Key-role of the laparoscopy in the Pancreatic Adenocarcinoma

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Laparoscopy and Pancreas

1911 ***Since the 90s***

Cystoscopy of abdominal cavity → Laparoscopy Staging

«***the cystoscope is introduced …reveal general metastases or a secondary nodule in the liver*** » by BM Bernheim Ann Surg

10-30%

(radiologically resectable/locally advanced)

Unnecessary laparotomy

Risk Factors

- **lesion >3cm**
- **CA 19-9 > 200 Ul/ml (*cholestasis!!!*)**
- **borderline tumor**

Laparoscopic Pancreatic Surgery

Staging Tool

large tumor >3cm

CA 19.9 > 200 Ul/ml

Borderline Tumor

Laparoscopic Resection

PD

Left Pancreatectomy

Crippa S. 2016; Sugiura T. 2012;Asaoka T. 2018; Schwarz l. 2014; Allen 2018

Laparoscopy staging

- simple laparoscopy exploration

  superficial liver metastases

  peritoneal metastases

- advanced laparoscopy exploration

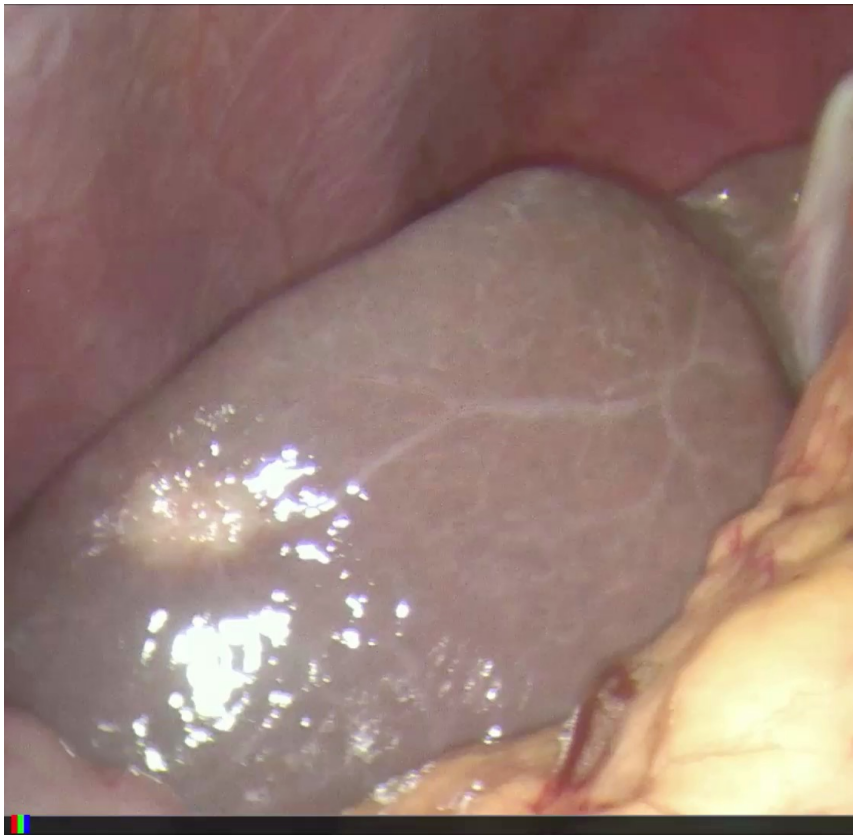
  Ultrasonography (LUS) liver exploration ± biopsy

