Pancreatic Cancer and Margins
Surgeon's View

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No Conflict of Interest

Margins and Margin Call

Margins and Margin Call

Economic downturns, universal health coverage, and cancer mortality in high-income and middle-income countries, 1990–2010: a longitudinal analysis

Mahiben Maruthappu, Johnathan Watkins*, Aisyah Mohd Noor, Callum Williams, Raghib Ali, Richard Sullivan, Thomas Zeltner, Rifat Atun*

Maruthappu M et al Lancet 2016; 388:684-695.

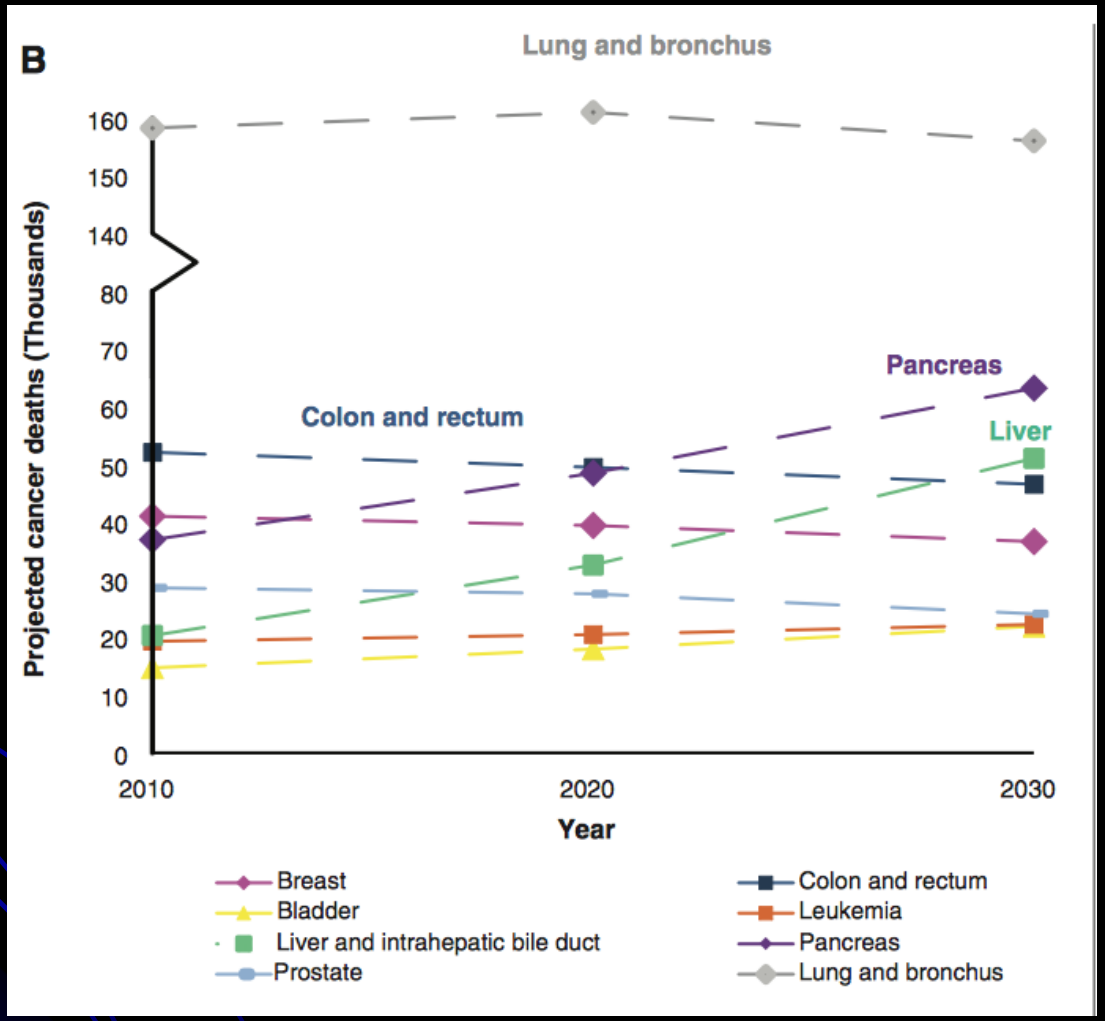
Pancreatic Cancer and Mortality 2016

Estimated Deaths

Males				Females		
Lung & bronchus	85,920	27%		Lung & bronchus	72,160	26%
Prostate	26,120	8%		Breast	40,450	14%
Colon & rectum	26,020	8%		Colon & rectum	23,170	8%
Pancreas	21,450	7%		Pancreas	20,330	7%
Liver & intrahepatic bile duct	18,280	6%		Ovary	14,240	5%
Leukemia	14,130	4%		Uterine corpus	10,470	4%
Esophagus	12,720	4%		Leukemia	10,270	4%
Urinary bladder	11,820	4%		Liver & intrahepatic bile duct	8,890	3%
Non-Hodgkin lymphoma	11,520	4%		Non-Hodgkin lymphoma	8,630	3%
Brain & other nervous system	9,440	3%		Brain & other nervous system	6,610	2%
All Sites	**314,290**	**100%**		**All Sites**	**281,400**	**100%**

Siegel RL et al CA Cancer J Clin 2016;66:7-30.

Pancreatic Cancer and Mortality 2030



Rahib L et al Cancer Res 2014;74:2913-2921.

A Margin-Negative R0 Resection Accomplished With Minimal Postoperative Complications Is the Surgeon's Contribution to Long-Term Survival in Pancreatic Cancer.

Howard TJ et al J Gastrointest Surg 2006;10:1338-1346.

Pancreatic Cancer and Survival

- Lymph Node Status (-ve v +ve) *P< 0.0001*
- Tumour Diameter (>3cm v <3cm) *P< 0.0001*
- Histological Grade (well diff vs poor diff) *P< 0.0001*
- Margin Status (-ve v +ve) *P< 0.0001*

Winter JM et al J Gastrointest Surg 2006; 10:1199-1211

Traditional R1 Margins

Variable	No. Pts	Med Sur	p value
Overall	360	25	
N0	174	32	
N1	186	22	
R0	300	28	
R1	60	22	
Maj Comp			
No	263	27	
Yes	93	22	

R0 17 mo
R1 11 mo (18%)

ESPAC-1
Ann Surg 2001

Raut CP et al Ann Surg 2007; 246: 52-60.

Pancreatic Cancer Margins

Original article

Redefining the R1 resection in pancreatic cancer

C. S. Verbeke[1], D. Leitch[1], K. V. Menon[2], M. J. McMahon[2], P. J. Guillou[2] and A. Anthoney[3]

Departments of [1]Histopathology, [2]Surgery and [3]Medical Oncology, University of Leeds and Leeds Teaching Hospitals NHS Trust, Leeds, UK
Correspondence to: Dr C. S. Verbeke, Department of Histopathology, St James's University Hospital, Beckett Street, Leeds LS9 7TF, UK (e-mail: caroline.verbeke@leedsth.nhs.uk)

Verbeke C et al Br J Surg 2006; 93: 1232-1237.

Pancreatic Cancer Margins

a Anterior CRM

b Posterior CRM

c SMV groove CRM

d SMV groove CRM

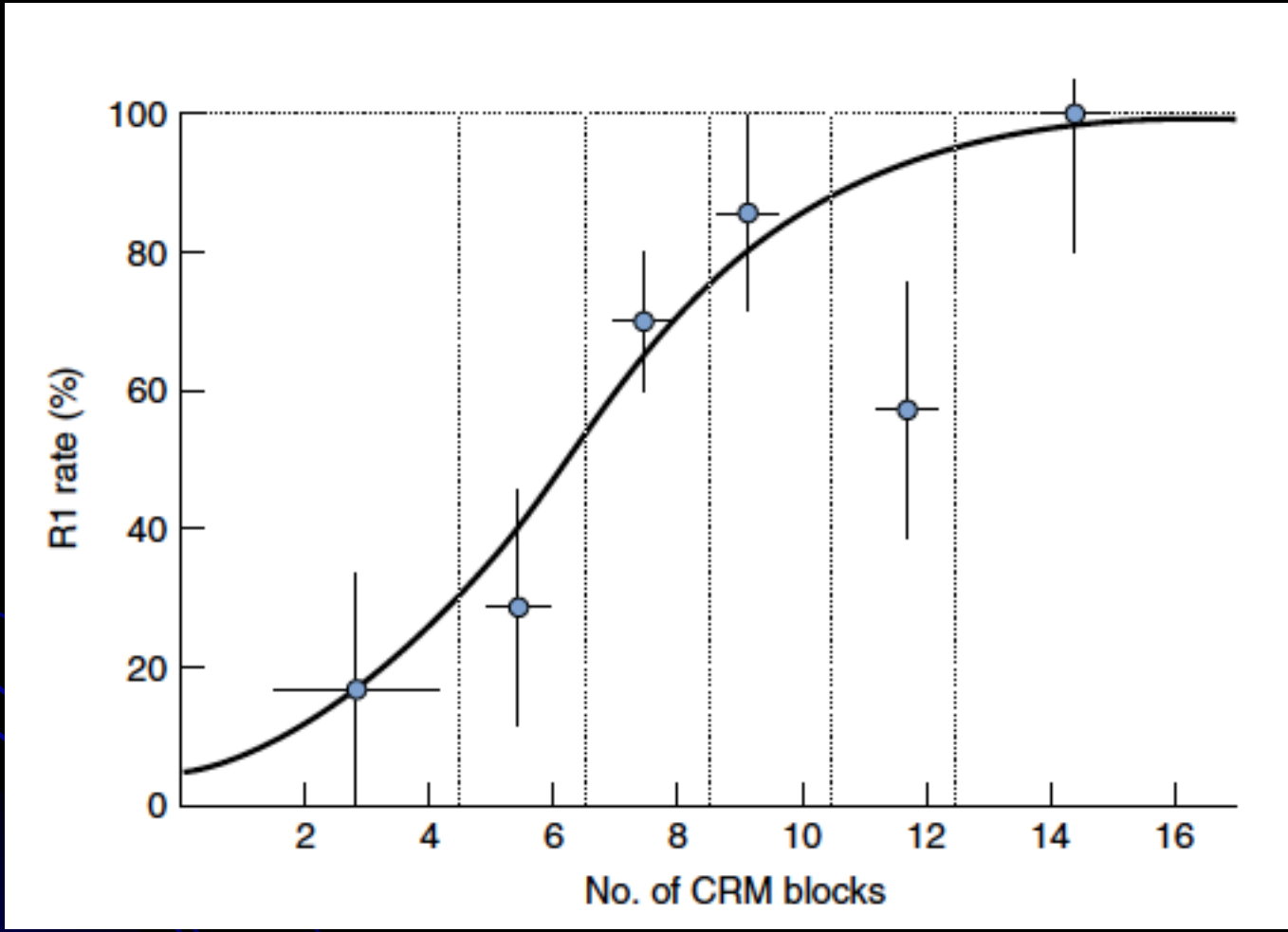
e Axial slicing

Pancreatic Cancer Margins

No of Pancreatic Cancer	26
Tumour Size cm	2.9 (2.0-5.0)
R1	22 (85%)
RM involved	
Post	14 (54%)
SMV groove	12 (46%)
Ant	4 (15%)
Neck	2 (8%)
No of Margins involved	
1	12 (46%)
2	5 (19%)
3 or 3+	5 (19%)

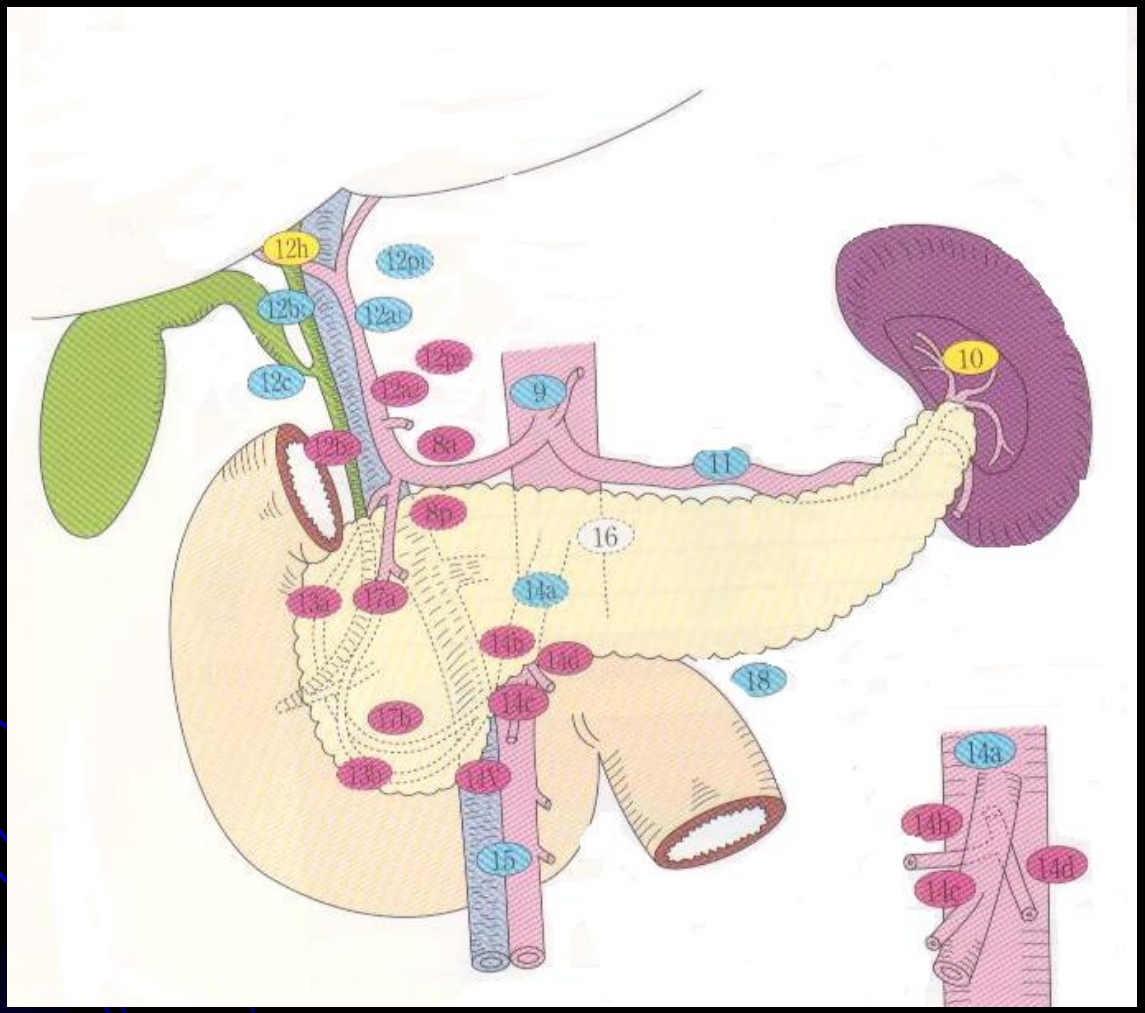
Verbeke C et al Br J Surg 2006; 93: 1232-1237.

Pancreatic Cancer Margins



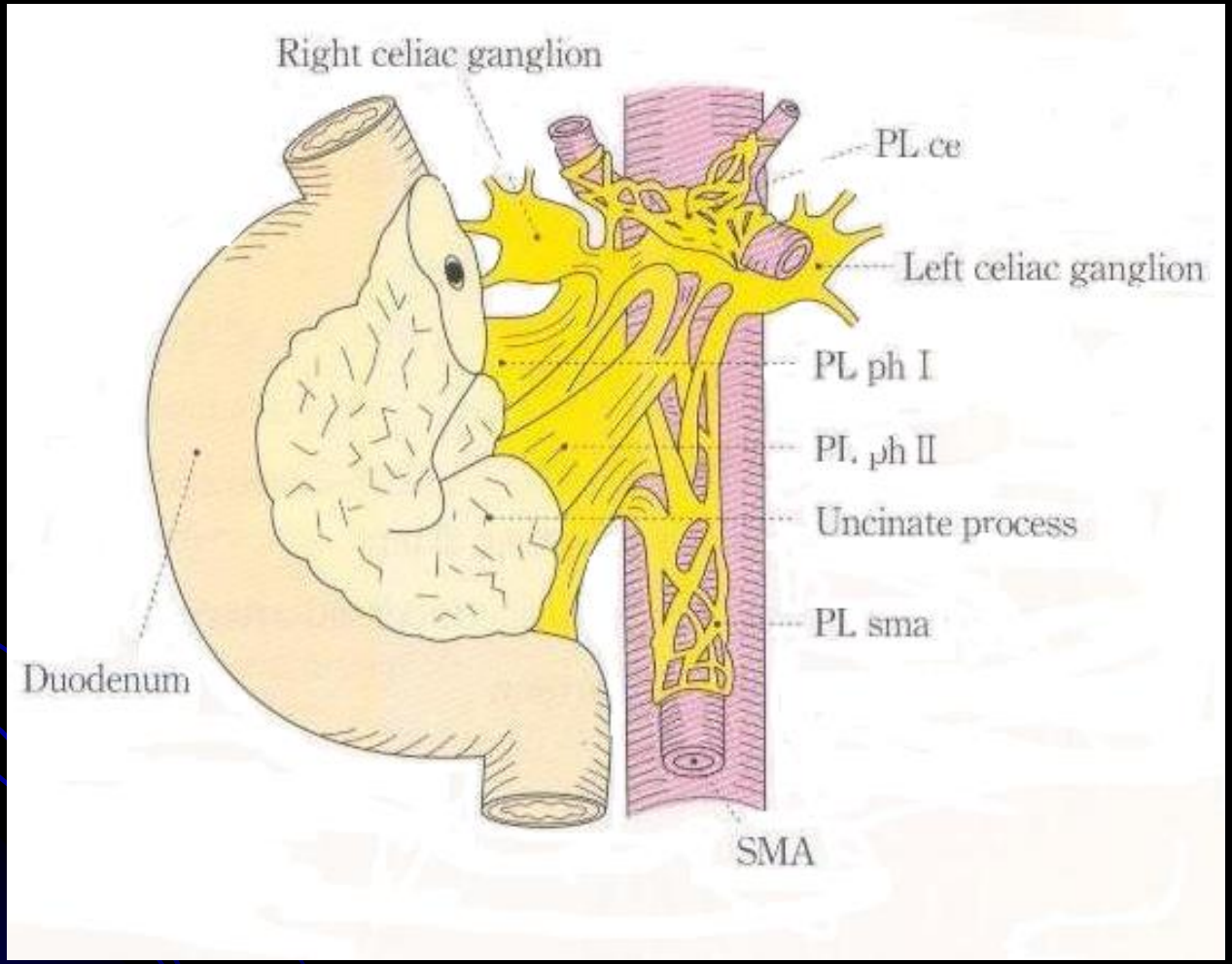
Verbeke C et al Br J Surg 2006; 93: 1232-1237.

