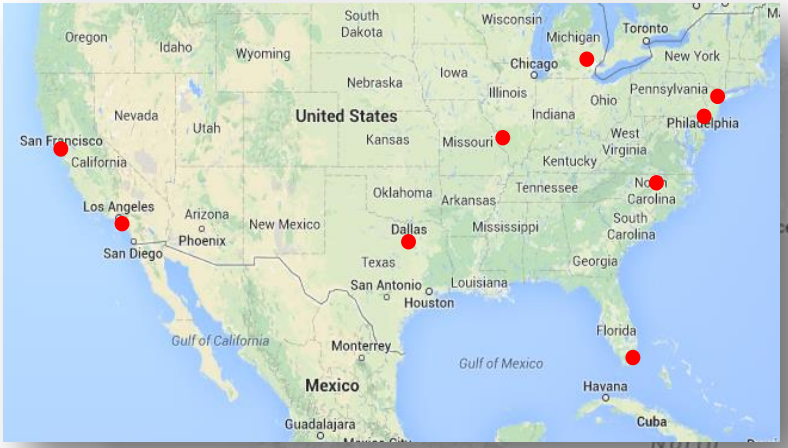
The views expressed in this publication are those of the author(s) and not necessarily those of the MRC, NHS, NIHR or the Department of Health.
*The EME Programme is funded by the MRC and NIHR, with contributions from the CSO in Scotland and NISCHR in Wales and the HSC R&D Division, Public Health Agency in Northern Ireland.

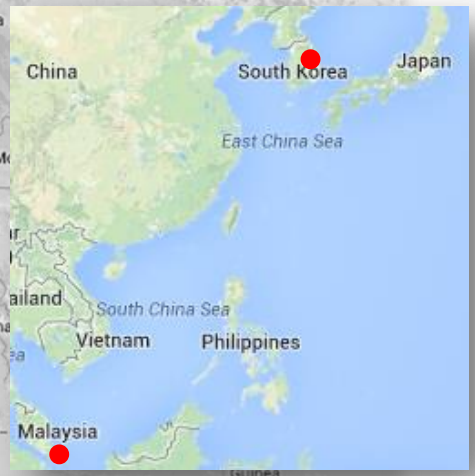
MRC Medical Research Council

NHS National Institute for Health Research

Courtesy of David jane

ROLARR Sites





400 patients
40 surgeons
29 sites
Baseline surgeon experience:

	No. lap operations	No. robotic operations
Median (range)	**91.5** (10, 800)	**25.0** (10, 180)
(Q1, Q3)	(41.5, 200.0)	(13.5, 55.0)

Primary endpoint – conversion to open surgery

Overall conversion rate: 10.1%

	Lap (n=230)	Robotic (n=236)	Total (n=466)	Difference in rates (95% CI)
Conversion	28 (**12.2%**)	19 (**8.1%**)	47 (**10.1%**)	4.1% (-1.4%, 9.6%)
Odds Ratio (95% CI) Robotic vs. Lap	0.61 (0.31, 1.21), p = 0.158			

A priori defined subgroup analyses

	Lap	Robotic	Total	Odds Ratio (95% CI)
Conversion				
Males: Yes	25/156 (**16.0%**)	14/161 (**8.7%**)	39/317 (12.3%)	0.46 (0.21, 0.99)
Low AR: Yes	22/165 **(13.3%)**	11/152 **(7.2%)**	33/317 (10.4%)	0.49 (0.21, 1.12)
Obese: Yes	15/54 **(27.8%)**	10/53 **(18.9%)**	25/107 (23.4%)	0.58 (0.21, 1.60)