  Ultrasonography (LUS) tumor evalution

  Intra-aorto-cavale (Ln 16) lymphonode picking

Laparoscopy staging

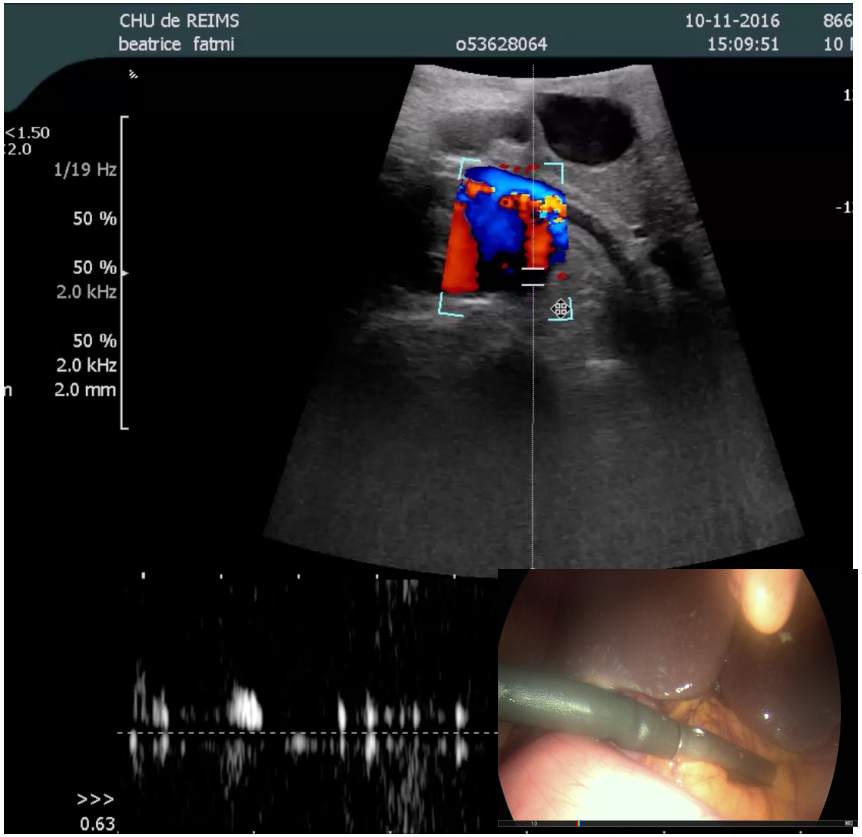
exploration and liver wedge resection



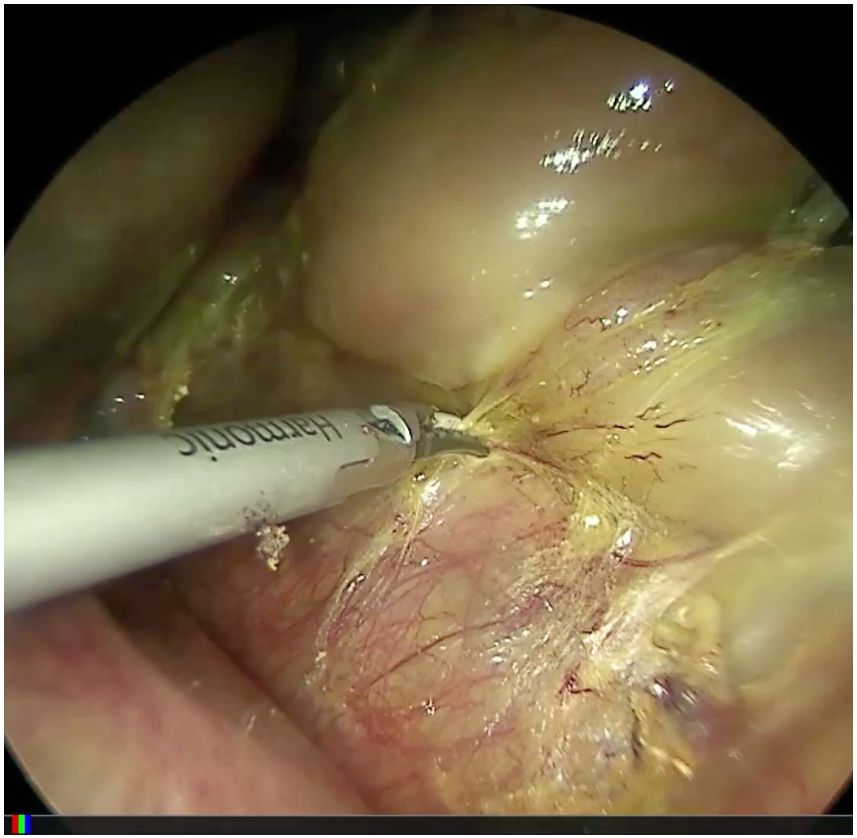
exploration+LUS+biopsy

Laparoscopy staging

LUS pancreas



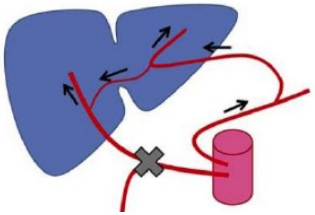
LN 16 lymphonode picking



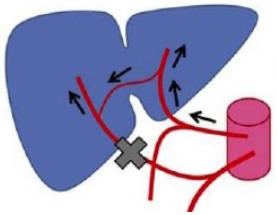
Laparoscopy staging

Borderline/advanced

- LUS before start the NA therapy
- sampling for cytological examination
- ligation of replaced RHA



Ishikawa M et al.
J Comput Assist Tomogr
2016, 40 : 171-175



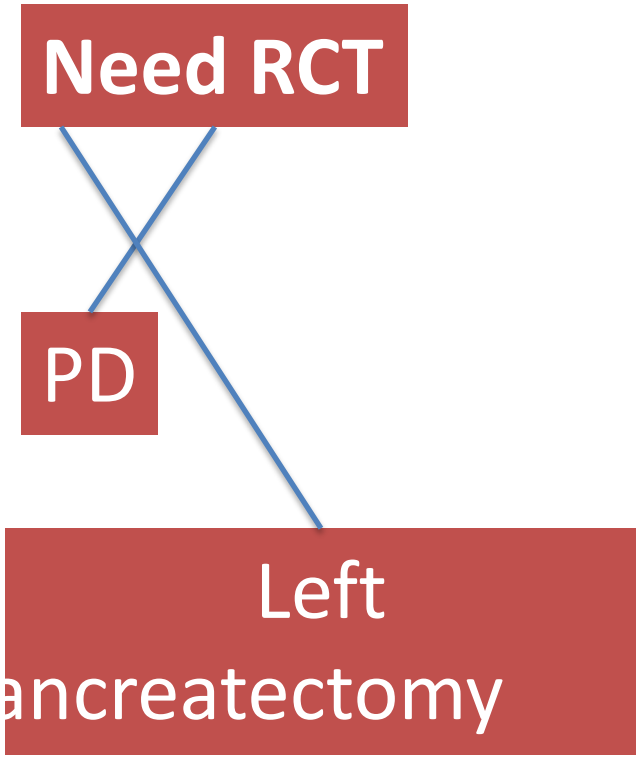
Take Message

- necessary in patients at risk of occult metastases *(hight CA 19.9 and large tumors)*
- could be useful in patients undergoing neoadjuvant chemotherapy *(abdominal washing in search of neoplastic cells; LUS)*
- could be represents the first step in resectable patients to evaluate LN 16

Laparoscopy and Pancreatic Resection

END-POINTS

- Not change ***the indications***
- Same ***radicality***
- Same *rate of* ***complication***
- ***Same*** ***oncological results***

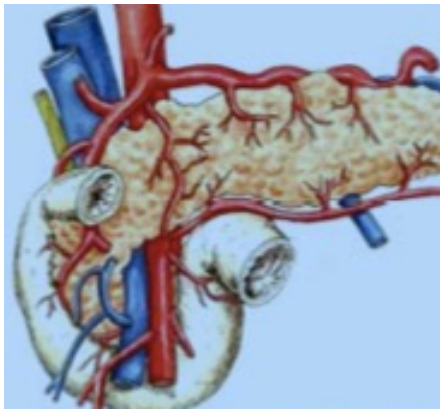


Kang CM. 2018;Lee CS 2018; Chen K. 2018; Gumbs AA 2011; Siech M. 2017; Correa-Gallego C. 2014

Laparoscopy and Pancreatic Resection

Laparoscopic limits = NO!!! but

Anatomical-Techical (LP easier than PD)



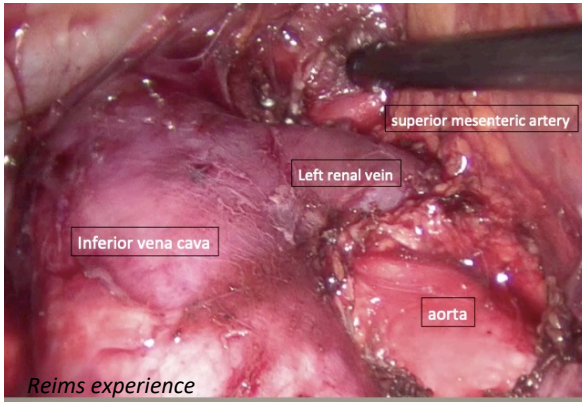
- retroperitoneal position
- close relatioship with major vessels
- fragile consistency of the pancreas
- loss of tactlie sensation
- technically demanding and time consuming operation
- requires expertise in pancreatic surgery and lap. advanced procedures

Laparoscopy and Pancreatic Resection

Laparoscopic benefits

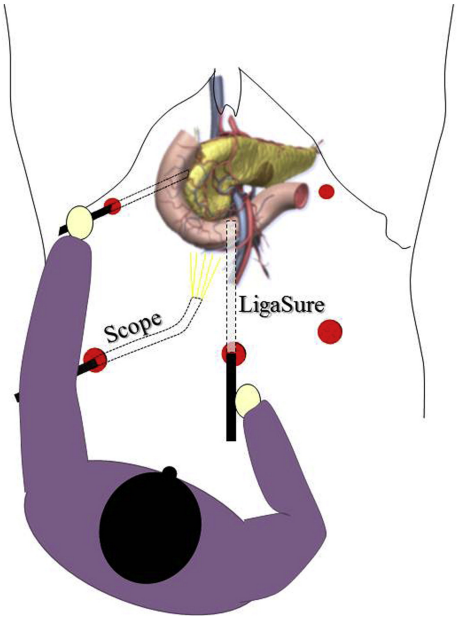
Medical

- Immunologic advantages of MI procedures
- same oncologic outcome of open ??
- Postoperative enhanced recovery after surgery (ERAS)



Technical

- magnification and optics
- caudale vision for dissection of uncinate process
- best approach for « First mesenteric artery »
- hight rate of spleen conservation



Honda G JACS 2013

Palanivelu C. 2017;de Rooij T. 2019; Dokmak S.2015; Honda G 2013

Pancréatectomie distale

La pancréatectomie distale laparoscopie est la résection la plus couramment pratiquée

- *taux de conservation splénique plus élevé*
- *moins de douleur pos-opératoire*