Lymph node Stations in Pancreatic Surgery



JPS Classification Kanehara Press 2nd ed Tokyo 2003

Neural Plexuses in Pancreatic Surgery



JPS Classification Kanehara Press 2nd ed Tokyo 2003

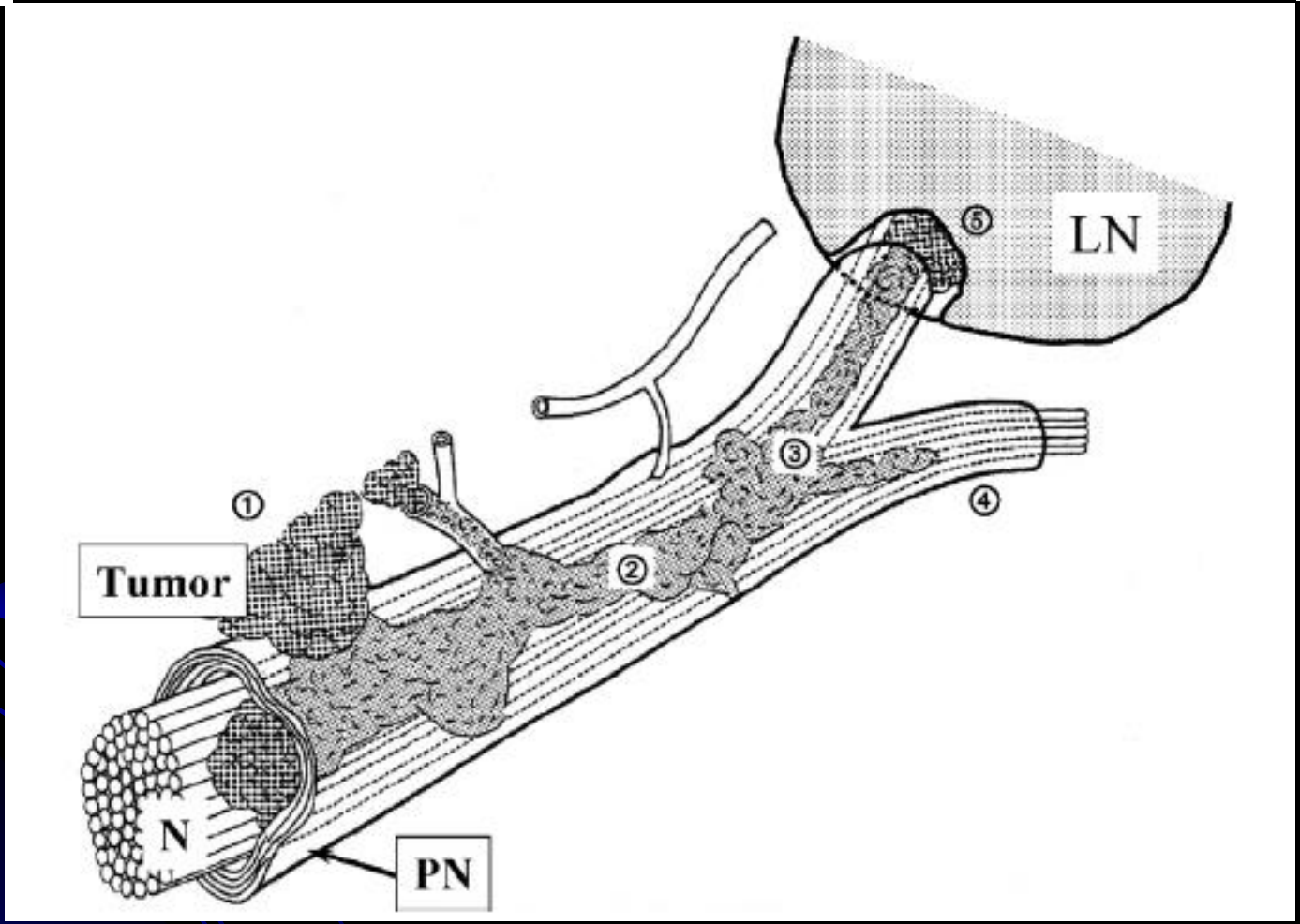
Margins: Detailed Histopathology

The Nature of Neural Invasion by Pancreatic Cancer

Masato Kayahara, MD, PhD, Hisatoshi Nakagawara, MD, PhD, Hirohisa Kitagawa, MD, PhD, and Tetsuo Ohta, MD, PhD

Kayahara M et al Pancreas 2007; 35: 218-223.

Margins: Detailed Histopathology



Kayahara M et al Pancreas 2007; 35: 218-223.

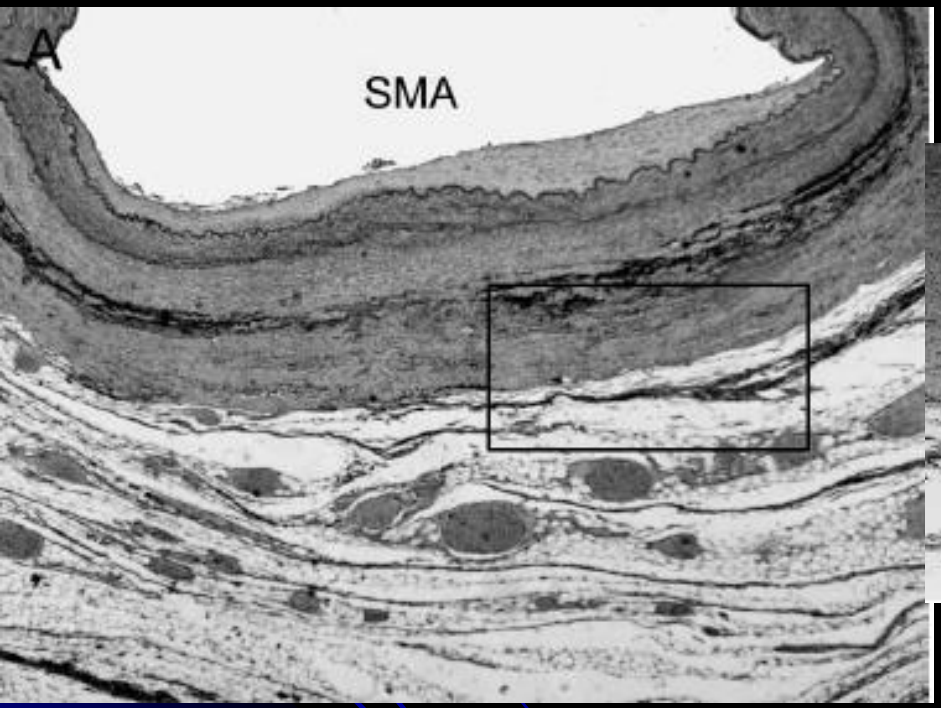
Margins: Detailed Histology

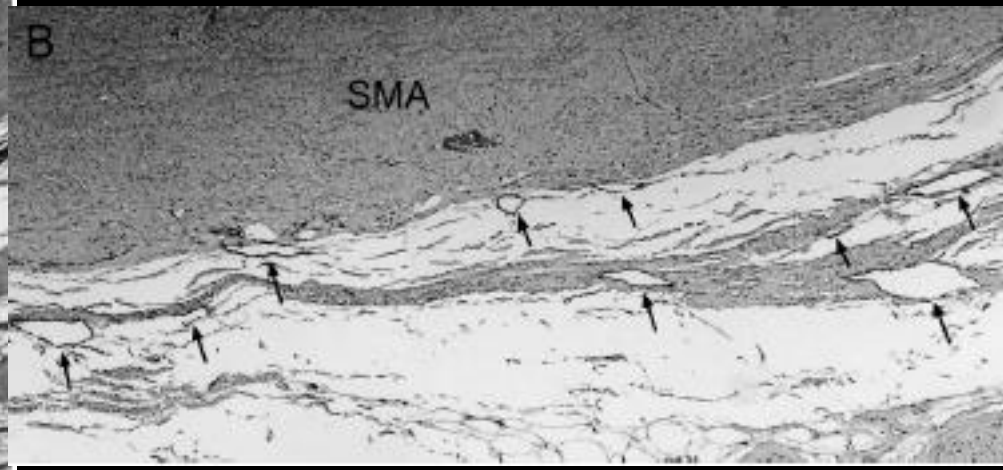
Distribution of Lymphatic Vessels in the Neural Plexuses Surrounding the Superior Mesenteric Artery

Gang Jin, MD,† Masanori Sugiyama, MD,* Hongfang Tuo, MD,* Atsuko Oki, MD,* Nobutsugu Abe, MD,* Toshiyuki Mori, MD,* Tadahiko Masaki, MD,* Yasunori Fujioka, MD,‡ and Yutaka Atomi, MD**

Jin G et al Pancreas 2006; 32: 62-66.

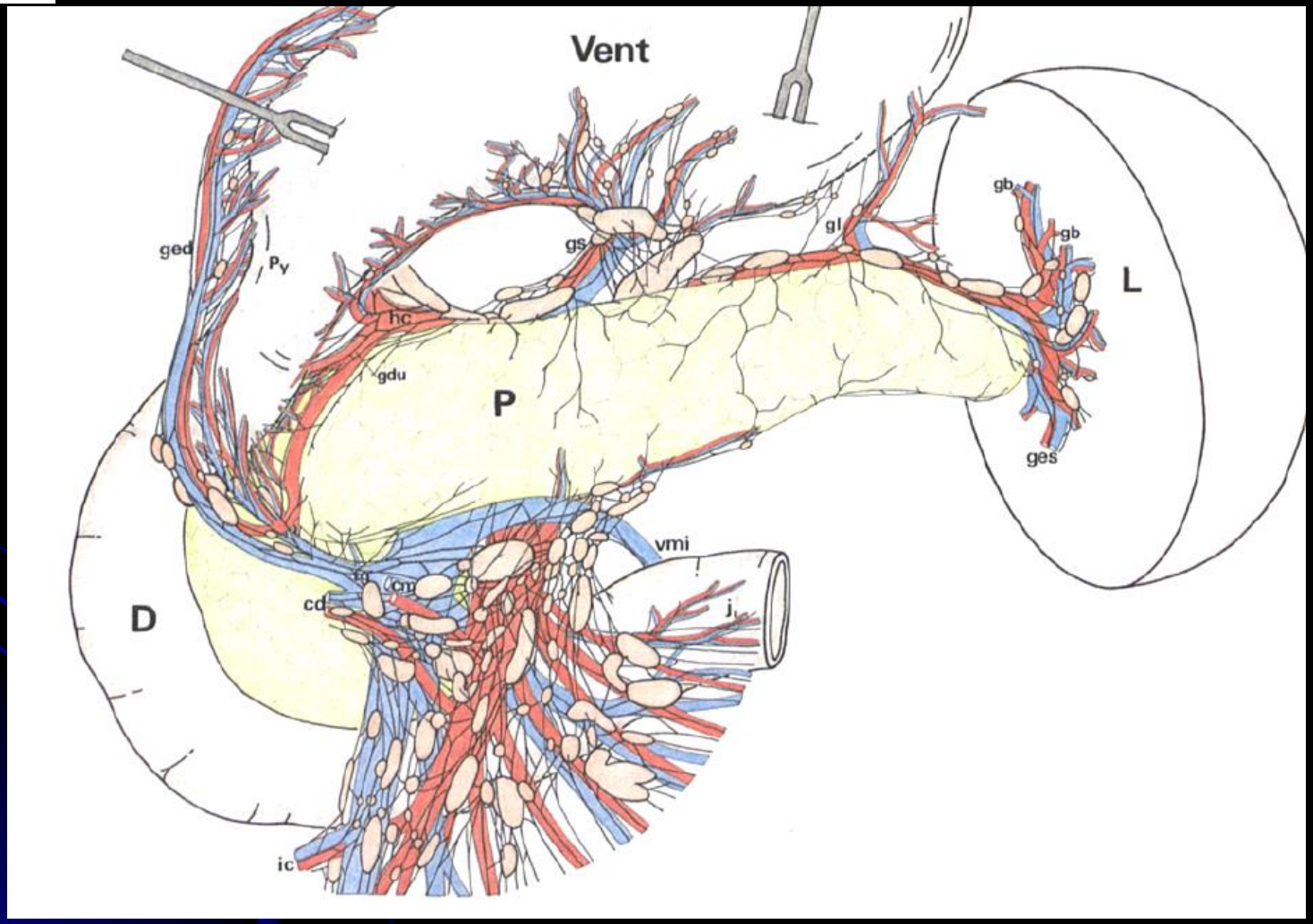
Margins: Detailed Histology





Jin G et al Pancreas 2006; 32: 62-66.

Surgical Pathology



Deki H et al Surg Radiol Anat 1988; 10: 121-135.

Margins: Detailed Histopathology

ORIGINAL ARTICLE

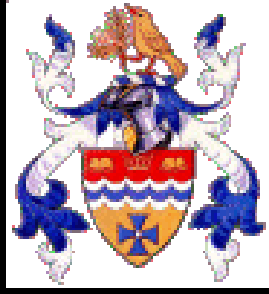
Pancreas Head Carcinoma

Frequency of Invasion to Soft Tissue Adherent to the Superior Mesenteric Artery

Masahiro Noto, MD, Koichi Miwa, MD, Hirohisa Kitagawa, MD, Masato Kayahara, MD, Hiroyuki Takamura, MD, Koichi Shimizu, MD, and Tetsuo Ohta, MD

Noto M et al Am J Surg Pathol 2005; 29: 1056-1061.

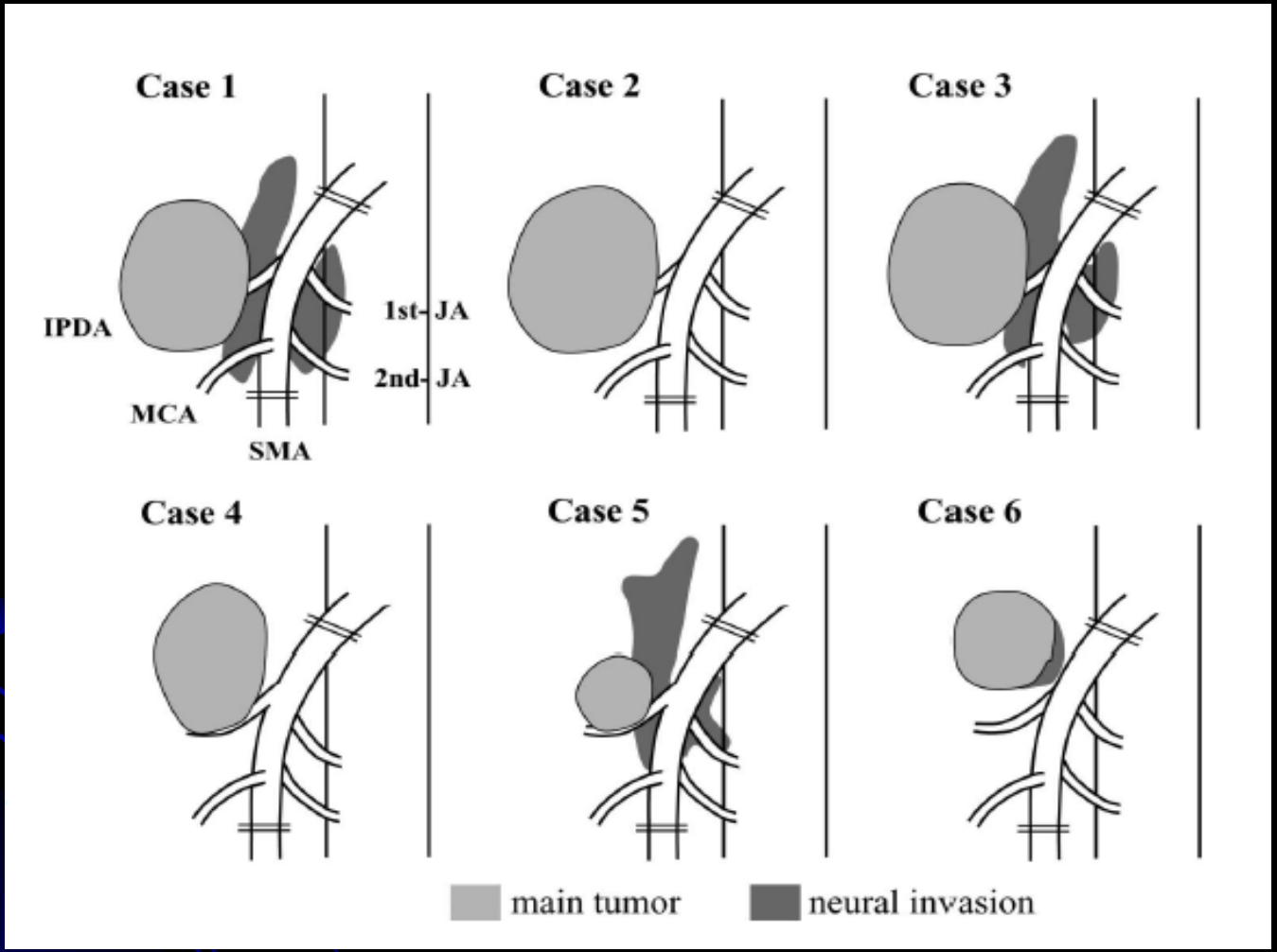
Margins: Detailed Histopathology



Patient No	Sections	pT Stage	PLsma	Lymphnode status	p Stage	R Status
1	1220	4	+	3/42	III	0
2	940	3	-	8/15	IIB	0
3	2352	4	+	11/22	III	0
4	1784	3	_	3/22	IV	0
5	1848	4	+	9/37	III	0
6	2312	3	+	3/47	IIB	0