Primary endpoint – reasons for conversion

	Lap (n=28)	Robotic (n=19)
Reasons for intra-op conversion to open*		
Adhesions	1 (3.6%)	0 (0.0%)
Advanced cancer	3 (10.7%)	4 (21.1%)
Anaesthetic complication	0 (0.0%)	1 (5.3%)
Completion of rectal/pelvic dissection	**11 (39.3%)**	**9 (47.4%)**
Difficult colonic mobilisation	3 (10.7%)	2 (10.5%)
Haemorrhage	3 (10.7%)	3 (15.8%)
Obesity	**6 (21.4%)**	**0 (0.0%)**
Robotic collisions	0 (0.0%)	1 (5.3%)
Visceral injury	1 (3.6%)	2 (10.5%)

* To note the reasons for conversion are not mutually exclusive

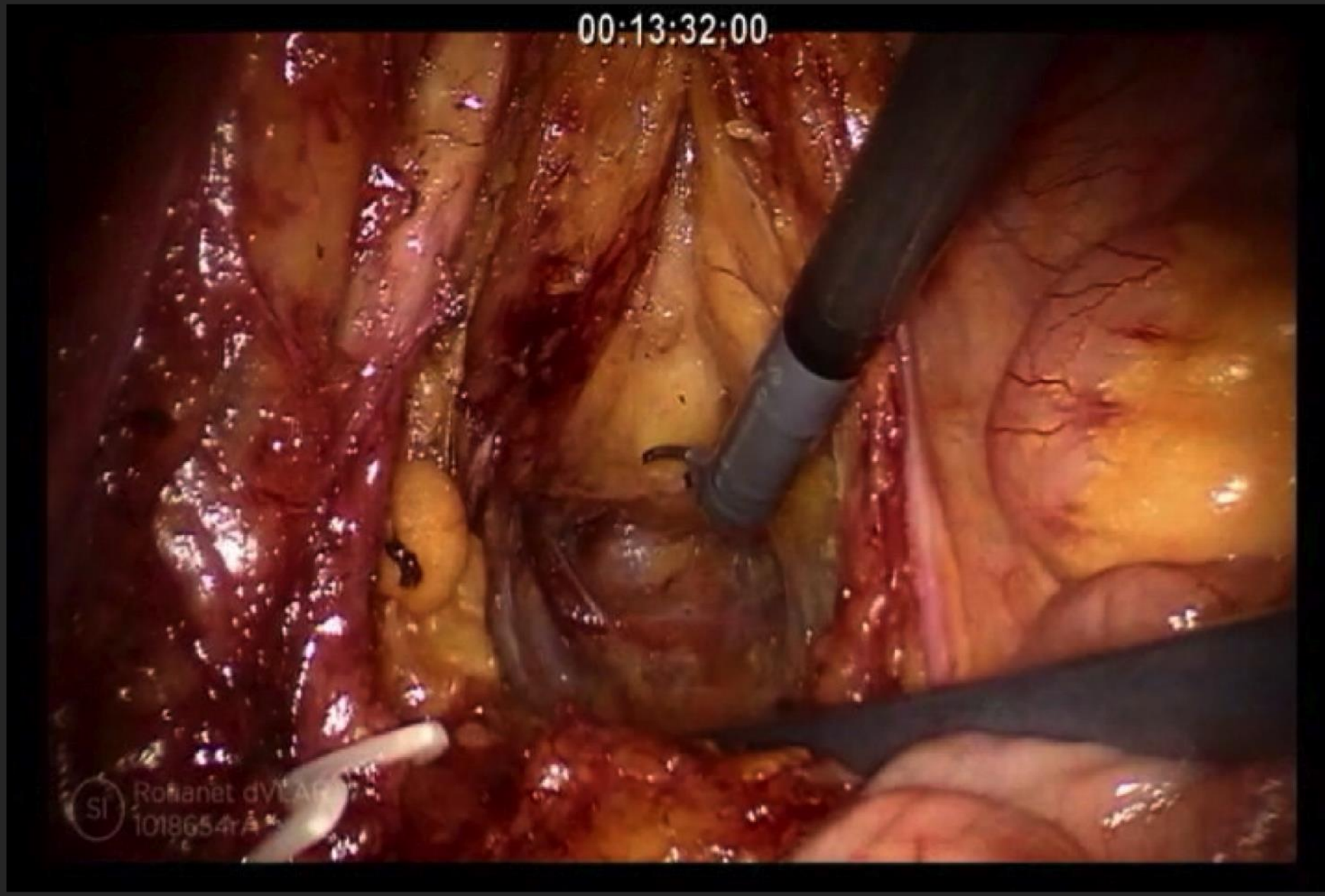
Conclusions - ROLARR

Primary end-point