Tumeur maligne: du 4.7 a 100%

Diamètre du tumeur: du 2 a 3.8 cm

Temps opératoire: du 188 a 304 min

Perde sanguine: du 70 a 422 cc

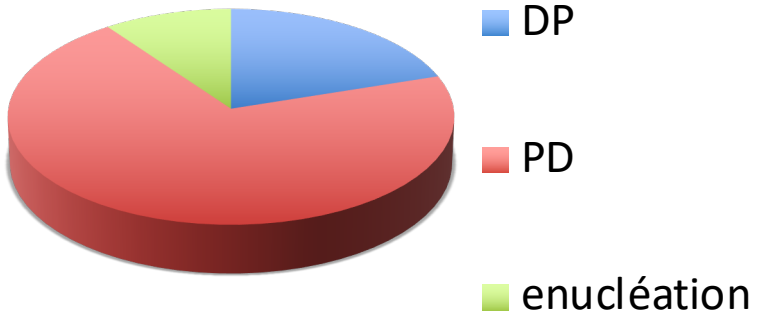
Conversion: 0-30%

Fistule Pancréatique: du 11.3 a 29.7 %

Marge positive: 3-26%

N° de ganglions prélevé: 6-16.5

Hospitalisation: 4-8 jours



Cushieri A. J.R.Coll.Surg. 1995; Jayaraman S. J.Am.Coll.Surg 2010; Dinorcia J. J.Gastrointest.Surg 2010; Kooby DA. J.Am.Coll.Surg 2010; Vijan SS Arch Surg 2010;; Butturini G. Surg Endosc 2011; Cho CS. Ann Surg 2011; Fox AM. Surg Endosc. 2012; Mehta SS. Surg Endosc.2012;Maggie D. JAMA 2013; Stauffer JA HPB 2013

Left Pancreatectomy

Laparoscopic left pancretectomy is **the treatment of choice** for begnin lesions and borderline tumors

Advantages:

-Reduced intraoperative blood loss

-quick recovery

-hight rate of spleen conservation

-apparentally reduced morbility and mortality

-Not compromised oncological principles ***(lymph node harvest and margin negative)***

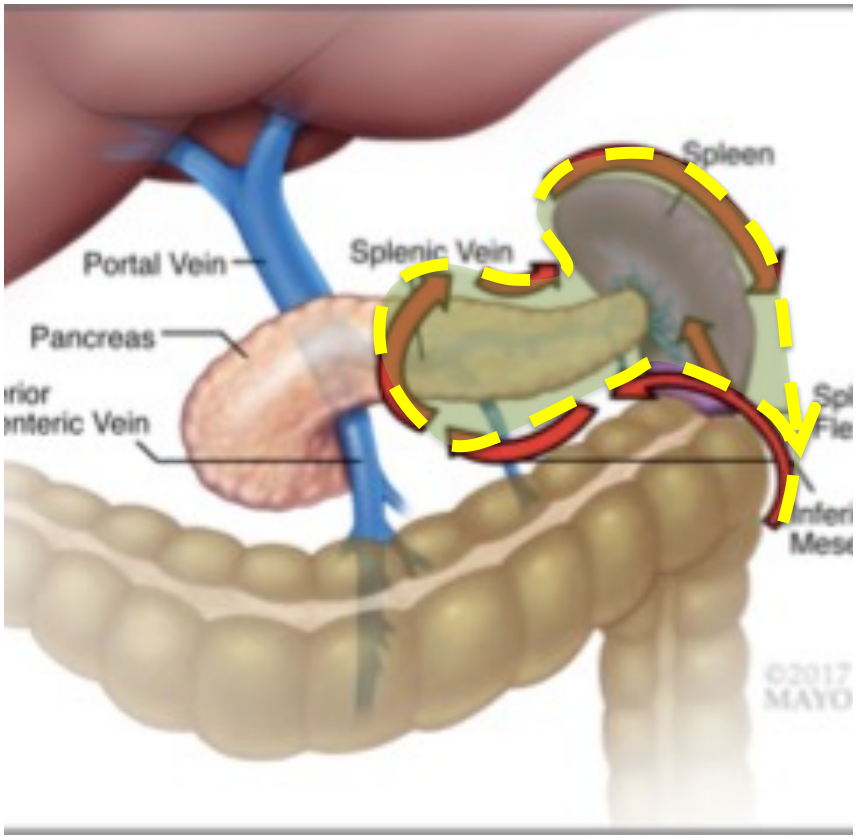
Cushieri A. J.R.Coll.Surg. 1995; Jayaraman S. J.Am.Coll.Surg 2010; Dinorcia J. J.Gastrointest.Surg 2010;Kooby DA. J.Am.Coll.Surg 2010; Vijan SS Arch Surg 2010;; Butturini G. Surg Endosc 2011; Cho CS. Ann Surg 2011; Fox AM. Surg Endosc. 2012; Mehta SS. Surg Endosc.2012;Maggie D. JAMA 2013; Stauffer JA HPB 2013;Ozmen M.M 2016; De Rooji T. 2019

Left Pancreatectomy

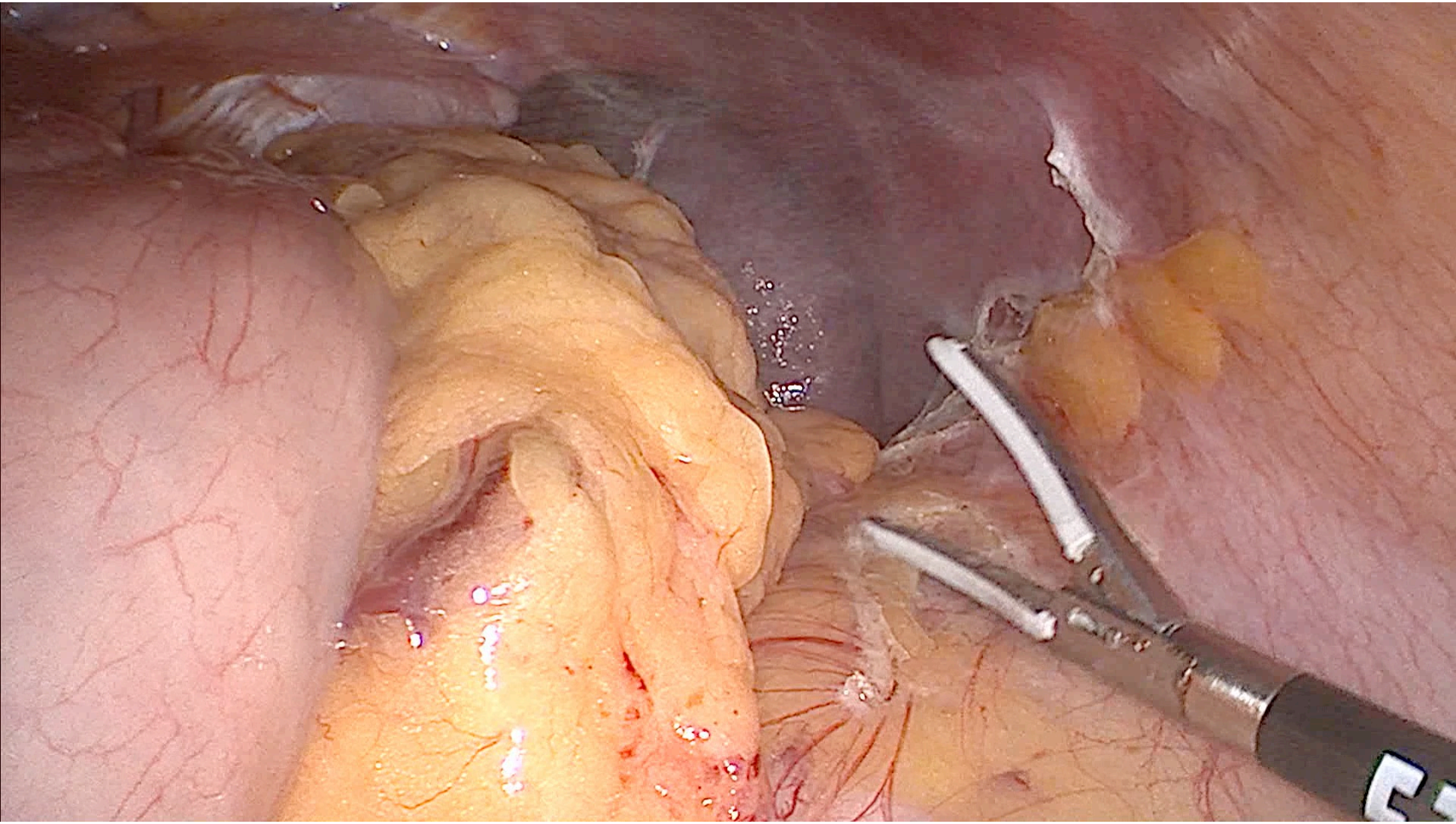
Technicals options

- Laparoscopic distal pancreatectomy with splenectomy (LDP)
- Laparoscopic spleen preserving distal pancreatectomy (LSpDP)
- laparoscopic spleen and vessel preserving distal pancreatectomy (LSVpDP)
- laparoscopic assisted distal pancreatectomy (LA-SVpDP)
- Single incision laparoscopic distal pancreatectomy
- Robot-assisted distal pancreatectomy