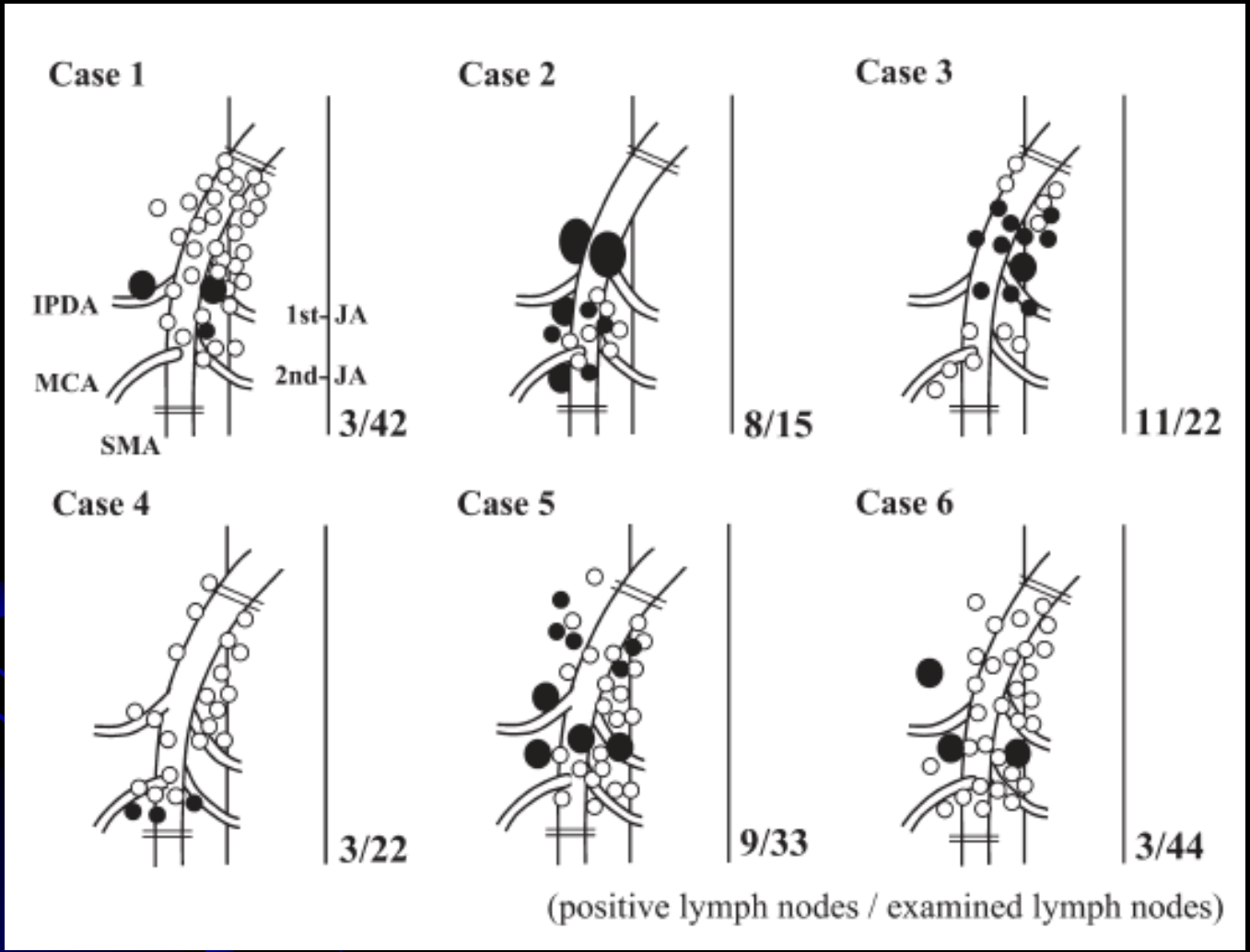
Noto M et al Am J Surg Pathol 2005; 29: 1056-1061.

Margins: Detailed Histopathology



Noto M et al Am J Surg Pathol 2005; 29: 1056-1061.

Margins: Detailed Histopathology



Noto M et al Am J Surg Pathol 2005; 29: 1056-1061.

Pancreatic Cancer Margins

VOLUME 27 · NUMBER 17 · JUNE 10 2009

JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT

Margin Clearance and Outcome in Resected Pancreatic Cancer

David K. Chang, Amber L. Johns, Neil D. Merrett, Anthony J. Gill, Emily K. Colvin, Christopher J. Scarlett, Nam Q. Nguyen, Rupert W.L. Leong, Peter H. Cosman, Mark I. Kelly, Robert L. Sutherland, Susan M. Henshall, James G. Kench, and Andrew V. Biankin

Chang C et al J Clin Oncol 2009; 27: 2855-2862.

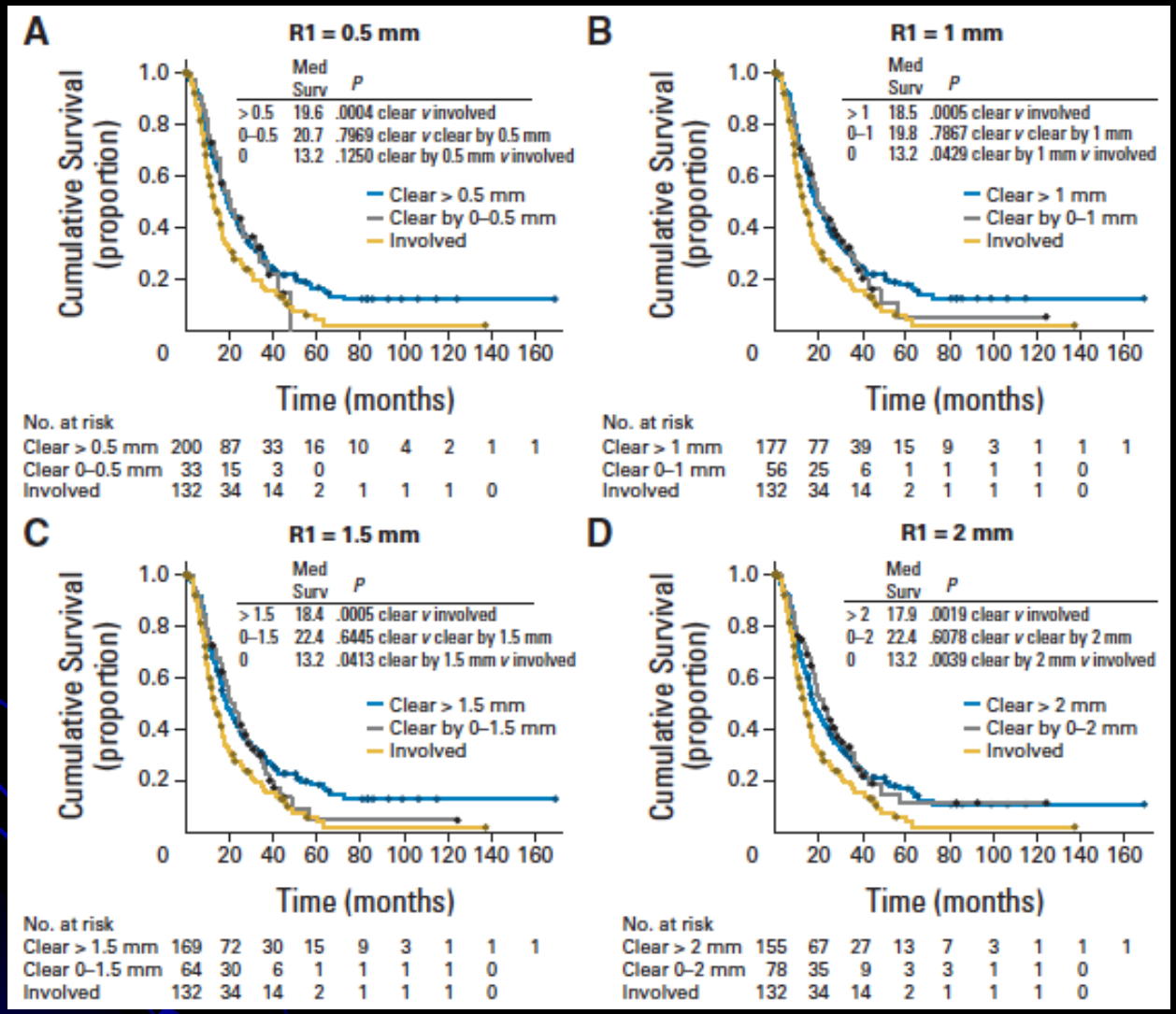
Pancreatic Cancer Margins

R1 Definition and Subgroup	No. of Patients (n = 365)	Median Survival (months)	Difference	3-Year Survival	Difference	5-Year Survival	Difference	*P* (log-rank)
0 mm								
Clear	233	19.6		28.0		15.5		
Involved	132	13.2	6.4	16.1	11.9	3.9	11.6	.0003*
≤ 0.5 mm								
Clear > 0.5 mm	200	19.6		28.0		16.6		.0004*
Clear by 0-0.5 mm	33	20.7	−1.1	26.9	1.1	0	16.6	.7969†
Involved	132	13.2	7.5	16.1	10.8	3.9	−3.9	.1250‡
≤ 1 mm								
Clear > 1 mm	177	18.5		27.5		17.6		.0005*
Clear by 0-1 mm	56	19.8	−1.3	29.2	−1.7	5.3	12.3	.7867†
Involved	132	13.2	6.6	16.1	13.1	3.9	1.4	.0429‡
≤ 1.5 mm								
Clear > 1.5 mm	169	18.4		28.9		18.5		.0005*
Clear by 0-1.5 mm	64	22.4	−4.0	25.0	3.9	4.6	13.9	.6445†
Involved	132	13.2	9.2	16.1	8.9	3.9	0.7	.0413‡
≤ 2 mm								
Clear > 2 mm	155	17.9		27.5		16.7		.0019*
Clear by 0-2 mm	78	22.4	−4.5	28.6	−1.1	11.2	5.5	.6078†
Involved	132	13.2	9.2	16.1	12.5	3.9	7.3	.0039‡

*P value for "clear" versus "involved."
†P value for "clear" versus "clear by X mm."
‡P value for "clear by X mm" versus "involved."

Chang C et al J Clin Oncol 2009; 27: 2855-2862.

Pancreatic Cancer Margins



Chang C et al J Clin Oncol 2009; 27: 2855-2862.

Pancreatic Cancer and Margins

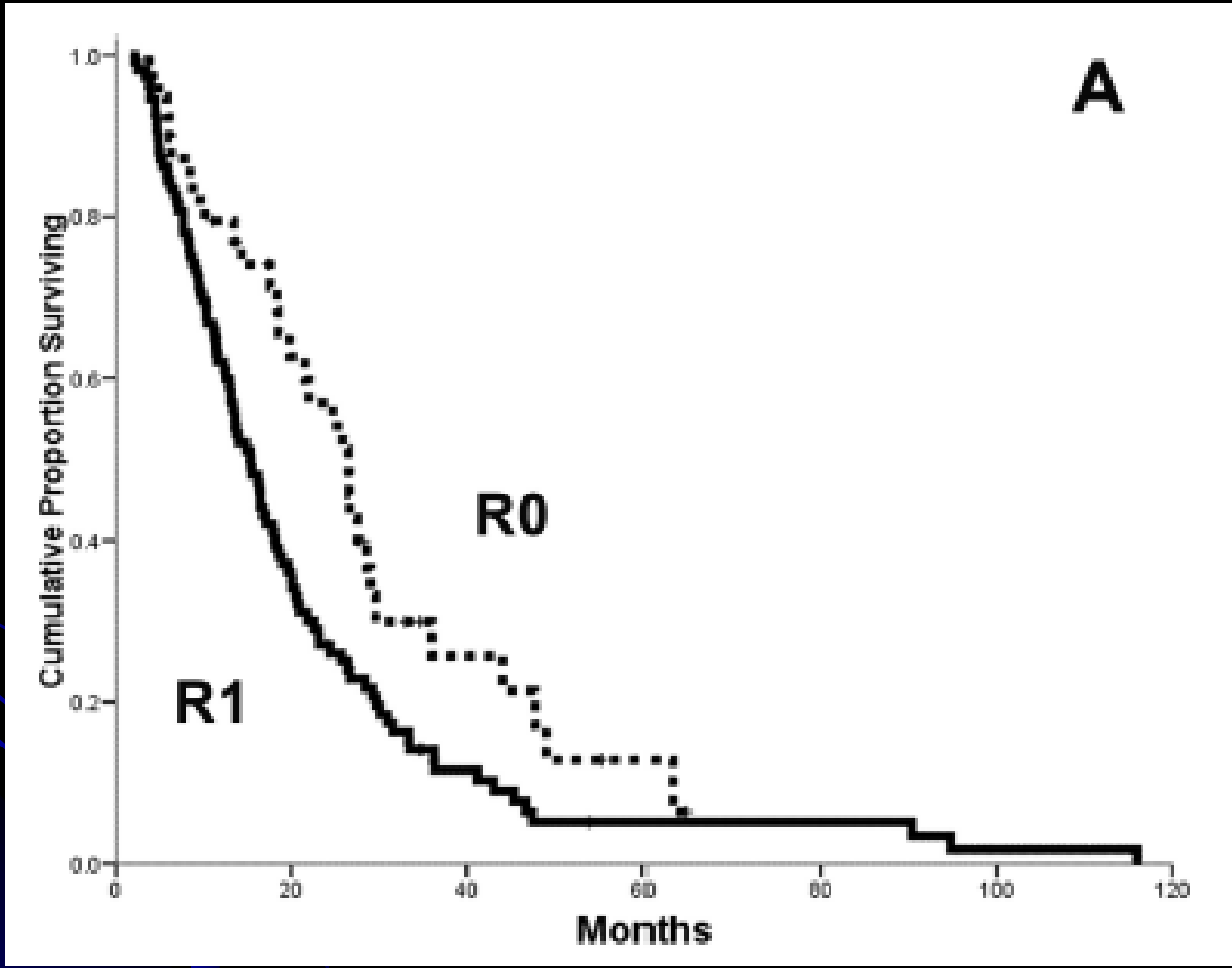
FEATURE

Positive Mobilization Margins Alone Do Not Influence Survival Following Pancreatico-Duodenectomy for Pancreatic Ductal Adenocarcinoma

Nigel B. Jamieson, MRCS,† Alan K. Foulis, MD,‡ Karin A. Oien, PhD,†‡ James J. Going, PhD,†‡ Paul Glen, MD,* Euan J. Dickson, MD,* Clem W. Imrie, FRCS,* Colin J. McKay, MD,* and Ross Carter, MD**

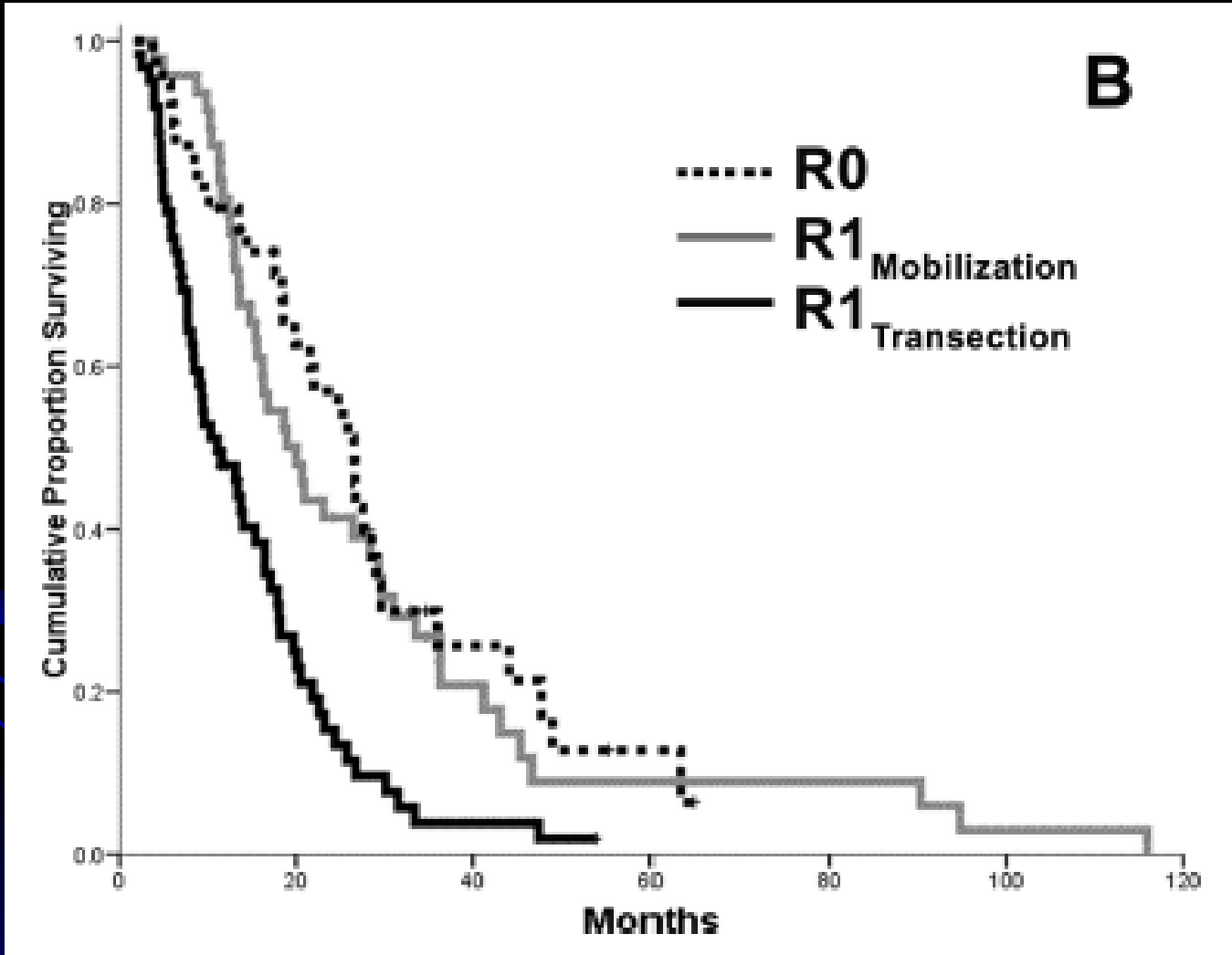
Jamieson NB et al Ann Surg 2010; 251: 1003-1010.