- **Conversion rate** lower following robotic surgery, but no statistically significant evidence of superiority compared to laparoscopic surgery
- Subgroup analysis:
  - Possible benefit in males, low anterior resection & obese

Secondary end-points

- Similar short term **pathological** outcomes
- Similar rates of 30-day & 6-month **complications**
- Small difference in **I-PSS**, **IIEF** and **FSFI** at 6-months compared to baseline
  - No difference Robotic vs. Laparoscopic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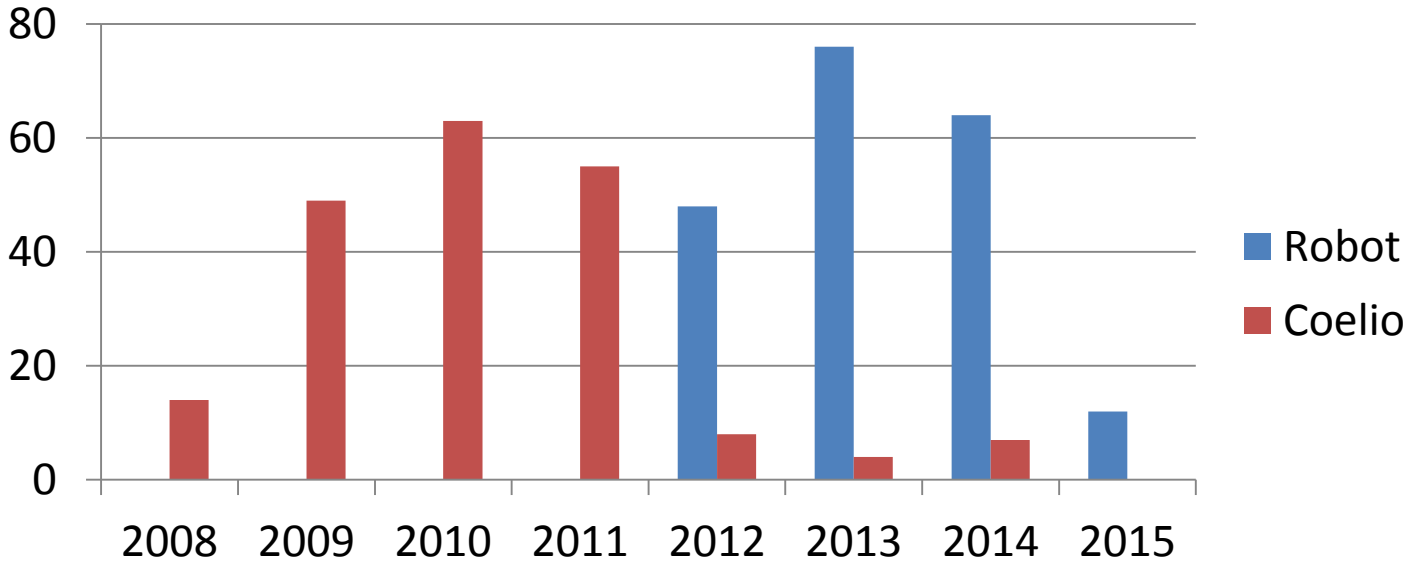
Robotic versus Laparoscopic Total Mesorectal Excision for Sphincter-saving Surgery: a single-center series of 400 consecutive patients.