Clockwise approch



Asburn H. Surg Endo 2019



Left Pancreatectomy

Controversial point

Splenic preservation

- ***Warshaw technique***
- ***Vessel preservation***

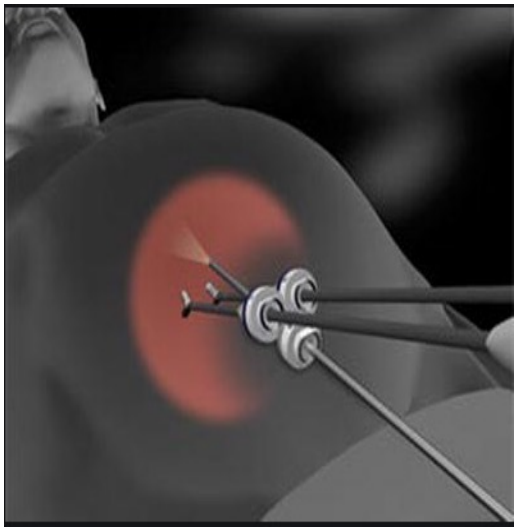
Location of the trocars

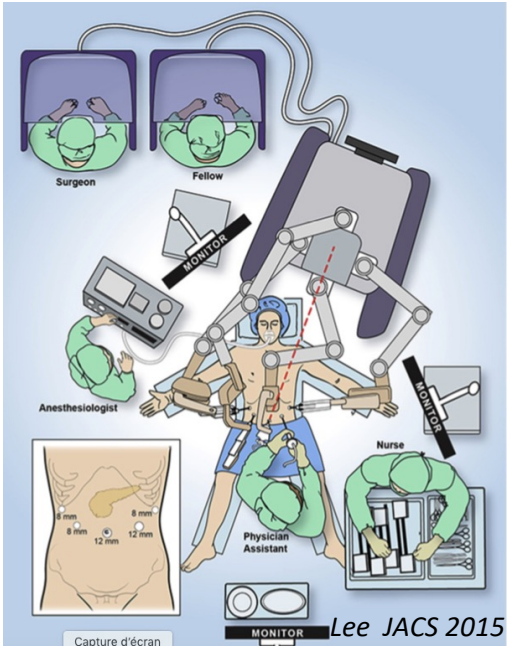
- ***Single Incision laparoscopic approach***
- ***Robot-assisted distal pancreatectomy***

Extent of resection

- ***Anterior RAMPS***
- ***Posterior RAMPS***

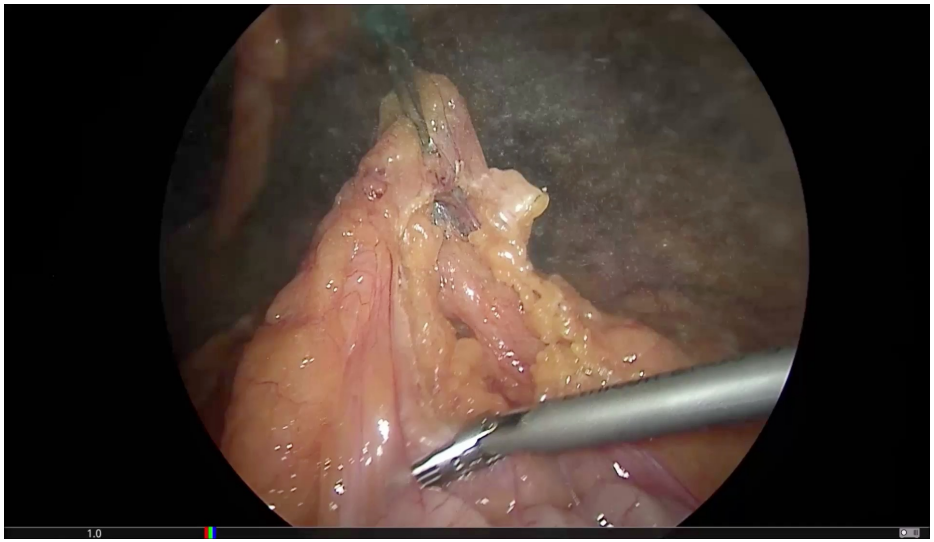
Parenchymal transection

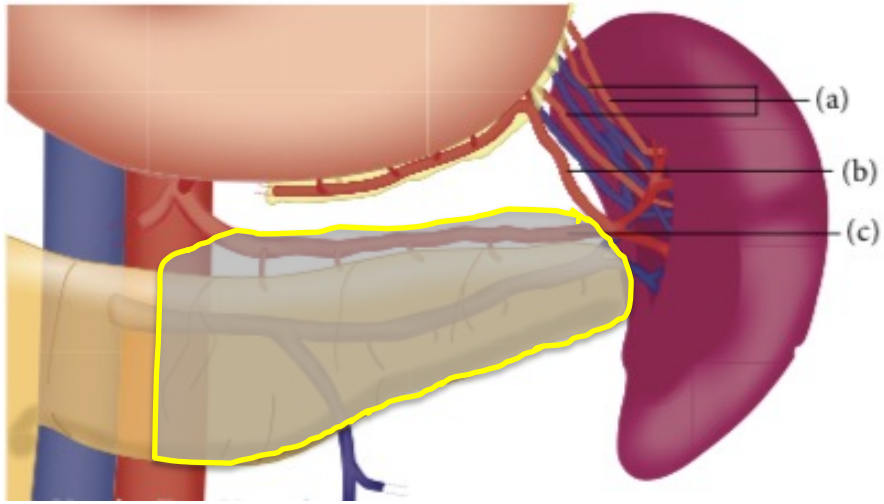




Lee JACS 2015

Laparoscopic spleen preserving left pancreatectomy :*Warshaw technique*





Peri-operative Outcomes

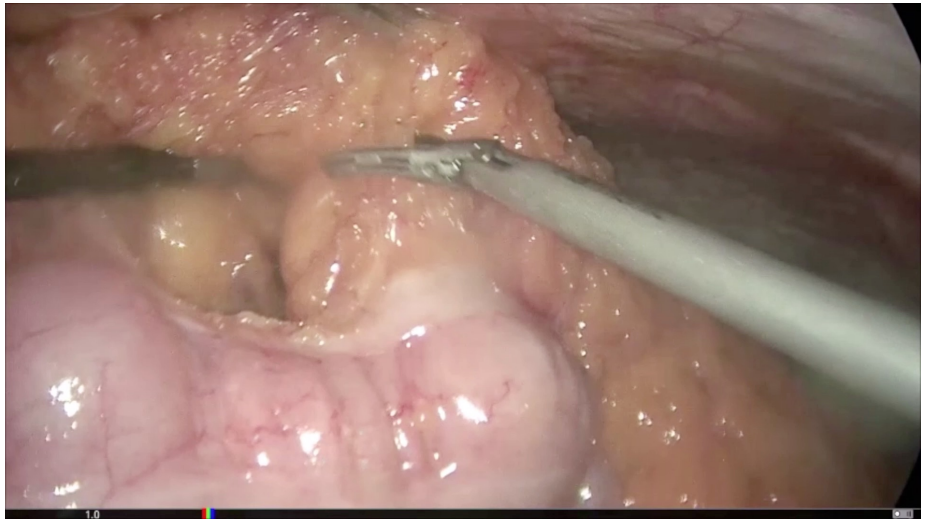
operating time	160(116-200)
Blood loss	301 cc
Length of stay	8 (6-11)