Pancreatic Cancer and Margins



Jamieson NB et al Ann Surg 2010; 251: 1003-1010.

Pancreatic Cancer and Margins



Jamieson NB et al Ann Surg 2010; 251: 1003-1010.

Pancreatic Cancer and Margins

Margin	Cases (%)	Median Survival months	95% CI	p
Total Mobilization Margin	48 (44%)	18.9	13.1-24.8	<0.001
Total Transection Margin	61 (66%)	11.1	7.1-15.1	

Jamieson NB et al Ann Surg 2010; 251: 1003-1010.

Pancreatic Cancer Margins and Survival

Resection Margins in Pancreatic Cancer

Caroline S. Verbeke, MD, PhD, FRCPath*

Verbeke CS Surg Clin N Am 2013; 93: 647-662.

Pancreatic Cancer Margins and Survival

Comparison of the rate of microscopic margin involvement (R1) and median survival after surgical resection of ductal adenocarcinoma of the pancreas between studies using the axial slicing technique or another grossing technique

Reference (Year)	Number of Patients	R1 Rate (%)	Median Survival R0	Median Survival R1
Axial Slicing Technique				
Verbeke et al,[1] 2006	54	85	37	11
Esposito et al,[16] 2008	111	76	—	—
Menon et al,[17] 2009	27	82	>55	14
Campbell et al,[18] 2009	163	79	25	15
Jamieson et al,[19] 2010	1848	74	26	15
Other Technique				
Willet et al,[20] 1993	72	51	20	12
Millikan et al,[21] 1999	84	29	17	8
Benassai et al,[22] 2000	75	20	17	9
Sohn et al,[6] 2000	616	30	12	19
Neoptolemos et al,[12] 2001	111	19	17	11
Raut et al,[15] 2007	360	17	28	22
Westgaard et al,[23] 2008	40	45	16	11
Hsu et al,[24] 2010	509	44	19	11
Gnerlich et al,[25] 2012	285	34	22	16

Verbeke CS Surg Clin N Am 2013; 93: 647-662.

Pancreatic Cancer Margins and Survival

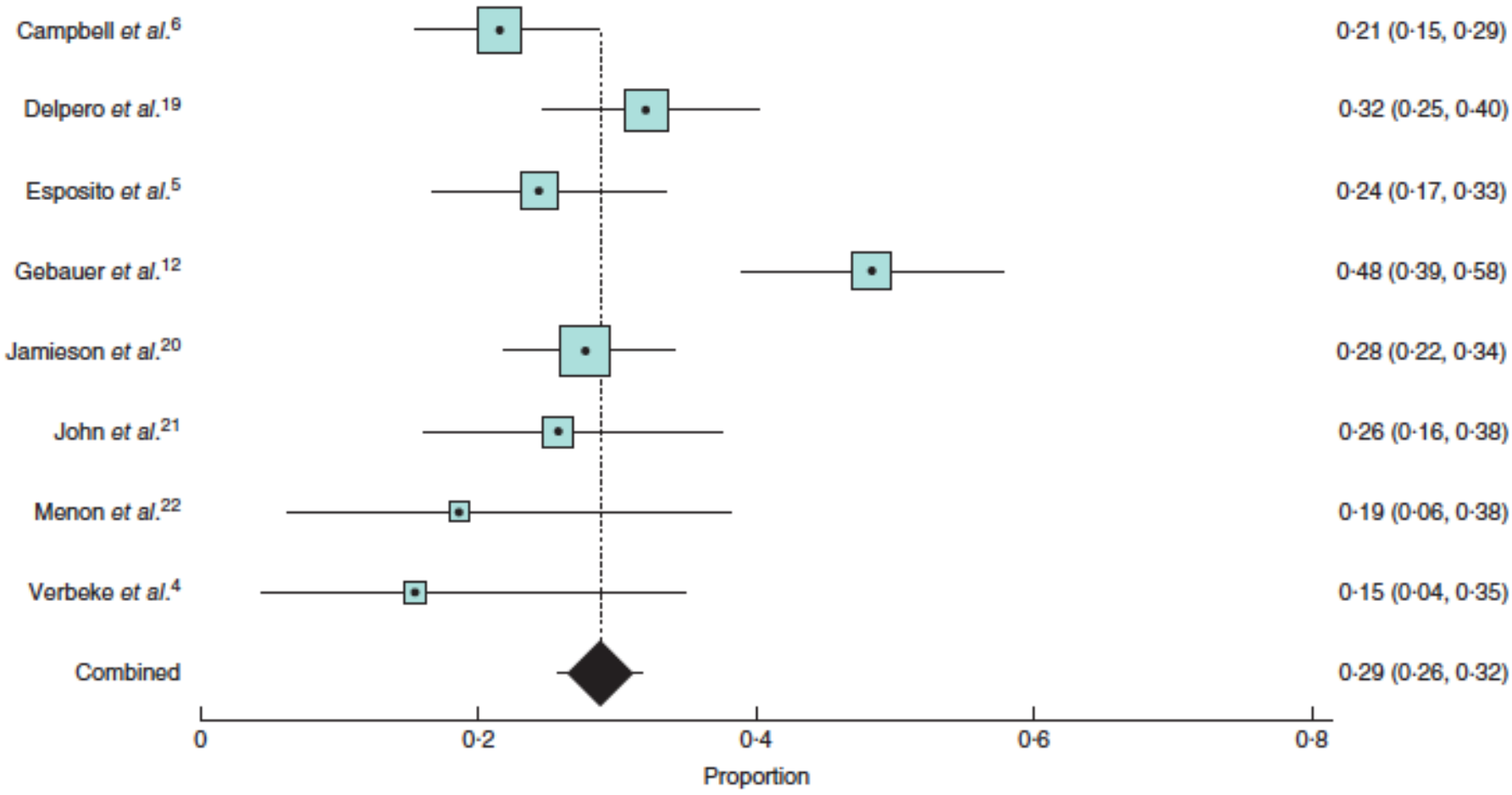
Systematic review

Meta-analysis of radical resection rates and margin assessment in pancreatic cancer

M. D. Chandrasegaram[1,9,10], D. Goldstein[2], J. Simes[1], V. Gebski[1], J. G. Kench[3,8], A. J. Gill[4], J. S. Samra[5,8], N. D. Merrett[6,10], A. J. Richardson[7,8] and A. P. Barbour[11]*

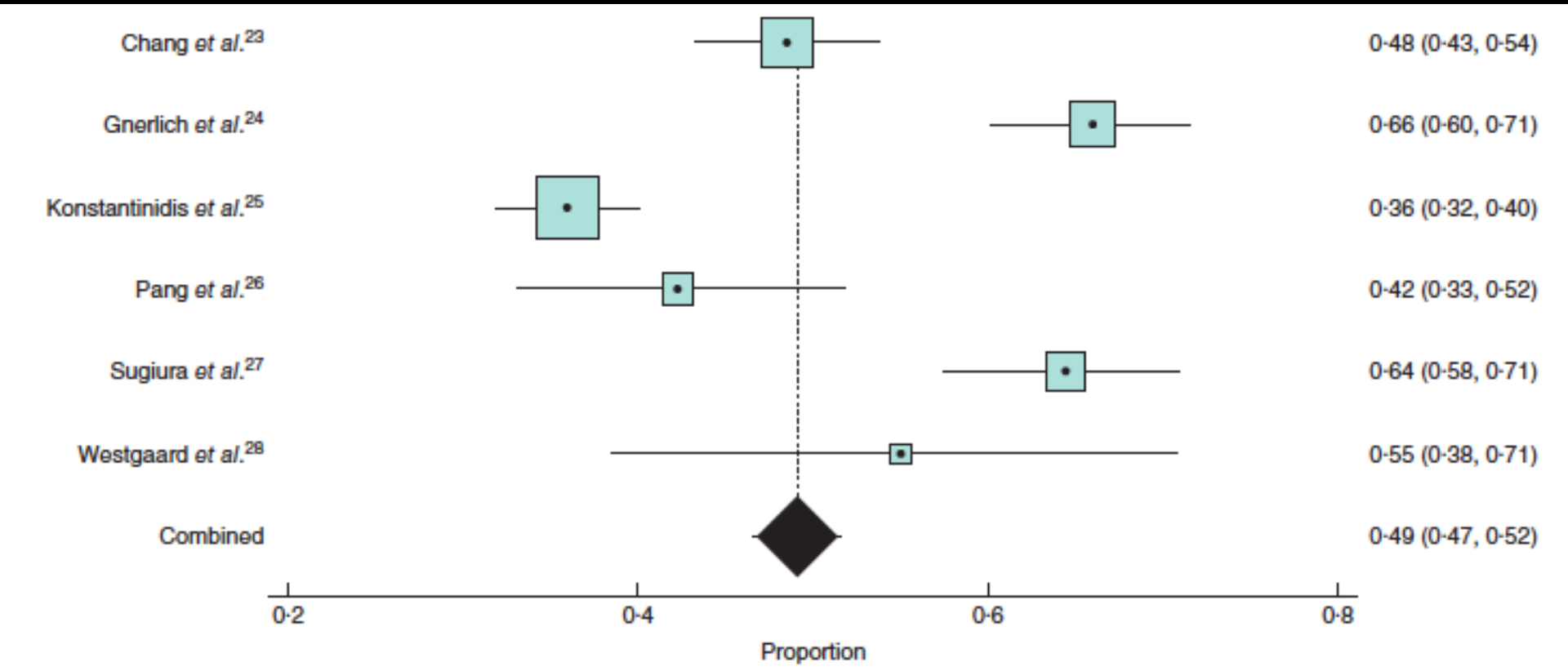
Chandrasegaram MD et al Br J Surg 2015; 102: 1459-1472.

Pancreatic Cancer Margins and Survival



Chandrasegaram MD et al Br J Surg 2015; 102: 1459-1472.

Pancreatic Cancer Margins and Survival



Chandrasegaram MD et al Br J Surg 2015; 102: 1459-1472.

Pancreatic Cancer and Neck Margin

PAPERS OF THE 134TH ASA ANNUAL MEETING

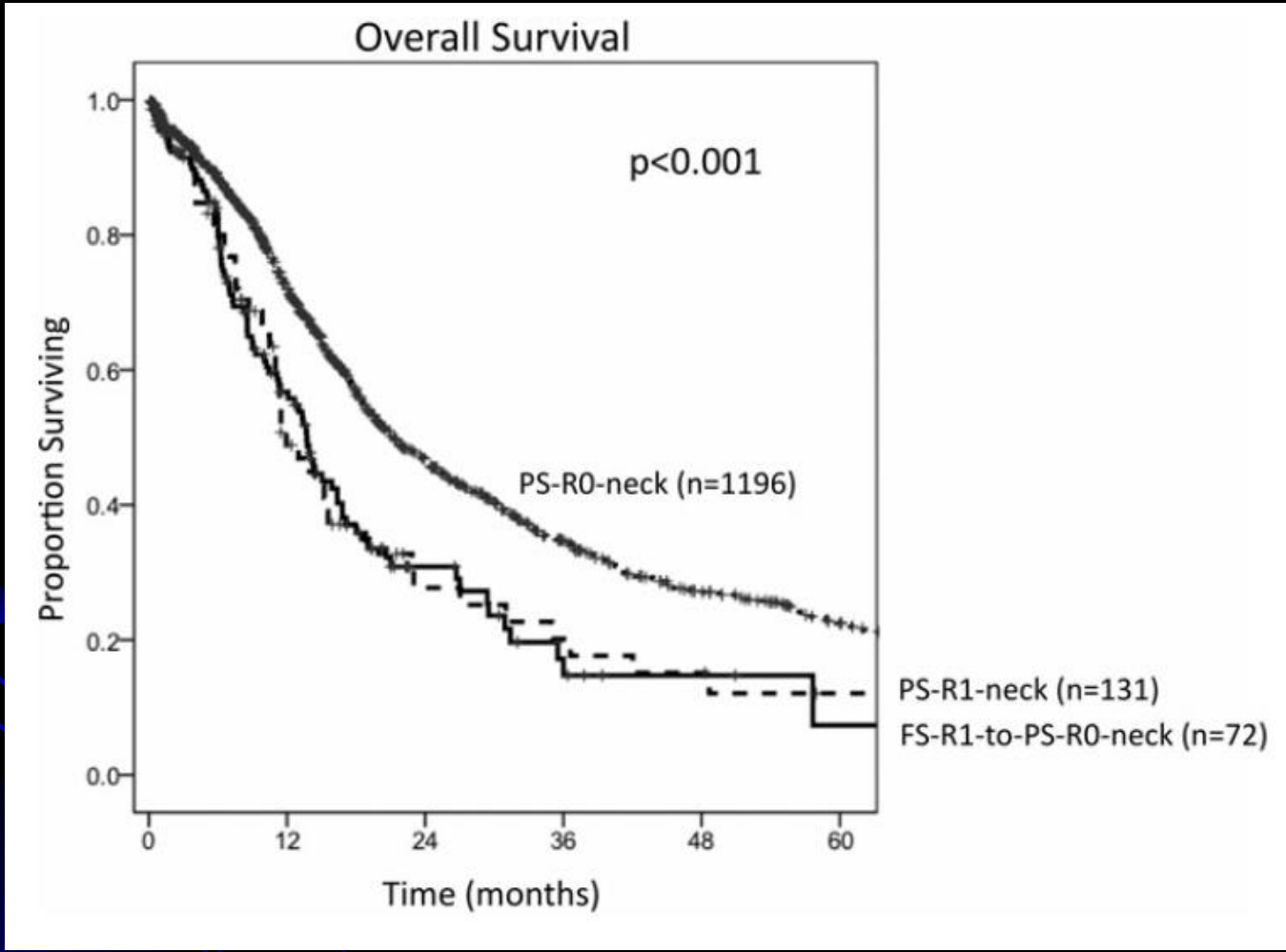
Value of Intraoperative Neck Margin Analysis During Whipple for Pancreatic Adenocarcinoma

A Multicenter Analysis of 1399 Patients

David A. Kooby, MD, Neha L. Lad, MD,* Malcolm H. Squires, III, MD,* Shishir K. Maithel, MD,* Juan M. Sarmiento, MD,* Charles A. Staley, MD,* N. Volkan Adsay, MD,† Bassel F. El-Rayes, MD,‡ Sharon M. Weber, MD,§ Emily R. Winslow, MD,§ Clifford S. Cho, MD,§ Kathryn A. Zavala, MD,§ David J. Bentrem, MD,¶ Mark Knab, MD,¶ Syed A. Ahmad, MD,‖ Daniel E. Abbott, MD,‖ Jeffrey M. Sutton, MD,‖ Hong Jin Kim, MD,** Jen Jen Yeh, MD,** Rachel Aufforth, MD,** Charles R. Scoggins, MD, MBA,†† Robert C. Martin, MD, PhD,†† Alexander A. Parikh, MD,‡‡ Jamie Robinson, MD,‡‡ Yassar M. Hashim, MD,§§ Ryan C. Fields, MD,§§ William G. Hawkins, MD,§§ and Nipun B. Merchant, MD‡‡*