P Rouanet & al. ASCRS May 2016

- 8/08 -> 2/15: 400 RC consecutively operated in MCI
- Homogeneous serie
  - Standardized technique : Full robot, one docking
  - 1 surgeon
- 200 R-TME / 200 L-TME



Patients' characteristics	R-TME (n = 200)	L-TME (n = 200)	*p*-value
Median age (range)	64 (25-85)	63.5 (35–86)	0.810
Age ≤ 60 > 60	 78 (39.2%) 121 (60.8%)	 78 (39.0%) 122 (61.0%)	0.968
BMI ≤ 30 > 30	 172 (86.0%) 28 (14.0%)	 170 (86.3%) 27 (13.7%)	0.932
Gender Male Female	 131 (65.5%) 60 (34.5%)	 136 (68.0%) 64 (32.0%)	0.596
ASA Score I II III IV	 67 (34.2%) 91 (46.4%) 33 (16.8%) 5 (2.6%)	 62 (31.3%) 98 (49.8%) 35 (17.8%) 2 (1.0%)	0.616
Tumour location Upper ≥ 11 cm Mid 6 -10 cm Lower ≤ 5 cm	 27 (13.6%) 83 (41.9%) 88 (44.4%)	 39 (20.2%) 75 (38.9%) 79 (40.9%)	0.222
Initial MRI T stage 0 1 2 3 4	 1 (0.5%) 3 (1.6%) 20 (10.8%) 140 (75.3%) 22 (11.8%)	 0 (0.0%) 3 (2.0%) 26 (17.2%) 108 (71.5%) 14 (9.3%)	0.393
Pre-operative RCT (Neoadjuvant therapy)	140 (70.0%)	131 (65.5%)	0.336

Surgical results	R-TME (n = 200)	L-TME (n = 200)	*p-value*
Type of anastomosis Side to End Direct CAA* Pouch CAA Lateral CAA	 120 (60.0%) 27 (13.5%) 28 (14.0%) 25 (12.5%)	 103 (51.5 %) 30 (15.0%) 65 (32.5%) 2 (1.0%)	<0.001
Inter Sphincteric Resection Complete Partial Mucosectomy Mixte None	 1 (0.5%) 71 (35.7%) 3 (1.5%) 1 (0.5%) 123 (61.8%)	 4 (2.0%) 84 (42.4%) 3 (1.5%) 2 (1.0%) 105 (53.0%)	0.326
Trans-anal TME	10 (5.0%)	26 (13.0%)	0.005
Median operative time (range)	243 min (70-437)	232 min (103-432)	0.076
Diverting ileostomy	135 (67.5%)	137 (68.5%)	0.830
Median estimated blood loss (range)	200mL (0-800)	100mL (0-1600)	0.143
Conversion	4 (2.0 %)	19 (9.5%)	0.001

*CAA: Colo-anal anastomosis

Operative time	R-TME	L-TME	*p*-value
Median	243 min	232 min	0.076
Min - max	70 – 437	103-482	

Operative time	R-TME Operative time (calendar period)			*p*-value
	1st period (n=66)	2nd period (n=66)	3rd period (n=68)	<0.001
Median (min-max)	276 (110-437)	228 (70-379)	233 (126-349)	

CONVERSION	R-TME	L-TME	Total	Odds Ratio (95% CI)
Males	4/131 (3.1%)	13/136 (9.6%)	17/267 (6.4%)	0.30 (0.007-1.00) ***p=0.043***
Low Anterior Resection	1/76 (1.3%)	8/84 (9.5%)	9/160 (5.6%)	0.13 (0.003-0.99) ***p=0.035***
Obese	1/28 (3.6%)	5/27 (18.5%)	6/55 (9.1%)	0.16 (0.3 -1.65) *p=0.101*