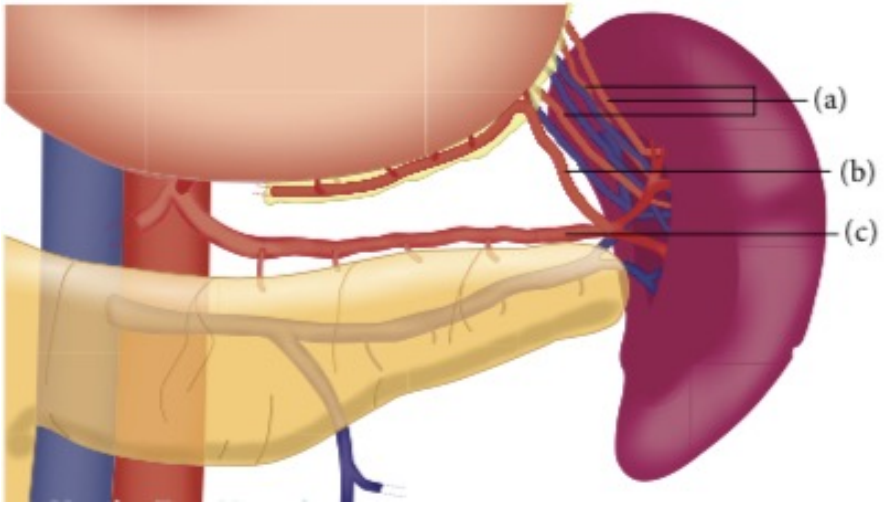
Complications

- Splenic infarctions 22%
- Perigastric varices 17%
- Chronic left-side abdominal pain 38%
- Post-operative splenectomy 2%

Beane 2011; Fernandez-Cruz 2004; Ferrone 2011; Song 2011; Taylor 2010; Melotti 2008;Mabrut 2005; Aldridge 1991;Jain 2013; Adam 2015

laparoscopic spleen and vessel preserving left pancreatectomy : *Kimura technique*





Peri-operative Outcomes

operating time	215 (150-367)
Blood loss	391 cc
Length of stay	11 (4-21)

Complications

- Splenic infarctions 2%
- Pancreatic fistula 17%

Beane 2011; Fernandez-Cruz 2004; Ferrone 2011; Song 2011; Taylor 2010; Melotti 2008;Mabrut 2005; Aldridge 1991;Jain 2013; Adam 2015

Pancreas Transection

Management of stump closure

- linear stapler reinforced (4.8- 3.5-2.8 mm)
- energie device + suture
- hand-sewn closure
- vascular endo-surgery if section of splenic vessels

Progressive Compression technique

Ji 2016; Zhang 2015 ;Ozmen 2016; De Rooij 2015; Asburn 2019

Minimally invasive versus open distal pancreasectomy (LEOPARD): study protocol for a randomized controlled trial

De Rooij T *et al*

trial 2017

1° outcome: postoperative hospital stay: LDP best that ODP

2° outcome: functional recovery; perioperative bleeding; complications; need for pain medicament and quality of life

LEOPARD study : Results

De Rooij T *et al* Ann Surg 2019

	Mini invasive N=54	Open N=57	Relative Risk (95% CI)	P
Primary Outcome				
Time to funtional recovery median	4 (3-6)	6(5-8)		<0.001
Restored mobility	4(2-5)	5(3-6)		0.01
adequate pain control with oral medication	3(2-3)	4(3-5)		<0.001
Reached at least 50% required caloric intake	3(2-5)	6(4-7)		<0.001
No need for fluid administration	3(2-5)	4(3-6)		0.001
No sign of infection	4(3-6)	6(5-8)		<0.001

LEOPARD study : Results

Secondary Outcome	Mini invasive N=54	Open N=57	Relative Risk (95% CI)	P
operative time median min	217 (135-277)	179 (129-231)		0.005
blood loss mean mL	150 (50-350)	400 (200-775)		<0.001
Pancreatic fistula (B/C	39% (33-6%)	23% (21-2%)	1.72 (0.96-3.09)	0.07
delayed gastric emptying (B/C)	6% (0-6%)	19% (13-7%)	0.30 (0.09-1.03)	0.04
postoperative bleeding	4% (4-0%)	4% (2%-2%)	1.12 (0.16-7.65)	>0.99
lenght of initial hospital day median	6 (4-7)	8 (6-9)		<0.001
readmission	29%	25%		0.57
lenght of total hospital stay median	6(4-13)	8(6-12)		0.004

LEOPARD study : Results
De Rooij T *et al*

Ann Surg 2019

- 2 days reduction in time to functional recovery
- No difference in terms of complications

Reims Experience minivasive PD ± Splen.

janvier 2013 - december 2020

45 ptz

operative time median min	**260**
blood loss mean ml	200
Pancreatic fistula (B/C)	15%/8%
delayed gastric emptying	7%
postoperative bleeding	4%
lenght of total hospital stay median	7
mortality 90D	2.8%

Pancreaticoduodenectomy

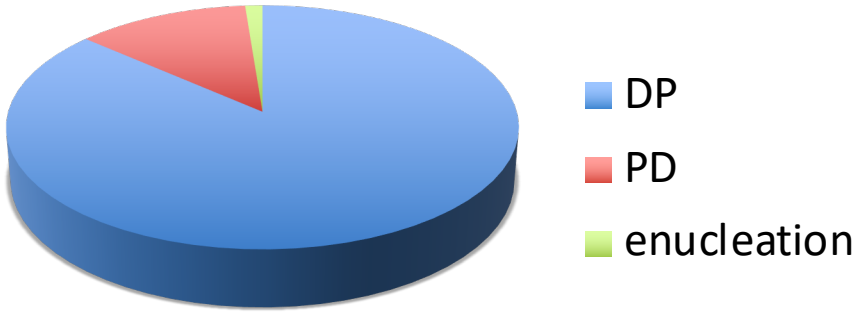
1994 First LPD by Gagner for benign lesion
746 LPD in the world

Contraindications

- vessel reconstruction
- association with anatomical hepatectomy

Intraoperative outcomes

conversion: 9.1% mais…… complete LPD is relatively difficult
average operative time : 464.3 min.
average blood loss: 320.7 mL