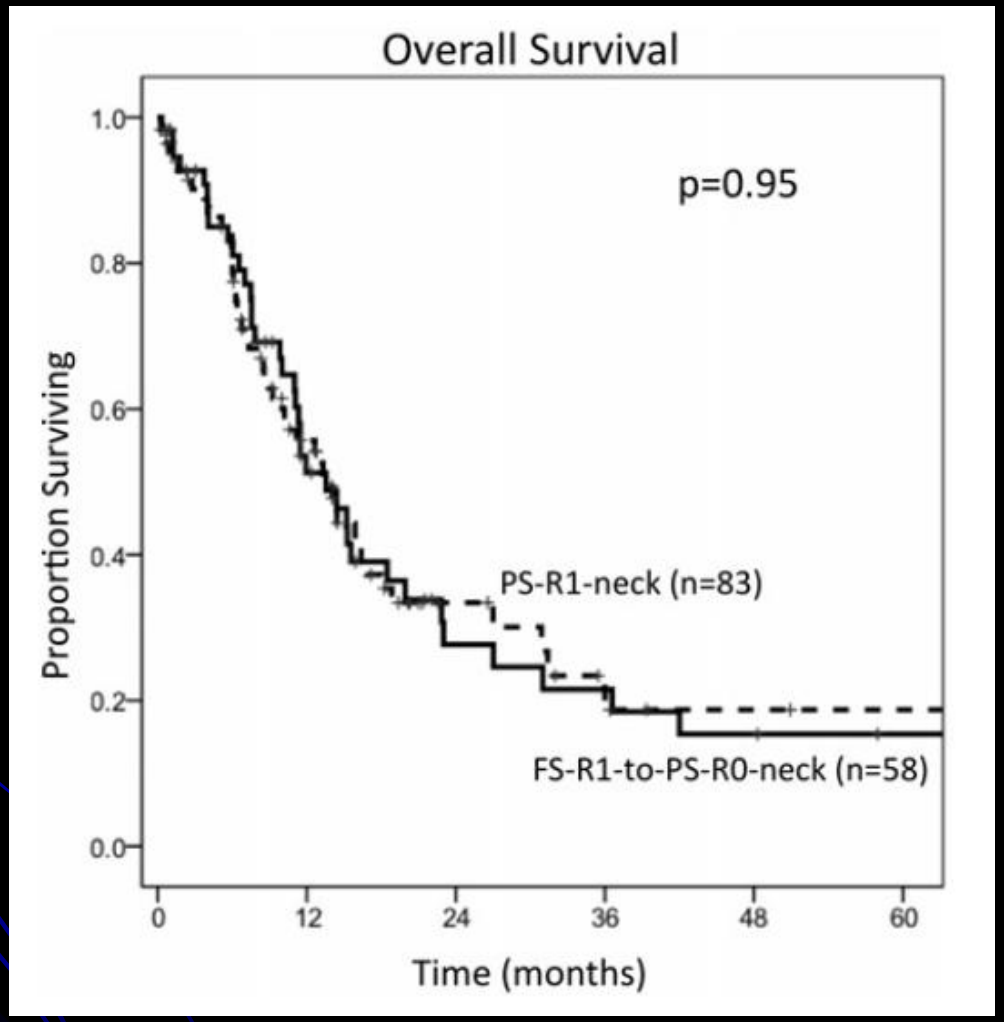
Kooby DA et al Ann Surg 2014; 260: 494-503.

Pancreatic Cancer and Neck Margin



Kooby DA et al Ann Surg 2014; 260: 494-503.

Pancreatic Cancer and Neck Margin



Kooby DA et al Ann Surg 2014; 260: 494-503.

Preoperative Imaging and Resection Margin

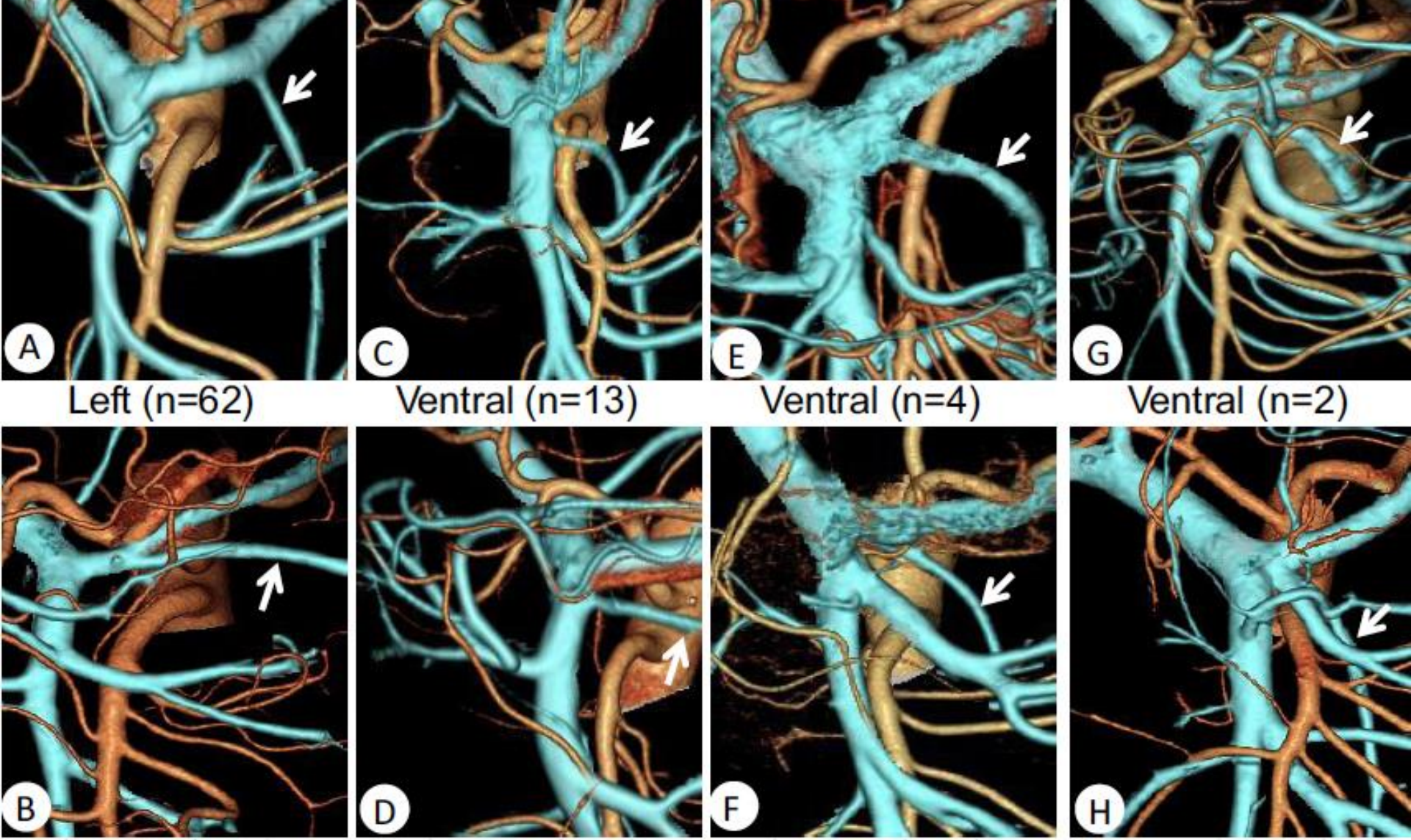
The American Journal of Surgery (2010) 200, 15–22

The American Journal of Surgery

Clinical Science

Analysis of anatomic variants of mesenteric veins by 3-dimensional portography using multidetector-row computed tomography

Sakaguchi T et al Am J Surg 2010; 200: 15-22.



Sakaguchi T et al Am J Surg 2010; 200: 15-22.

Preoperative Imaging and Resection Margin

Abdominal Imaging

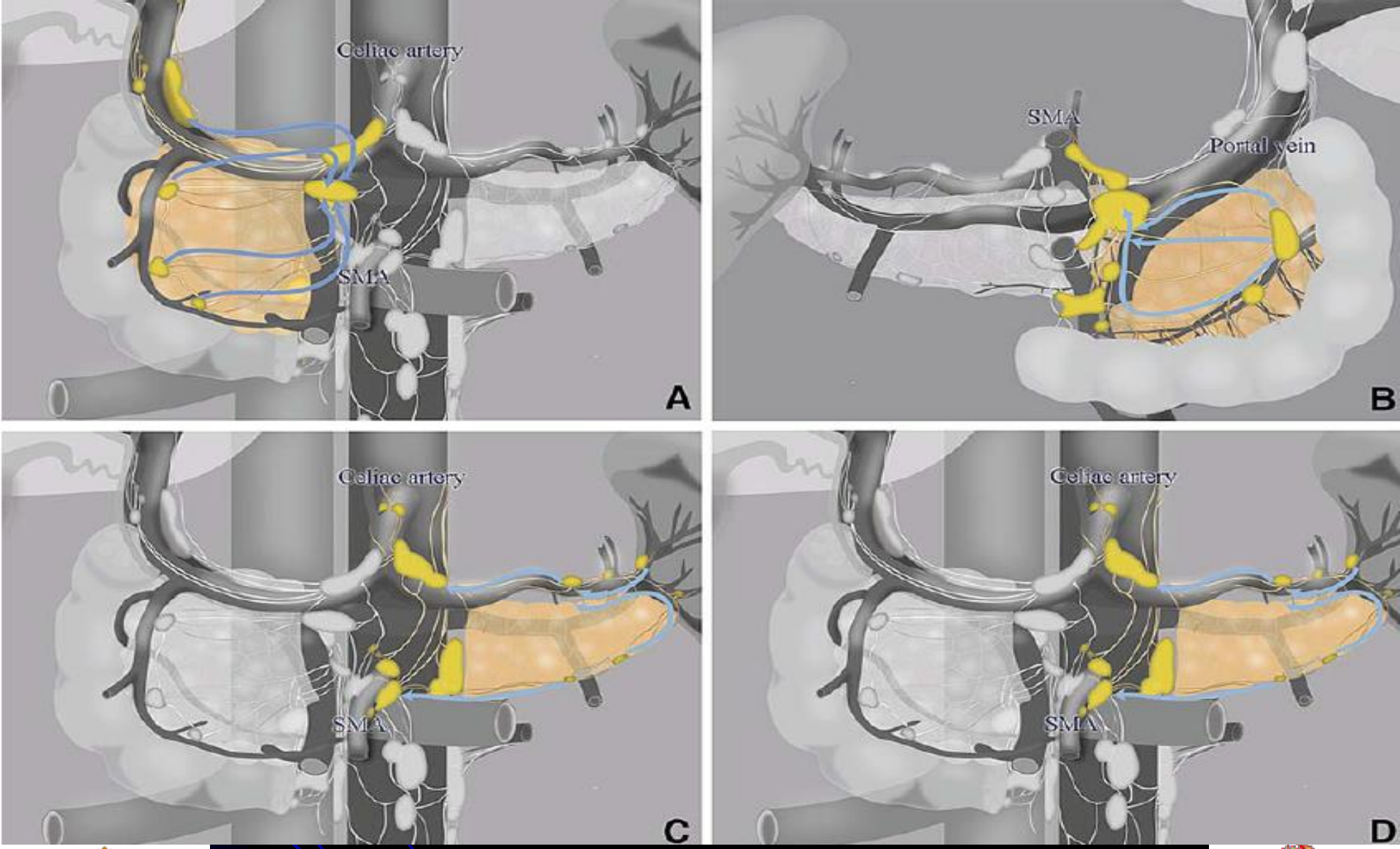
Published online: 30 October 2008

Abdom Imaging (2010) 35:154–162
DOI: 10.1007/s00261-008-9461-z

Peripancreatic lymphatic invasion by pancreatic carcinoma: evaluation with multi-detector row CT

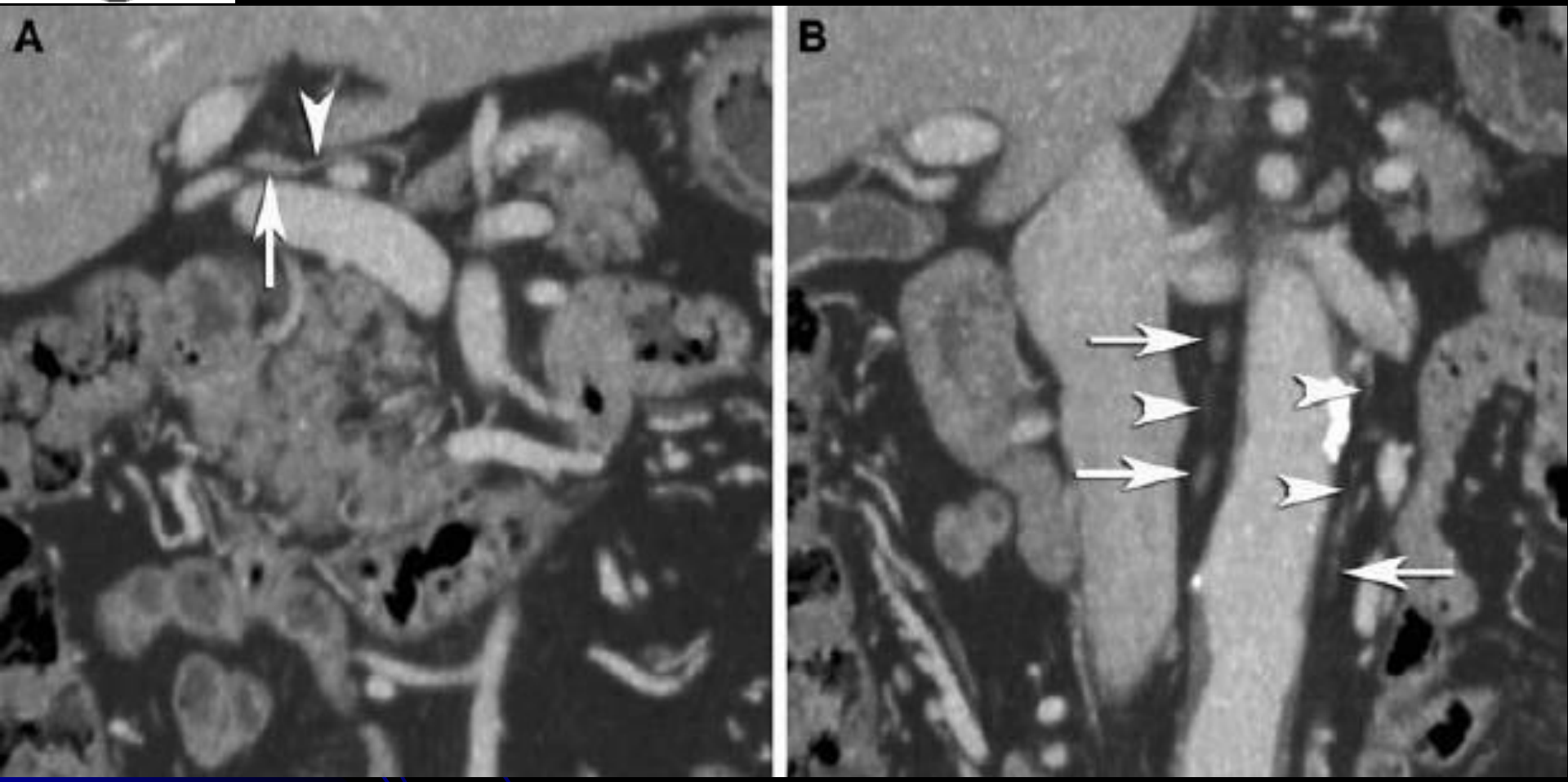
Michiaki Sai, Hiromu Mori, Maki Kiyonaga, Kazuhisa Kosen, Yasunari Yamada, Shunro Matsumoto

Sai M et al Abdom Imaging 2010; 35: 154-162.