CRM involvement	R-TME	L-TME	Total	Odds Ratio (95% CI)
Males	8/102 (7.8%)	13/106 (12.3%)	21/208 (10.1%)	0.61 (0.21-1.67) *p=0.360*
Low Anterior Resection	9/58 (15.5%)	7/65 (10.8%)	16/123 (13.0%)	1.52 (0.46-5.17) *p=0.593*
Obese	2/20 (10.0%)	3/21 (14.3%)	5/41 (12.2%)	0.67(0.05-6.63) *p=1.00*

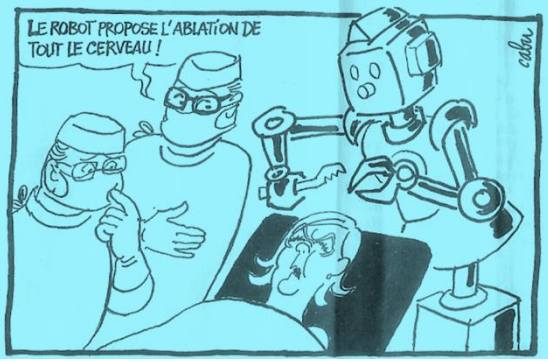
Canard Enchainé 4.2014

La machine à opérer qui saigne les hostos et les patients

Un robot venu des Etats-Unis révolutionne la chirurgie. Mais il maltraite la santé financière des hôpitaux. Et peut-être celle des malades…

INIE la chirurgie à la papa ! Un méga-robot a fait une entrée fracassante dans les blocs opé-oires. Depuis quelque temps, que hosto, chaque clinique veut nachine à opérer – Da Vinci, de petit nom. Une trouvaille en ma-e de com'. A chaque livraison d'un vel appareil, l'événement fait les titres de la presse locale : « *Un ot unique en Bourgogne* » (« Le rnal de Saône-et-Loire », 23/9/13), *robot qui combat le cancer* » Echo républicain », 16/9/13), « *On sté le nouveau robot à opérer* » e Parisien », 21/3/14), « *Opérer que transformé en jeu d'enfant* » a Montagne », 16/11/13).

t, pour l'inauguration, le fabri- américain, Intuitive Surgical, te le public à venir admirer la lors d'une journée portes ou-



facilite le travail », précise un ma darin. Le chirurgien est mieux in tallé : il est confortablement ass dans un fauteuil, devant une conso au lieu de se contorsionner des heur au-dessus du malade. Une proues technologique, saluent tous les pr ticiens.

Mais le malade y trouve-t-il s compte ? L'opération de la prosta est délicate. Il faut la retirer sans e dommager les nerfs voisins, qui co mandent l'érection et la fonction u naire. Et sans l'entailler, sinon cancer risque de se propager. Da une étude parue en avril dans « British Journal of Urology », Chr tian Barré a publié ses propres r sultats. Lui opère « à l'ancienne », ouvrant le patient. Résultat : son ta d'« entaille » est de 2,3 %… cont 15,6 % à l'hôpital Henri-Mondo

R-TME medico-economic study (S Colasse – H Mathieu Daude)

The way for improved profitability!

- **Today: Extra cost of 2000 €**
  - **6H30 for OR**
  - **13 d HL (daily charge 264 E)**
- **If we save**
  - **2 H for the OR (- 2H => saving 800 €)**
  - **5 D for HL (– 5d => saving 1790 €)**

ICM
Montpellier Cancer Institute

We obtain a Return On Investissement if we increase the number of patients

But with stable means (depreciation/consumables) +++

Robotic cancer surgery

M. H. Sodergren and A. Darzi
Institute of Global Health Innovation, Imperial College London. BJS 2013

Leading article

"Robotics is unlikely to displace the human element in the art of surgery, but, with adequate funding, resource allocation and market competition, robotic assistance will likely complement human surgical skills and significantly improve cancer surgery outcomes in the future."


THANK YOU
MERCI
ICM
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