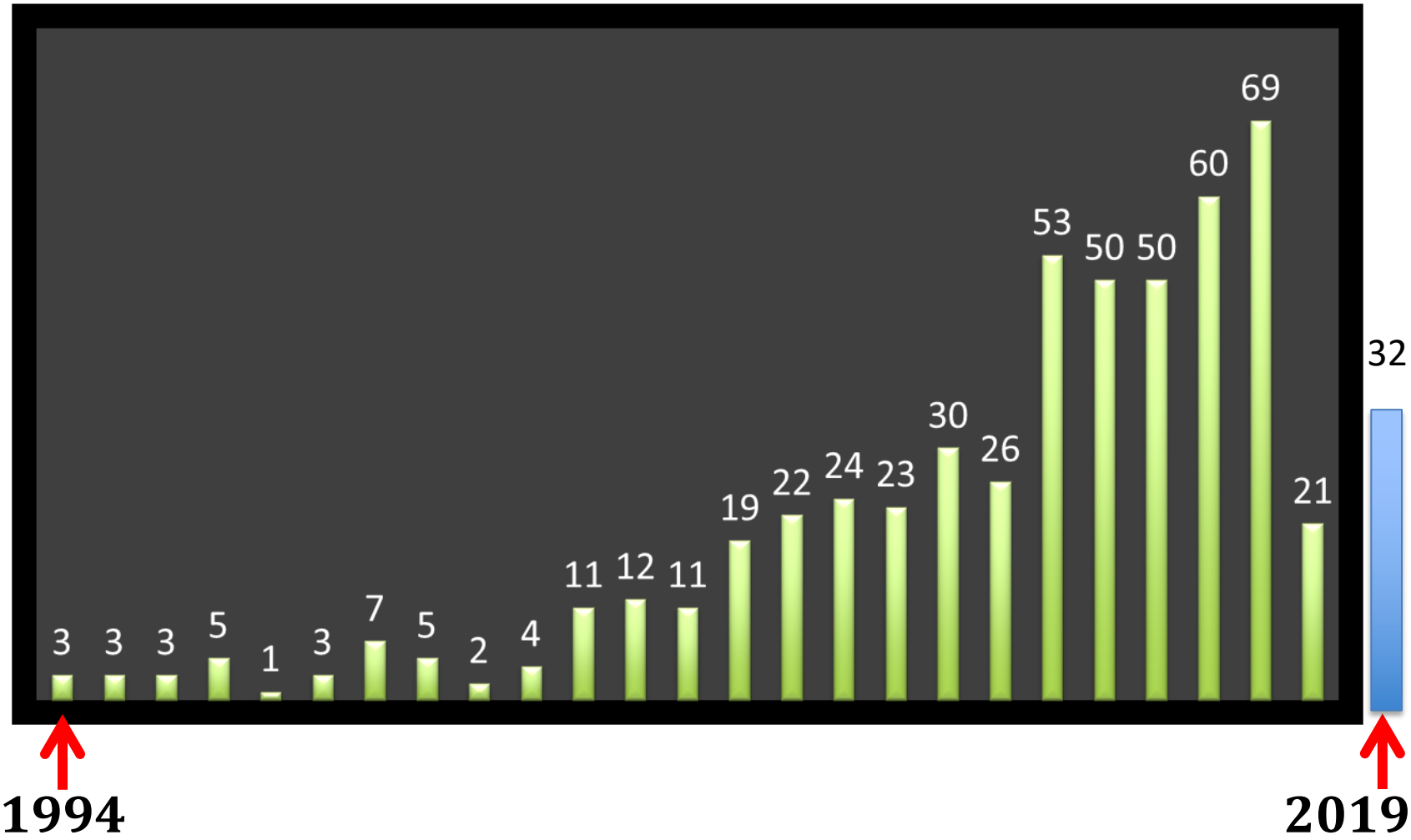
Postoperative outcomes

Morbility: 41.2%
pancreatic fistula: range 11.6-30%
delayed gastric emptying: range 9-15%
Mortality: 1.9%
average hospital stay: Europe: 21.3days; Asia: 13days; North America: 9.4days ???

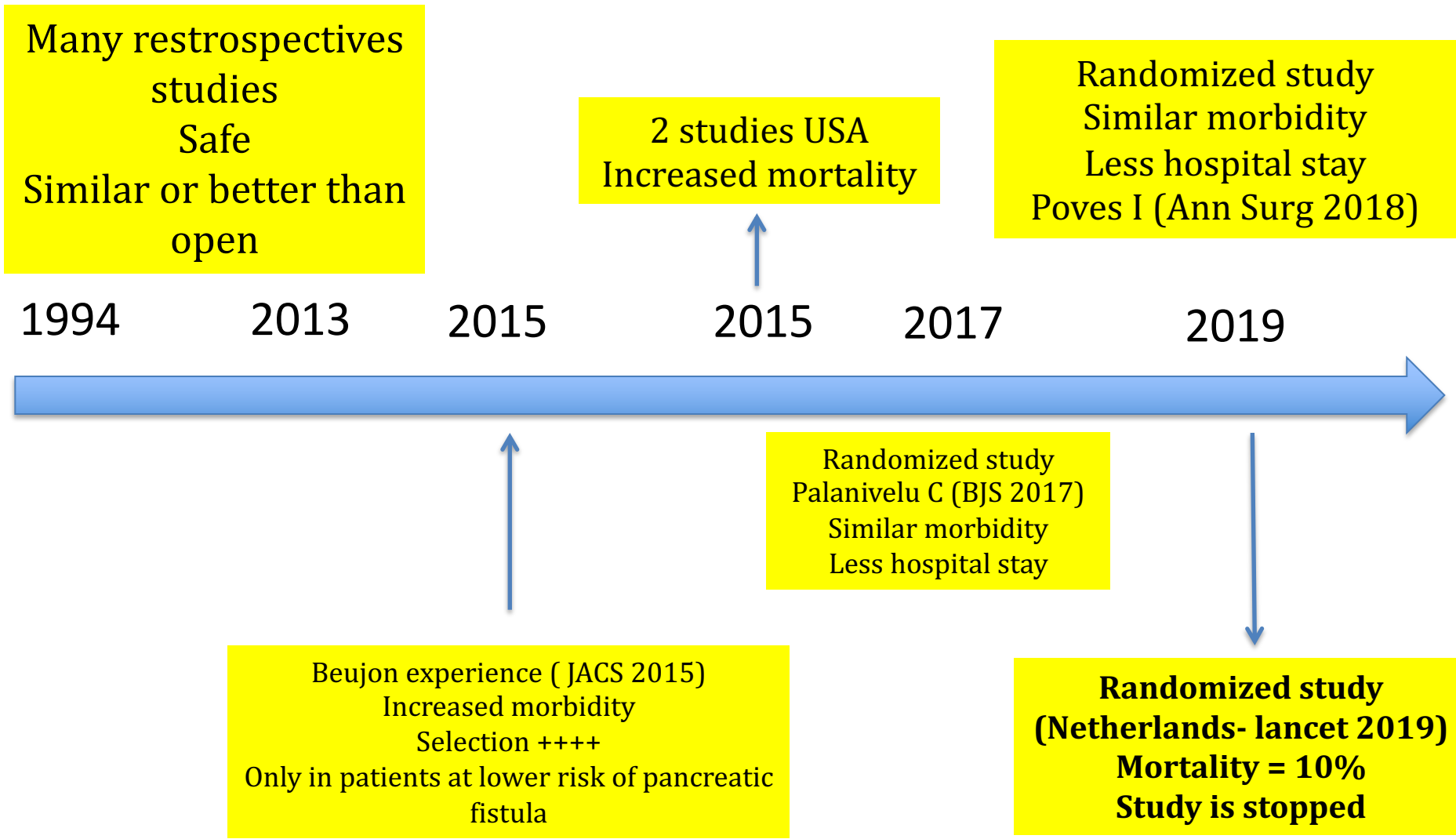
Ammori BJ Surg Endosc 2011; Strijser M. HPB 2013; Zhang J. 2013; Cirocchi R. Surg Oncol 2013; Correa-Gallego C; J Am Coll Surg 2014; Lei P. Surg Laparosc Endosc Percutan Tech 2014; Quin H.Plos One 2014 ;Boggi U. Surg endosc 2015; Dokmak S. J.Am.Coll.Surg 2015