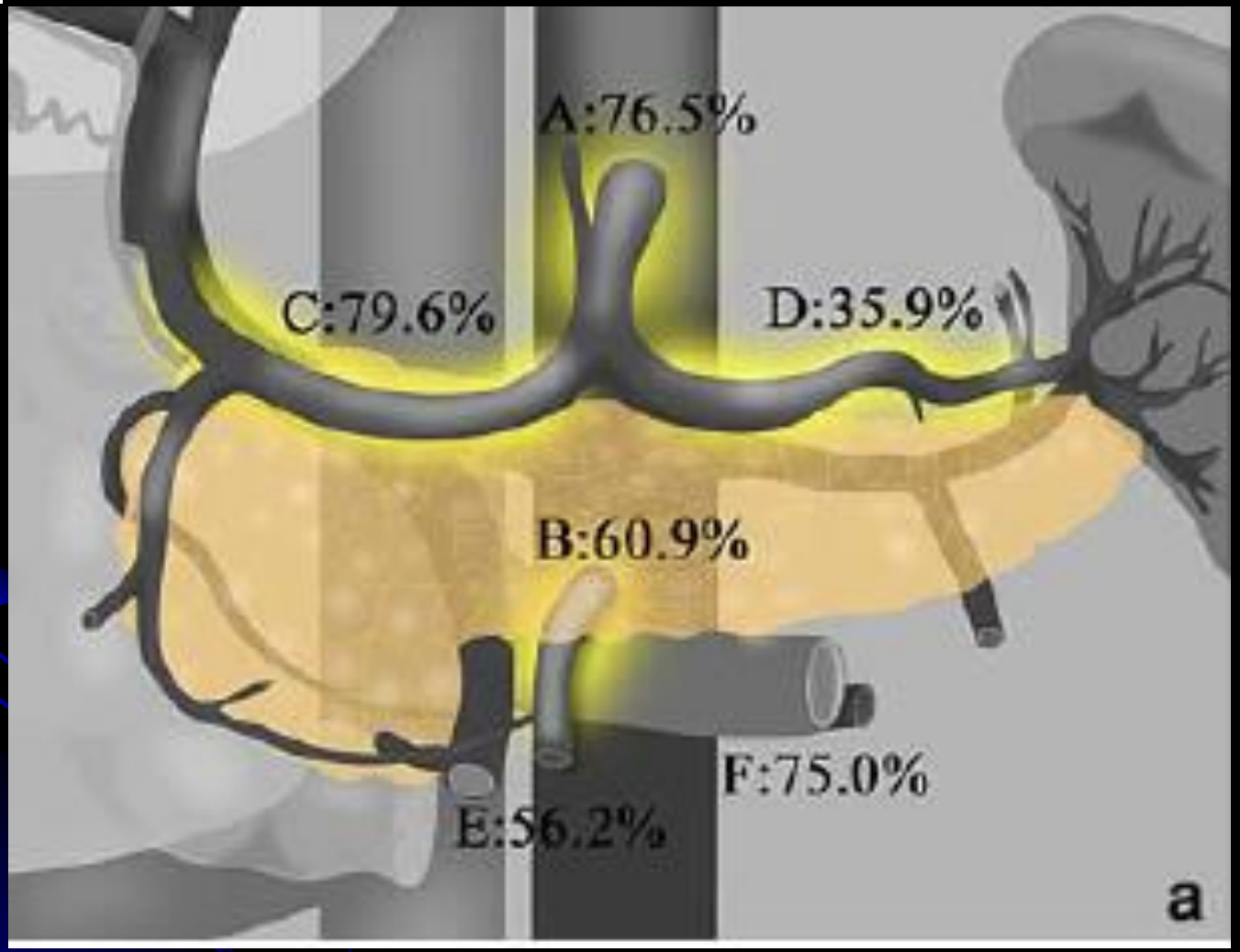
Sai M et al Abdom Imaging 2010; 35: 154-162.

Preoperative Imaging and Resection Margin



Sai M et al Abdom Imaging 2010; 35: 154-162.

Preoperative Imaging and Resection Margin



Sai M et al Abdom Imaging 2010; 35: 154-162.

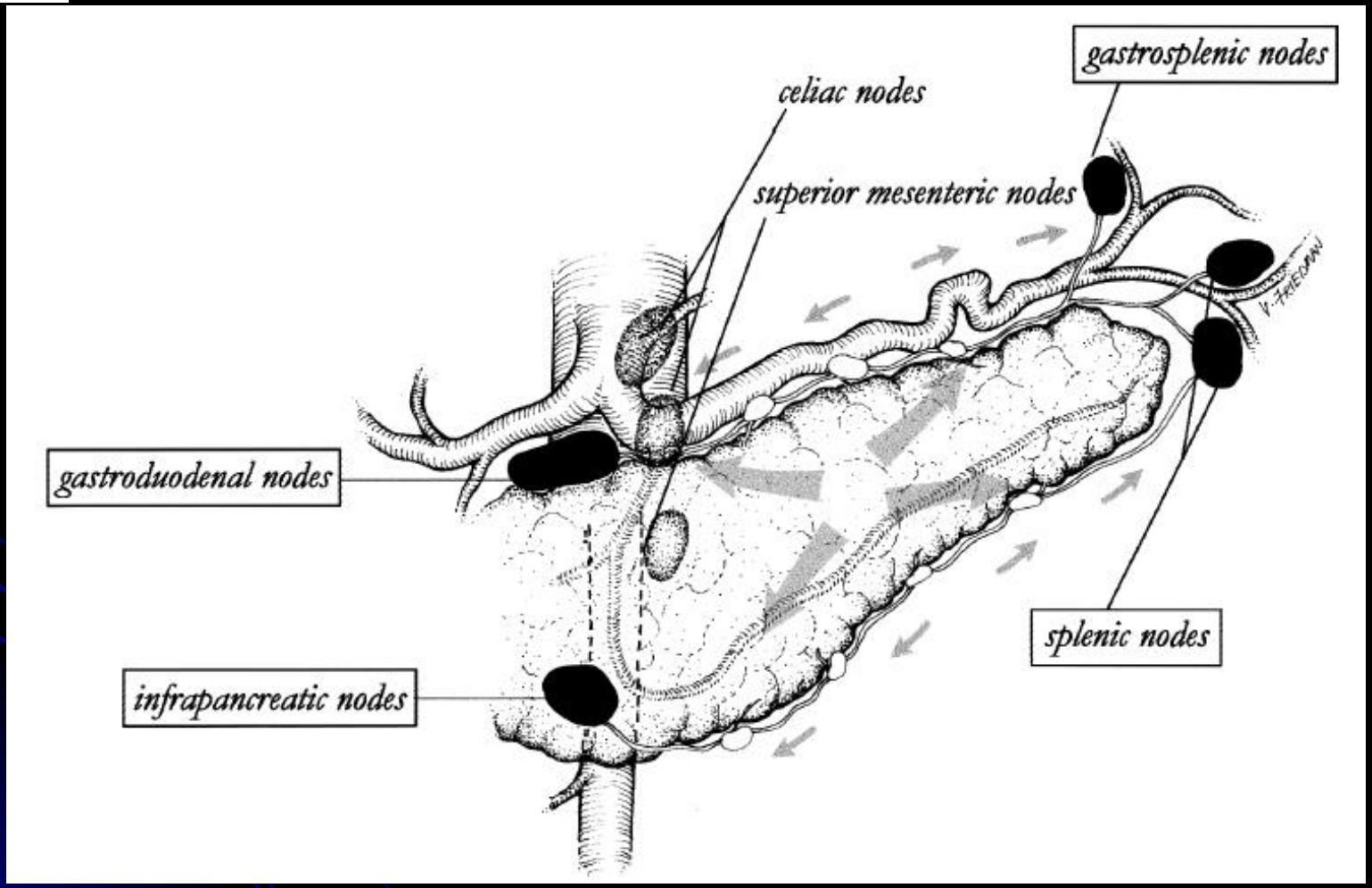
Surgical Approach to Pancreatic Body and Tail

Radical antegrade modular pancreatosplenectomy

Steven M. Strasberg, MD, Jeffrey A. Drebin, MD, PhD, *and* David Linehan, MD, *St. Louis, Mo*

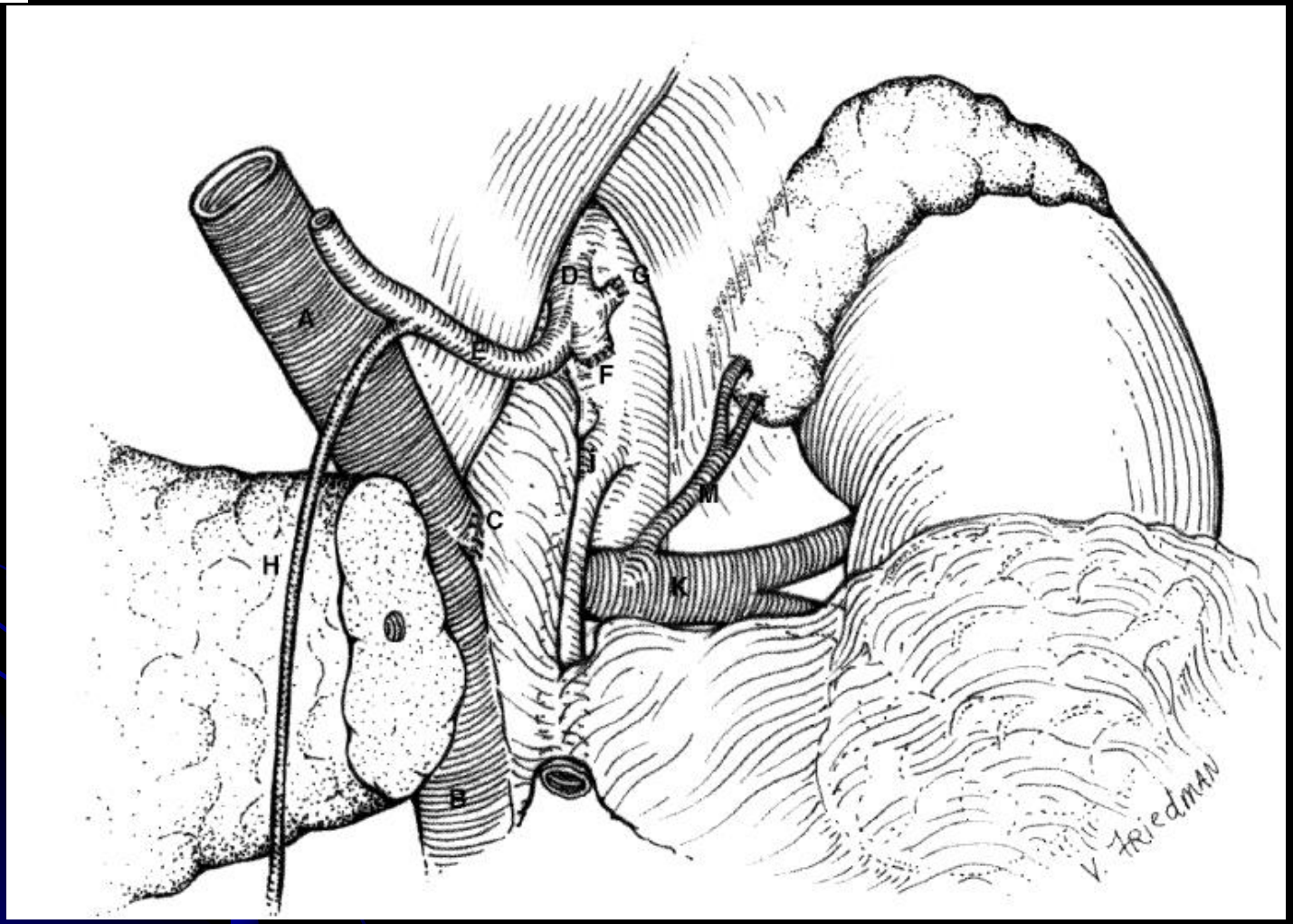
Strasberg SM et al Surgery 2003; 133: 521-527.

Surgical Approach to Pancreatic Body and Tail



Strasberg SM et al Surgery 2003; 133: 521-527.

Surgical Approach to Pancreatic Body and Tail



Strasberg SM et al Surgery 2003; 133: 521-527.

Surgical Approach to Pancreatic Head

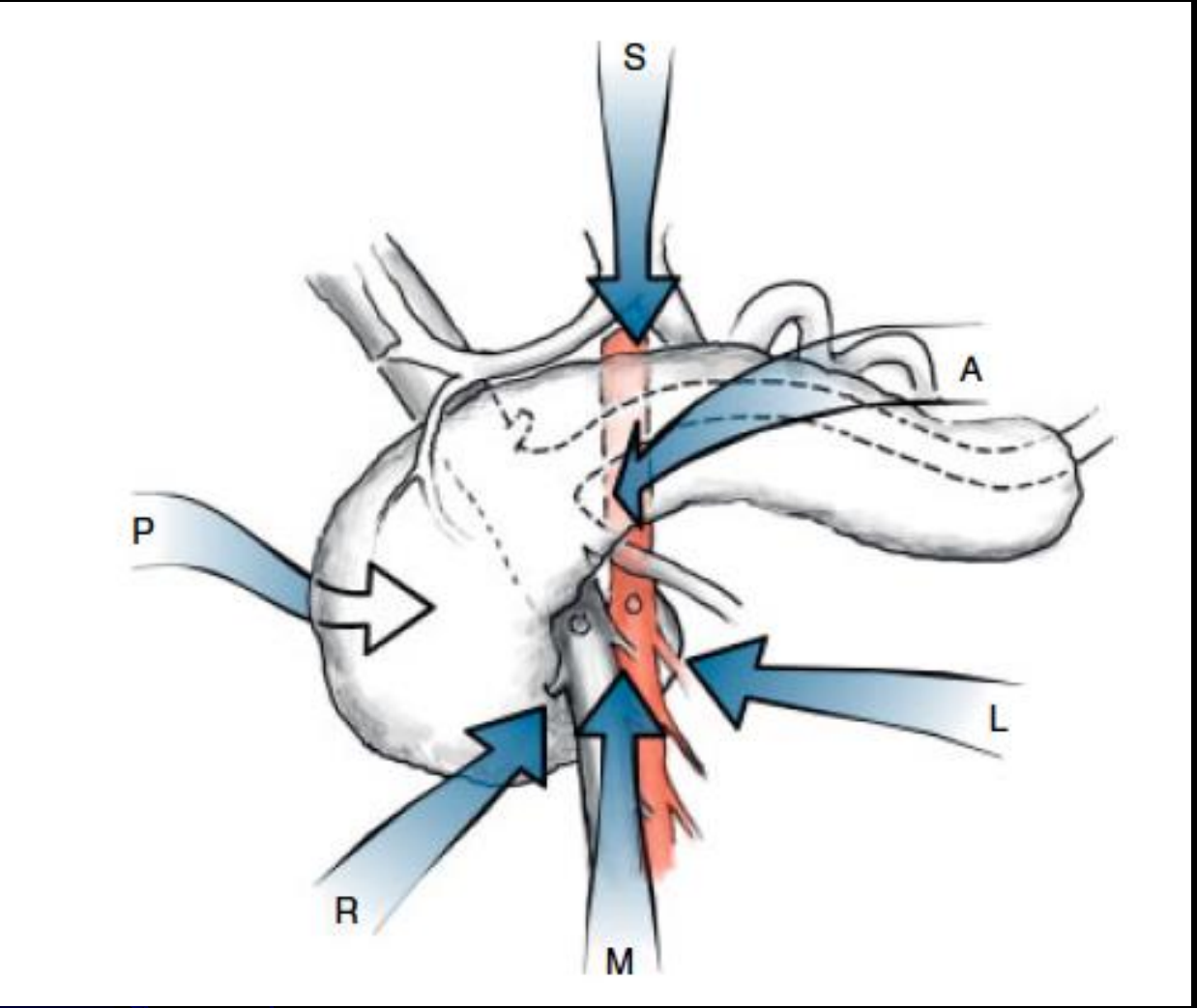
Review

‘Artery-first’ approaches to pancreatoduodenectomy

P. Sanjay[1,6], K. Takaori[3], S. Govil[4], S. V. Shrikhande[5] and J. A. Windsor[1,2]

Sanjay P et al Br J Surg 2012; 99: 1027-1035.

Surgical Approach to Pancreatic Head



Sanjay P et al Br J Surg 2012; 99: 1027-1035.

Surgical Approach to Pancreatic Head

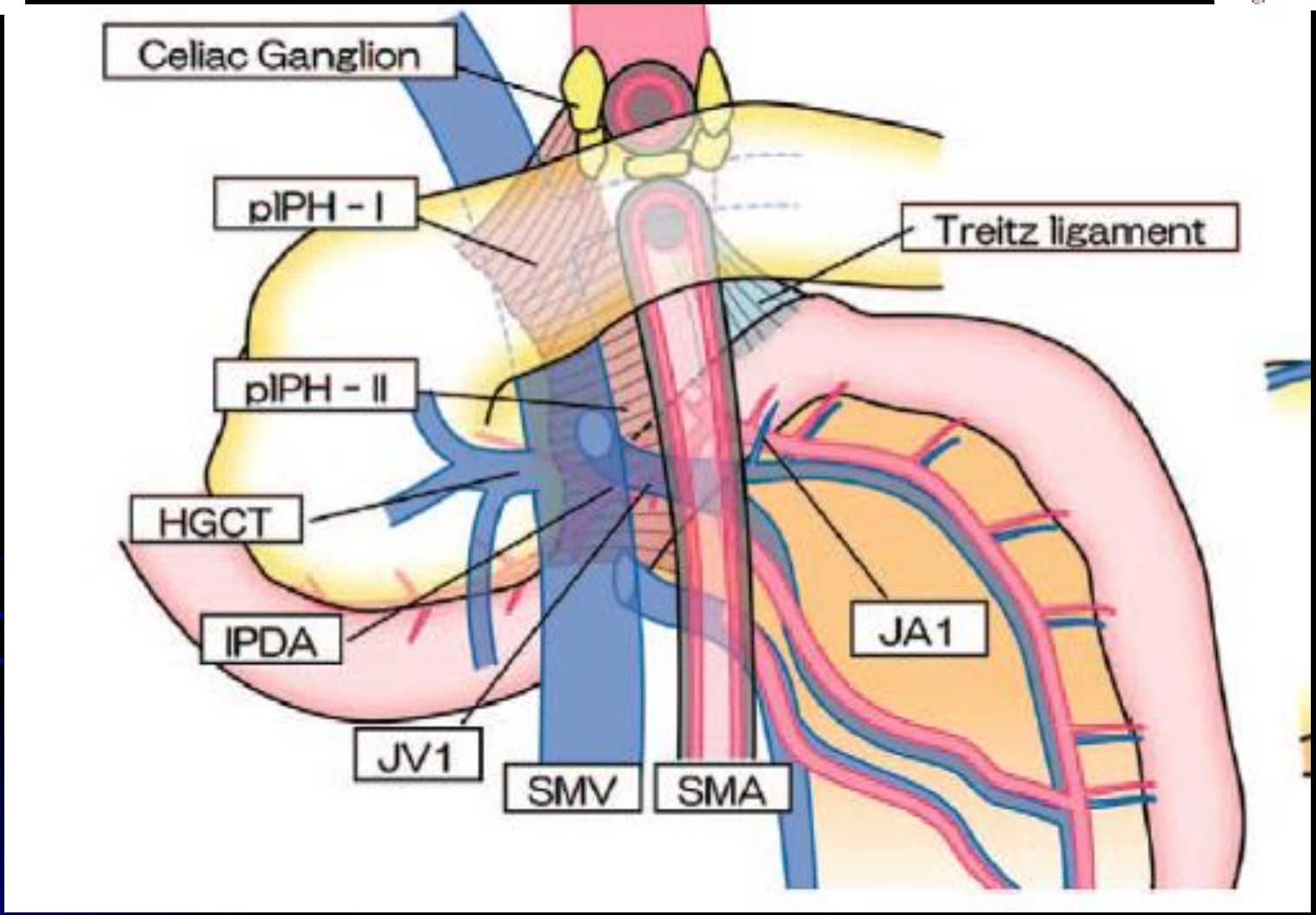
ORIGINAL ARTICLE

Pancreatoduodenectomy With Systematic Mesopancreas Dissection Using a Supracolic Anterior Artery-first Approach

Yosuke Inoue, MD, PhD, Akio Saiura, MD, PhD,* Ryuji Yoshioka, MD,† Yoshihiro Ono, MD, PhD,* Michiro Takahashi, MD, PhD,* Junichi Arita, MD, PhD,* Yu Takahashi, MD, PhD,* and Rintaro Koga, MD‡*

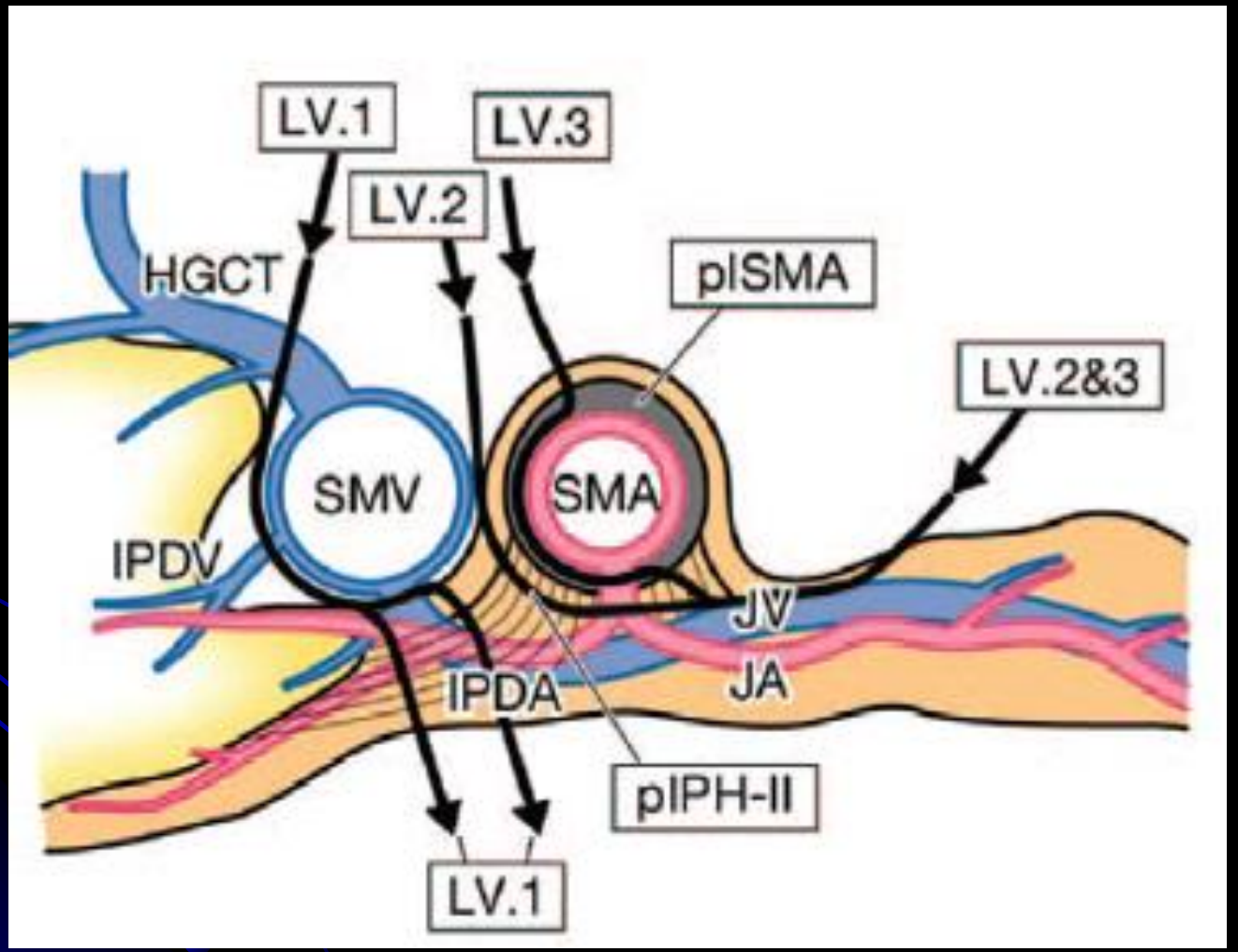
Inoue Y et al Ann Surg 2015; 262: 1092-1101.

Surgical Approach to Pancreatic Head



Inoue Y et al Ann Surg 2015; 262: 1092-1101.

Surgical Approach to Pancreatic Head



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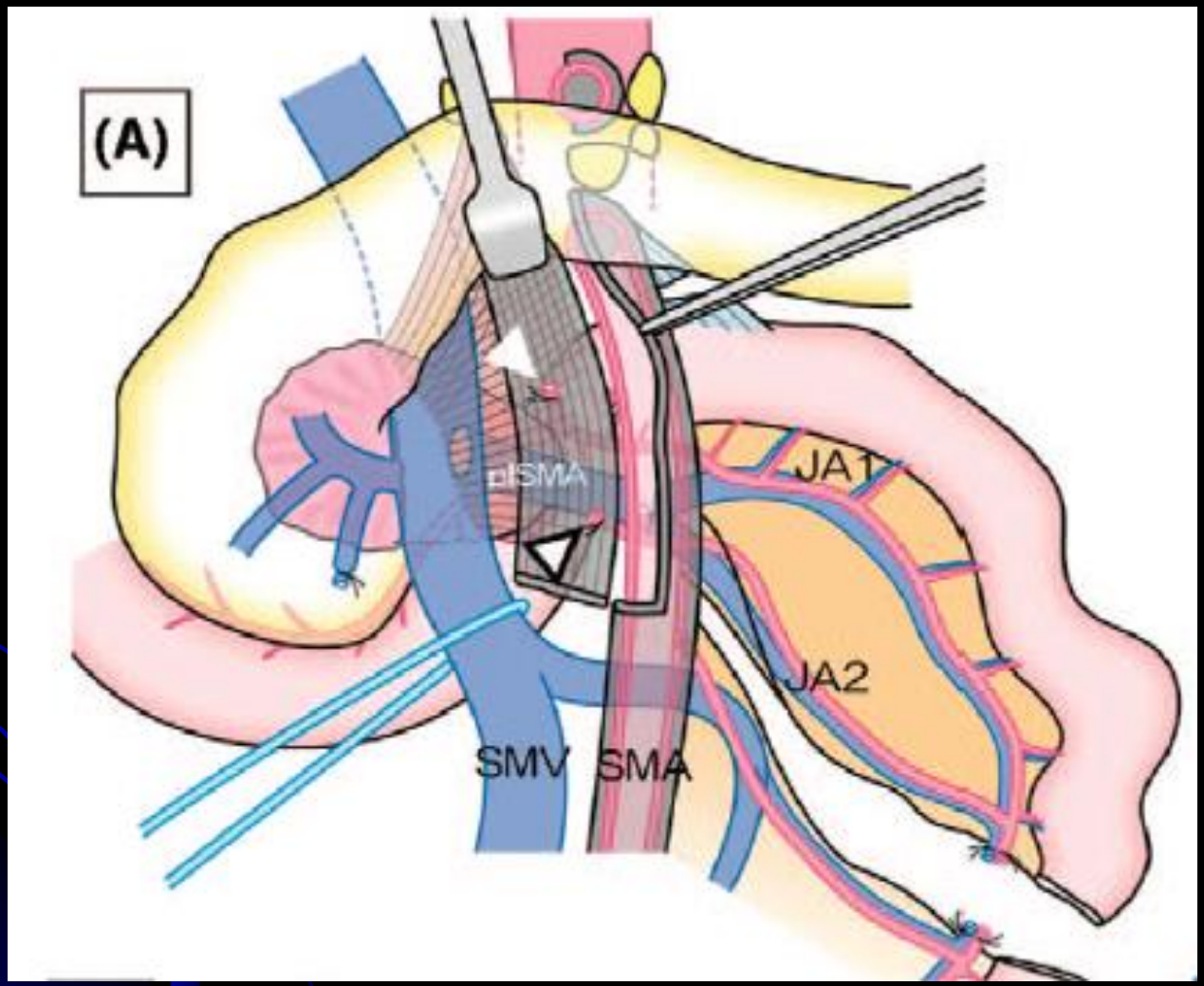
Surgical Approach to Pancreatic Head



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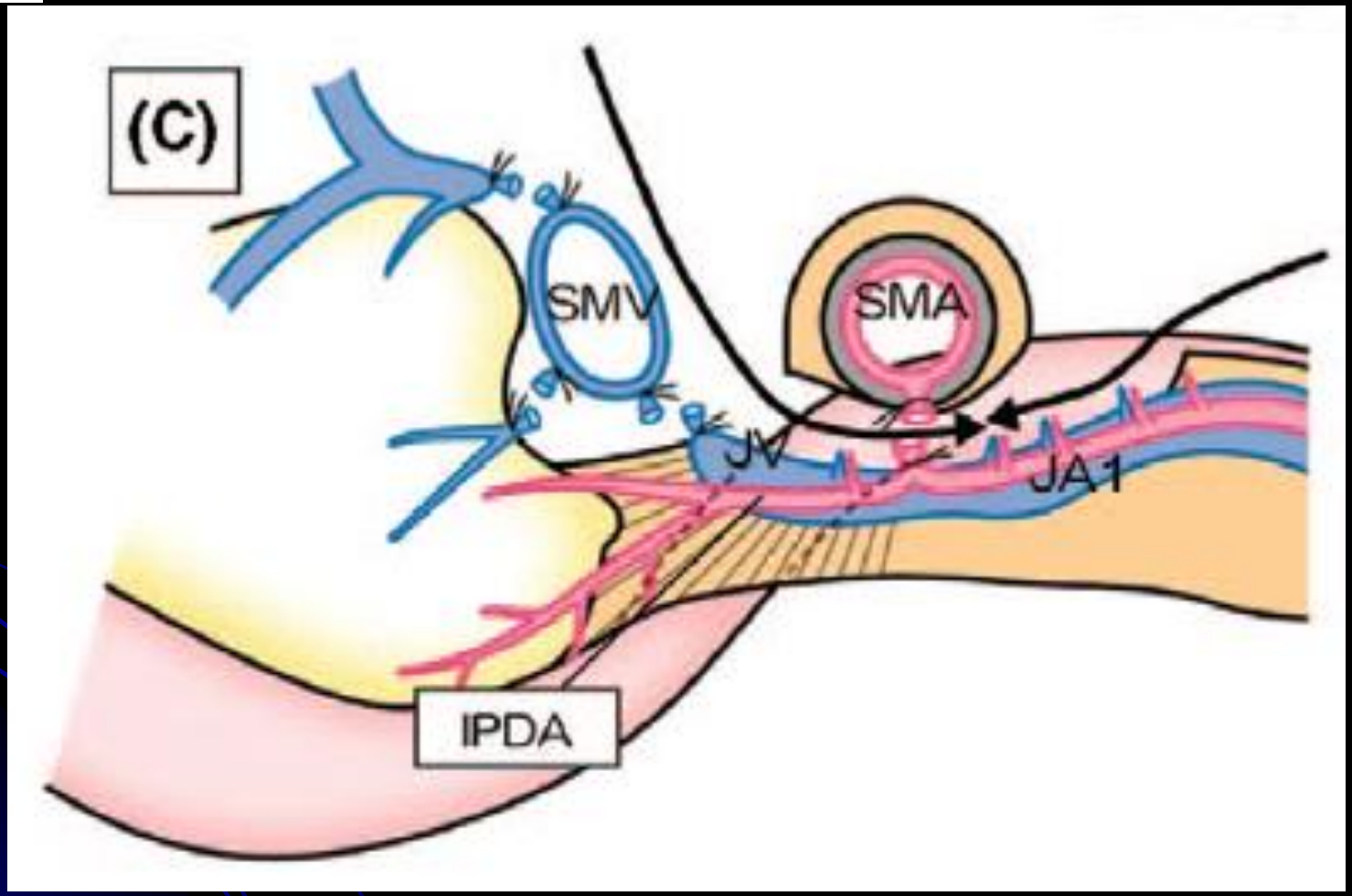
Surgical Approach to Pancreatic Head



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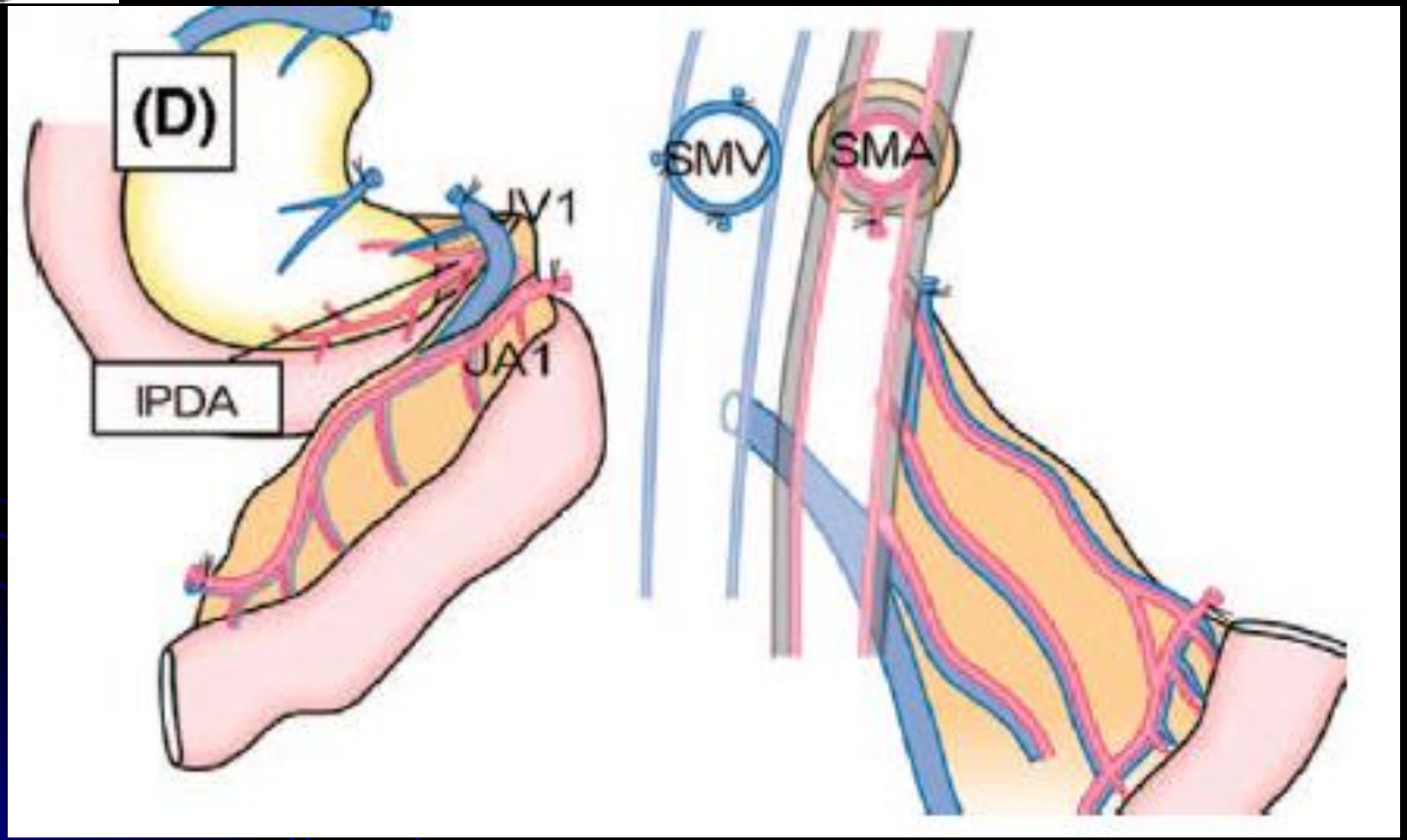
Surgical Approach to Pancreatic Head