Lap Pancreaticoduodenectomy

Annual Publication
« Laparoscopic pancreaticoduodenectomy »



LPD-Outcome



Sharpe SM et al JACS 2015; Adam MA et al, Ann Surg 2015; Hilst et al lancet 2019

Selection of Patients

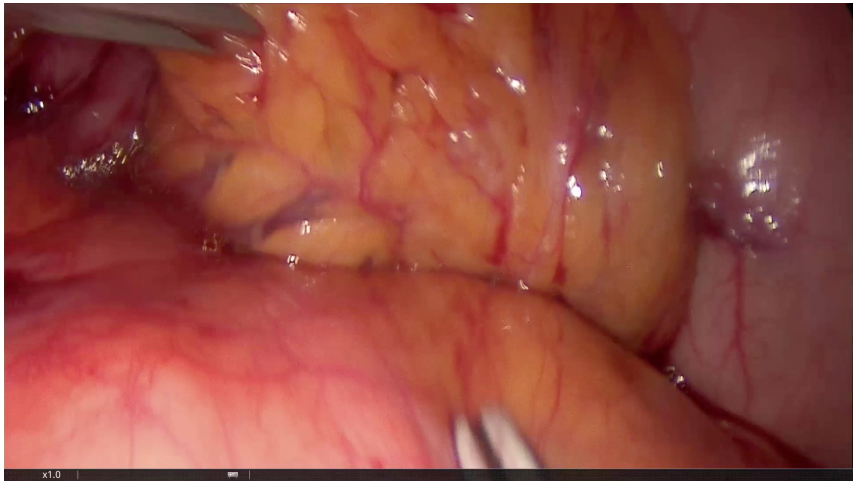
Contraindications

- obesity
- pancreatitis
- hight risk of POPF (type of tumor)
- adhesiolysis for previous open abdominal surgery
- combined vascular resection *(expert surgeons)*
- combined organ resection *(expert surgeons)*
- unusual vascular anatomy *(expert surgeons)*

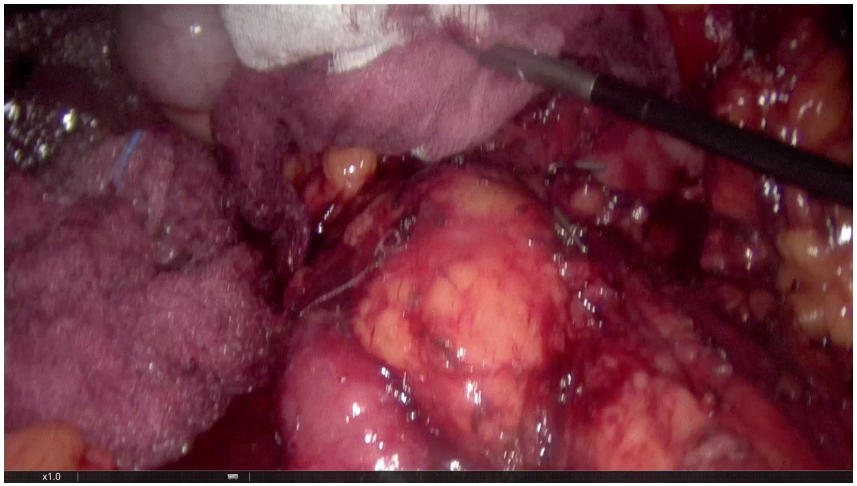
Ammori BJ Surg Endosc 2011; Strijser M. HPB 2013; Zhang J. 2013; Cirocchi R. Surg Oncol 2013; Correa-Gallego C; J Am Coll Surg 2014; Lei P. Surg Laparosc Endosc Percutan Tech 2014; Quin H.Plos One 2014 ;Boggi U. Surg endosc 2015; Dokmak S. J.Am.Coll.Surg 2015; Von Hilst lancet 2019

LPD-Selection of Patients

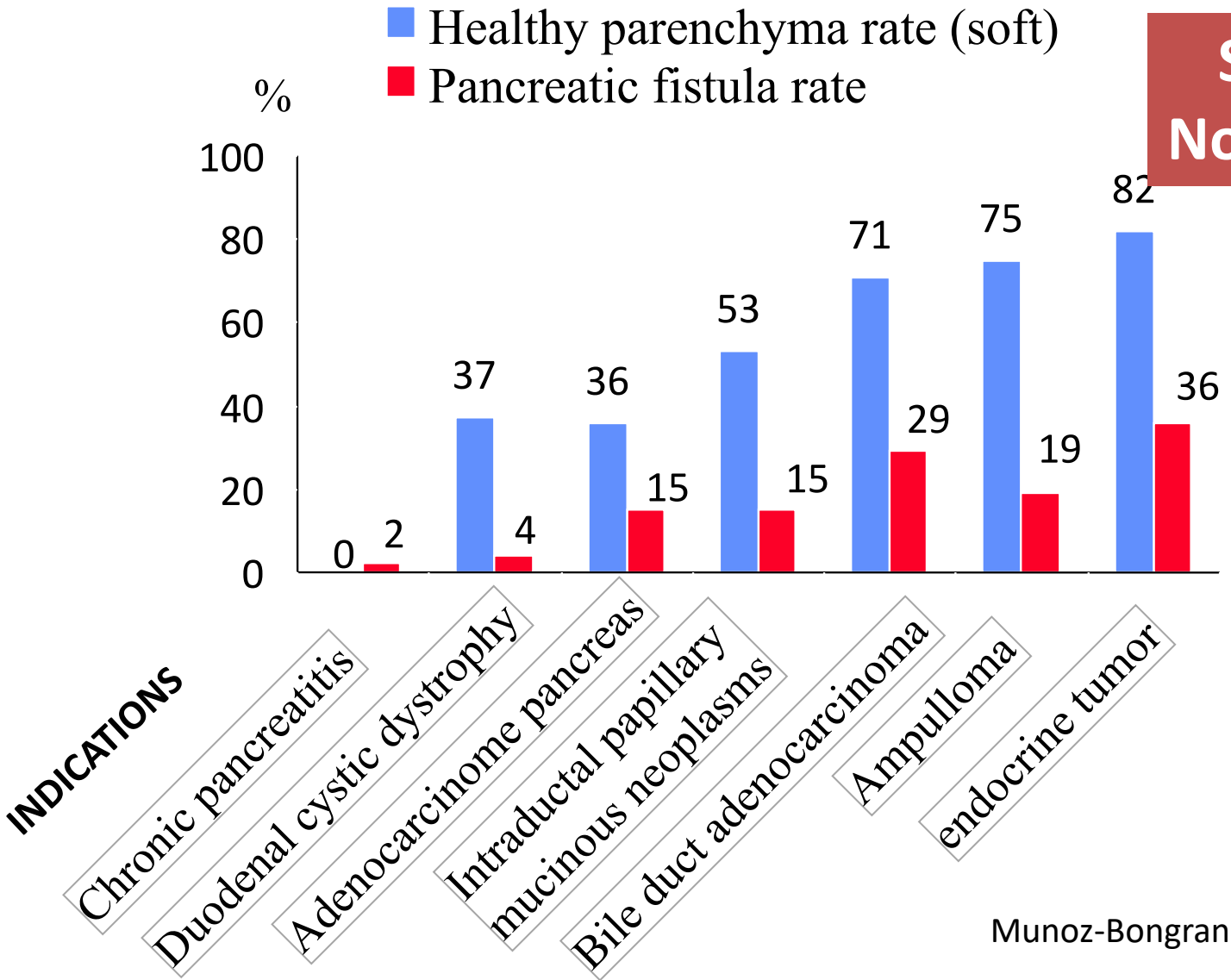
Mesenteric Panniculitis



Borderline tumor
after chemio/radio



POPF and quality of pancreas



Soft Pancr.
Non dilated W

Munoz-Bongrand J Am Coll Surg 2004

Laparoscopic Pancreaticoduodenectomy should not be routine for resection of periampullary tumors

Dokmak S. et al **J Am Coll Surg 2015**

Variables

size of tumor; pancreatic texture; morbility (Clavien-Dindo); pancreatic fistula; bleeding; delayed gastric emptying; biliary fistula, gastroenteric anastomosis fistula; pulmonary complications; harvested LN/invaed LN; R0; reintervention; drained collections; readmission; hospital stay;

All Patiens			
complication	Laparoscopic n=46	open n= 46	P
POPF grade C n (%)	11 (24)	3 (6)	0.007
Bleeding n (%)	11 (24)	3 (7)	0.02
Hospital stay d,mean (range)	25 (6-104)	23 (7-115)	0.59
Only Adenoca			
complication	laparoscopic n=15	open n=14	P
Major morbidity n (%)	2 (13)	0 (0)	0.09
Reintervention n (%)	2 (13)	0 (0)	0.09

Patient Selection

Oncologic outcomes

Short-term outcome

Ref.	Year	Country	Technique	No. of PDAC cases	Rate of R0 resection	No. of LN	Positive LN	Tumor size, cm
Sharp *et al*[23]	2015	United States	LPD	384	80.0%	18 ± 9.7	NR	3.2 ± 1.3
			OPD	4037	74.0%	16 ± 9.6	NR	3.3 ± 2.4
Song *et al*[24]	2015	South Korea	LPPPD	11	72.7%	15 ± 10	0.8 ± 1.2	2.8 ± 0.6
			OPPPD	261	81.0%	16.2 ± 9.6	1.5 ± 2.2	3.0 ± 1.2
Dokmak *et al*[25]	2015	France	LPD	15	60.0%	20 (8-59)	4.7 (0-32)	2.4 (1.5-4)
			OPD	14	50.0%	25 (8-47)	2.2 (0-12)	2.8 (2.5-4)
Chen *et al*[26]	2015	China	RPD	19	94.7%	18.1 ± 6.6	NR	3.0 ± 0.9
			OPD	38	92.1%	17.8 ± 7.1	NR	3.1 ± 1.0
Croome *et al*[20]	2014	United States	LPD	108	77.8%	21.4 ± 8.1	73.1%	3.3 ± 1.0
			OPD	214	76.6%	20.1 ± 7.5	72.0%	3.3 ± 1.3

537

60-90%

LPD vs OPD no difference

Laparoscopic versus open pancreatoduodenectomy for pancreatic or periampullary tumours (LEOPARD-2): a multicentre, patient-blinded, randomised controlled phase 2/3

Hilst J et al

Lancet gastroenterology&Hepatology 2019

4 centres In Netherlands > 20 PD x year

- Surgeons training programme for LPD before trial

- No vascular involvement

- randomized 1:1

Phase 3 results: Jan 31 – Nov 2017

- **Phase 2** to assess the safety of LPD (***complications and mortality)***
- **Phase 3** functional recovery in days : adequate pain control with only oral analgesia……

	LPD vs OPD
Mortality	*10% vs 2%*
Grade III°	50% vs 39%
POPF B/C	28% vs 24%

°Clavien-Dindo

Trial Prematurely interrupted

Lap. Hydrid PD

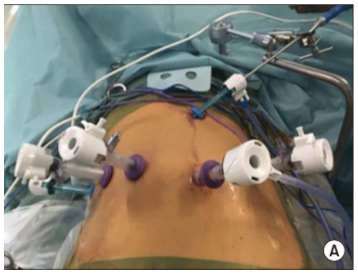
- Avoid large incision (lap. 1st step) if still metastatic
- Training seniors → Juniors
- Less morbility / mortality ????
- Better patients selection ++++

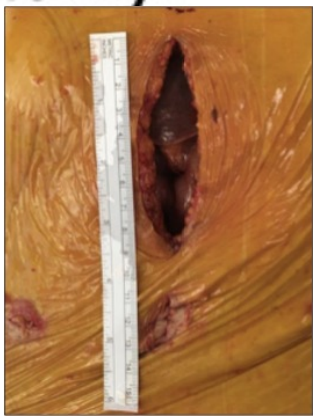
Toward

Robotic Surgery

anastomosis
clamping
} PD

Laparoscopic hybrid pancreaticoduodenectomy: Initial single center experience

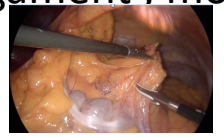




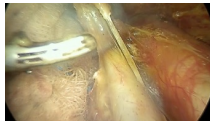
	n or mean	% or range
Men	11	53.3%
Age (years)	67.9	43-84
BMI (kg/m^2)	24.5	20.7-32
ASA		
II	7	33
III	14	67
Tumor Size (mm)	21	15-55
Vascular invasion	3	14.2
Neoadjuvant therapy	11	73.3
Operative time (minutes)	425	226-576
Conversion to open surgery	4	19
Estimated blood loss (ml)	317	60-800
Intraoperative transfusion	3	14.2
Total post-operative complications	9	42.8
Major post-operative complication*	3	14.2
Pancreatic fistula	4	19
Grade B	3	14.3
Grade C	1	4.7
Post-pancreatectomy hemorrhage	1	4.7
Delayed gastric emptying	4	19
Bile leak	2	9.5
Pulmonary embolism	2	9.5
Length of hospital stay (days)	14	9-23
90-days readmission	4	19
90-days mortality	1	4.7
Histologic subtype		
Adenocarcinoma	15	71.4
AAC	2	9.5
IPMN	2	9.5
CA	1	4.8
DA	1	4.8
Number of harvested LN	17.7	12-26
Invaded LN	1.7	1-7
R0 rate	17	80
R1 >0<1 mm	2	9.5
R1 0 mm	2	9.5
Postoperative chemotherapy	15	71.4
Follow-up (months)	7.5	3-12

Ann Hepatobiliary Pancreat Surg 2021

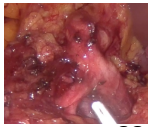
Stepwise approach for laparoscopic ibryd PD

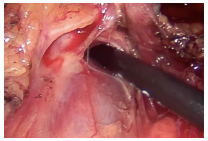
1 step: Open of the gastrocolic ligament , mobilized the right colon flexure and control of the right gastrocolic vessels 

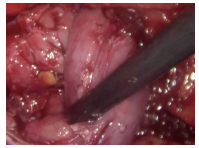
2 step: Mobilization of the duodenum (kocker manouvre) and if necessairy artery first approch 

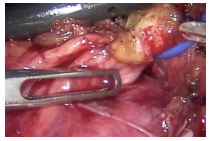
3 step: picking of LN 16 (intra aorto-cava) 

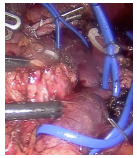
4 step: gastric resection 

5 step: Exposing the structures of the hepatoduodenal ligament (limphoadenectomy) and dividing the gastoduodenal artery 

6 step: Dissection the neck of the pancreas off the SM-PV trunk 

7 step: Section of the Treitz and jejunum brought behind the mesentric vessels 

8 step: Transection the pancreas and common bile duct 

9 step: Uncinate process dissection 

10 *step*: open anastomosis

Take Message

- Laparoscopic pancreatic resection is feasible but no consensus for PD
- Probably not difference in terms of radicality and oncological outcome (more RCT)

but

- Learning curve is difficult and long
- Patients selection is decisive for final result