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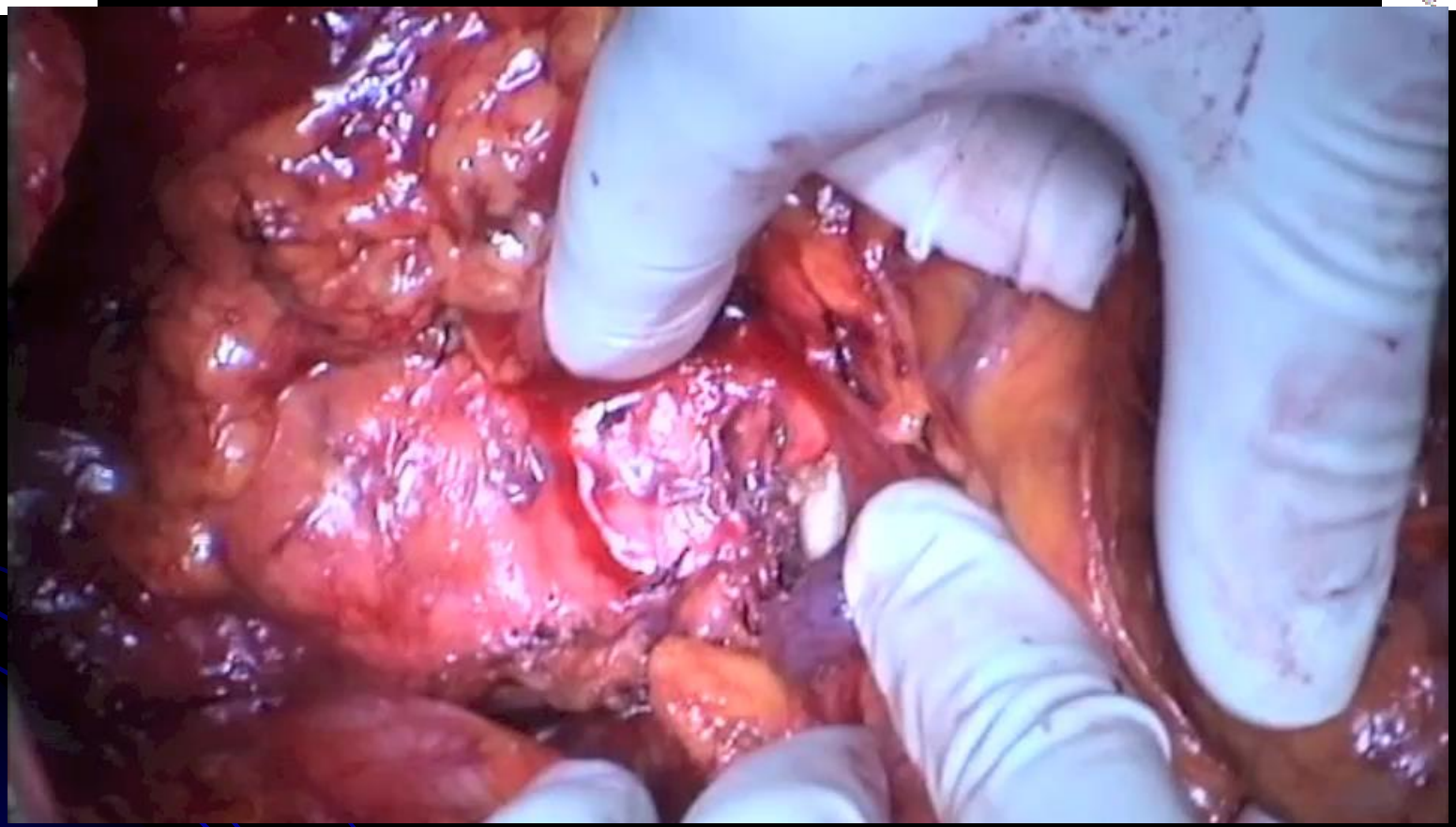
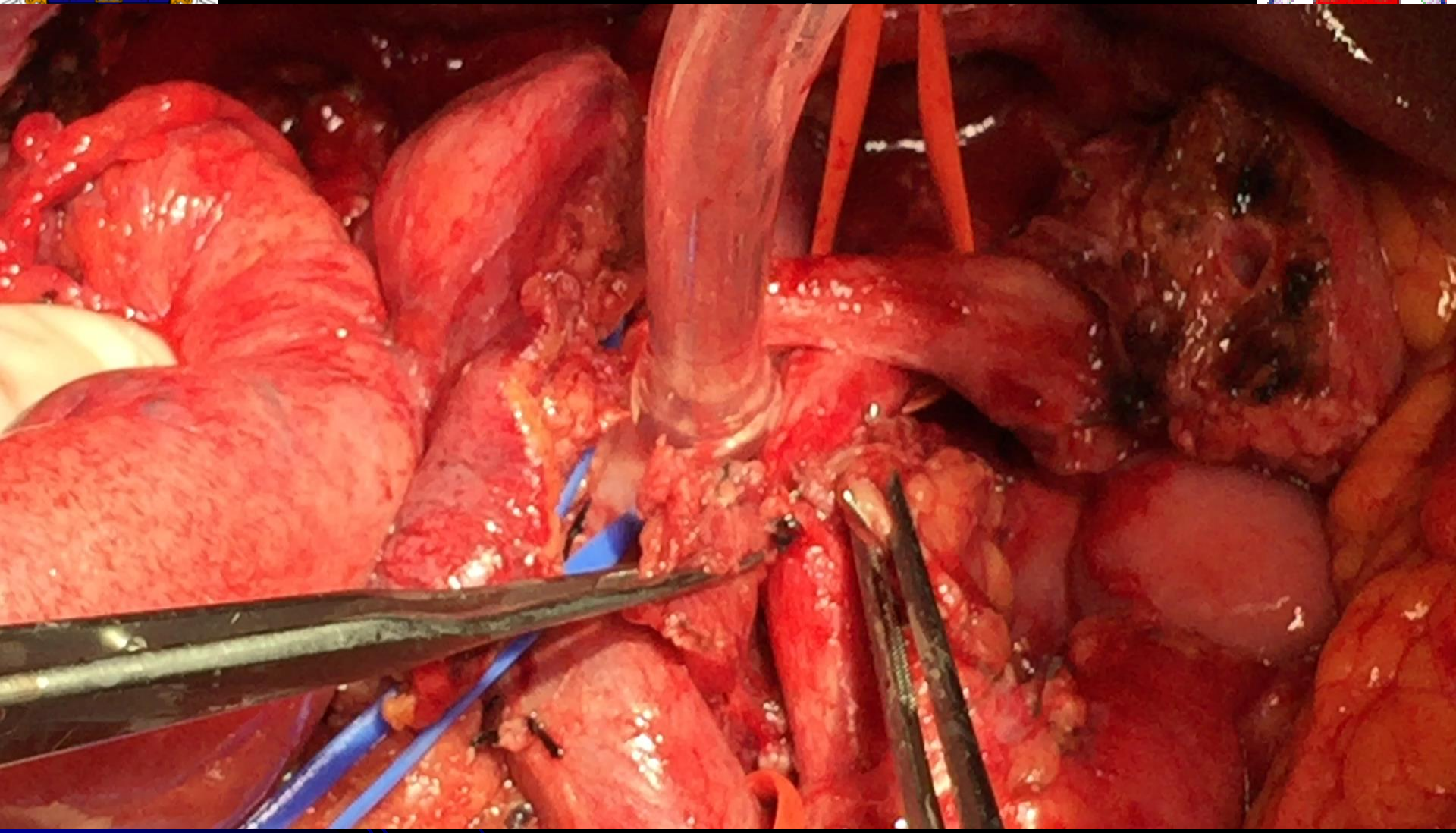
Surgical Approach to Pancreatic Head



Surgical Approach to Pancreatic



Neoadjuvant Treatment and Histopathology

Original Article

Histologic Grading of the Extent of Residual Carcinoma Following Neoadjuvant Chemoradiation in Pancreatic Ductal Adenocarcinoma

A Predictor for Patient Outcome

Deyali Chatterjee, MD[1]; Matthew H. Katz, MD[1]; Asif Rashid, MD, PhD[2]; Gauri R. Varadhachary, MD[3]; Robert A. Wolff, MD[3]; Hua Wang, MD, PhD[3]; Jeffrey E. Lee, MD[1]; Peter W. T. Pisters, MD[1]; Jean-Nicolas Vauthey, MD[1]; Christopher Crane, MD[4]; Henry F. Gomez, MD[1]; James L. Abbruzzese, MD[3]; Jason B. Fleming, MD[1]; and Huamin Wang, MD, PhD[2]

Chatterjee D et al Cancer 2012; 118:3182-3190.

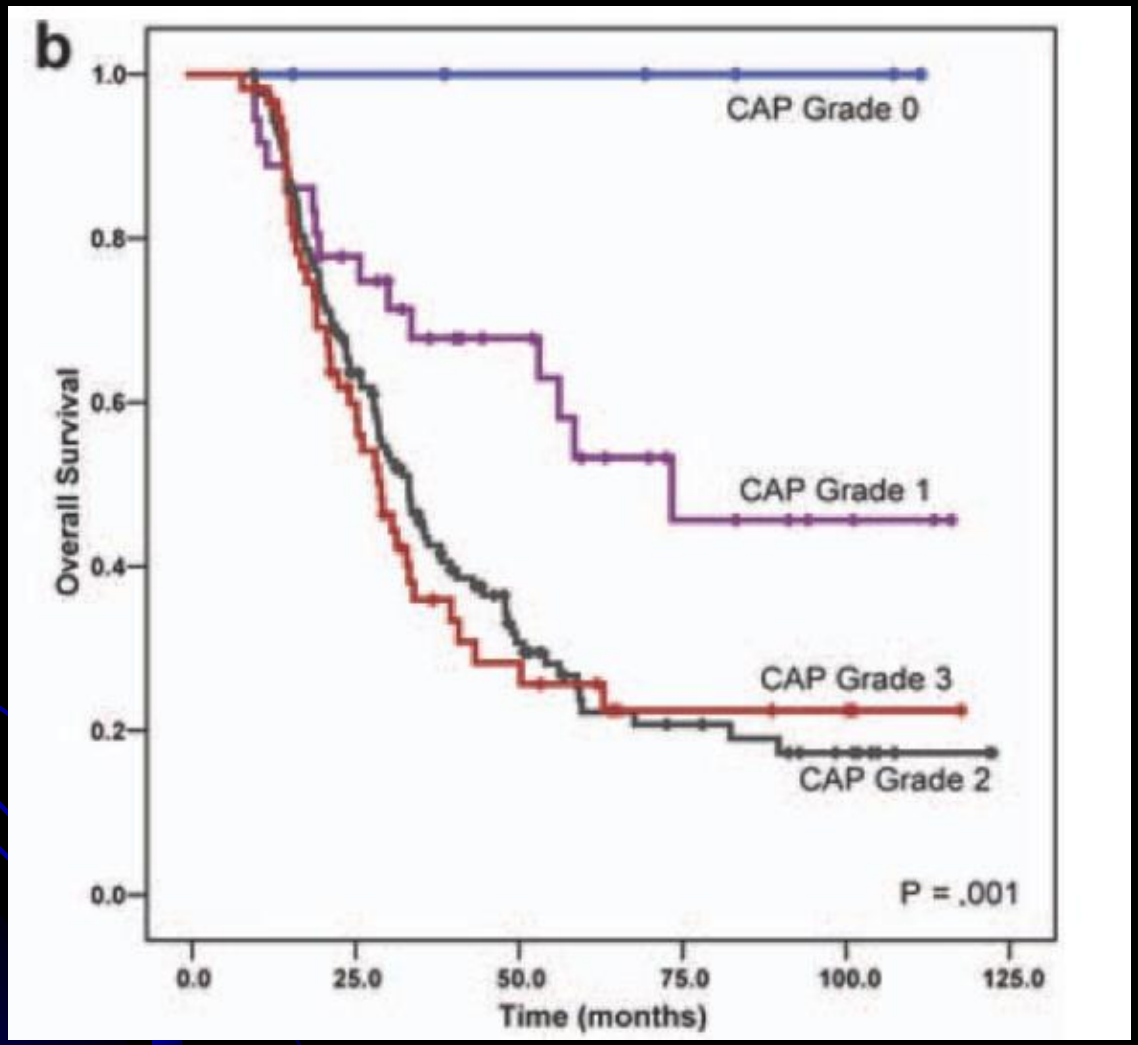
Neoadjuvant Treatment and Histopathology

College of the American Pathologists (CAP)

CAP Grade	% Viable tumour cells
0	Complete Response
1	Minimal Response
2	Moderate Response
3	Poor Response

Washington K et al Northfied, IL: College of American Pathologists 2010

Neoadjuvant Treatment and Histopathology



Chatterjee D et al Cancer 2012; 118:3182-3190.

Neoadjuvant Treatment and Histopathology

CAP Grade	% Viable tumour cells	% Patients
0	Complete Response	2.7%
1	Minimal Response	16.1%
2	Moderate Response	55.6%
3	Poor Response	25.6%

Chatterjee D et al Cancer 2012; 118:3182-3190.

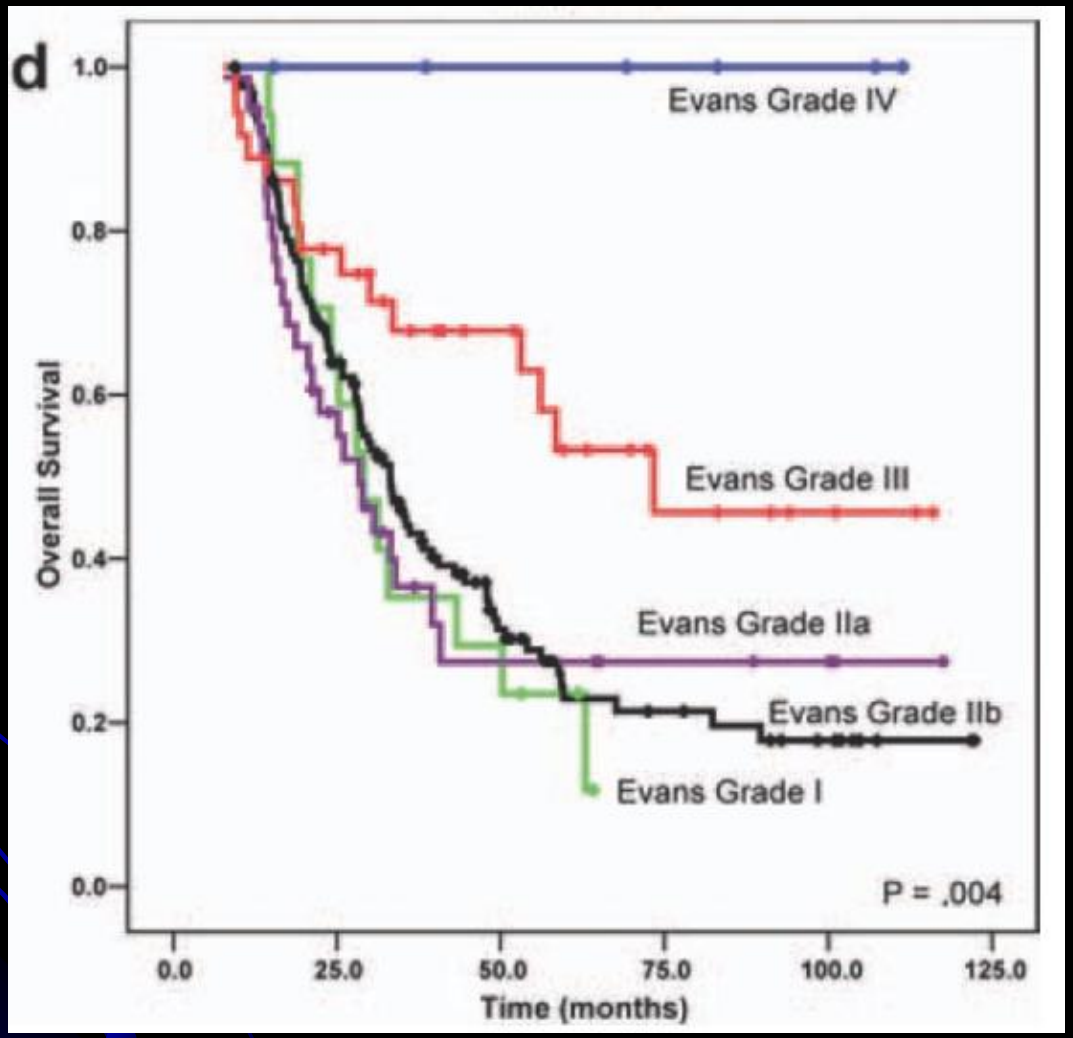
Neoadjuvant Treatment and Histopathology

Evans Grade

Evans Grade	Tumour response
I	No Tumour Destruction <10 %
IIA	Destruction of 10%-50%
IIB	Destruction of 51%-90%
III	Few Viable Cells < 10%
IV	No Viable Tumour cells

Evans DB et al Arch Surg 1992;127:1335-1339.

Neoadjuvant Treatment and Histopathology



Chatterjee D et al Cancer 2012; 118:3182-3190.

Neoadjuvant Treatment and Histopathology

ORIGINAL ARTICLE

Perineural and Intraneural Invasion in Posttherapy Pancreaticoduodenectomy Specimens Predicts Poor Prognosis in Patients With Pancreatic Ductal Adenocarcinoma

Deyali Chatterjee, MD, Matthew H. Katz, MD,* Asif Rashid, MD, PhD,† Hua Wang, MD, PhD,‡ Alina C. Iuga, MD,† Gauri R. Varadhachary, MD,‡ Robert A. Wolff, MD,‡ Jeffrey E. Lee, MD,* Peter W. Pisters, MD,* Christopher H. Crane, MD,‖ Henry F. Gomez, MD,* James L. Abbruzzese, MD,‡ Jason B. Fleming, MD,* and Huamin Wang, MD, PhD†*

Chatterjee D et al Am J Surg Path 2012; 36:409-417.

Neoadjuvant Treatment and Histopathology

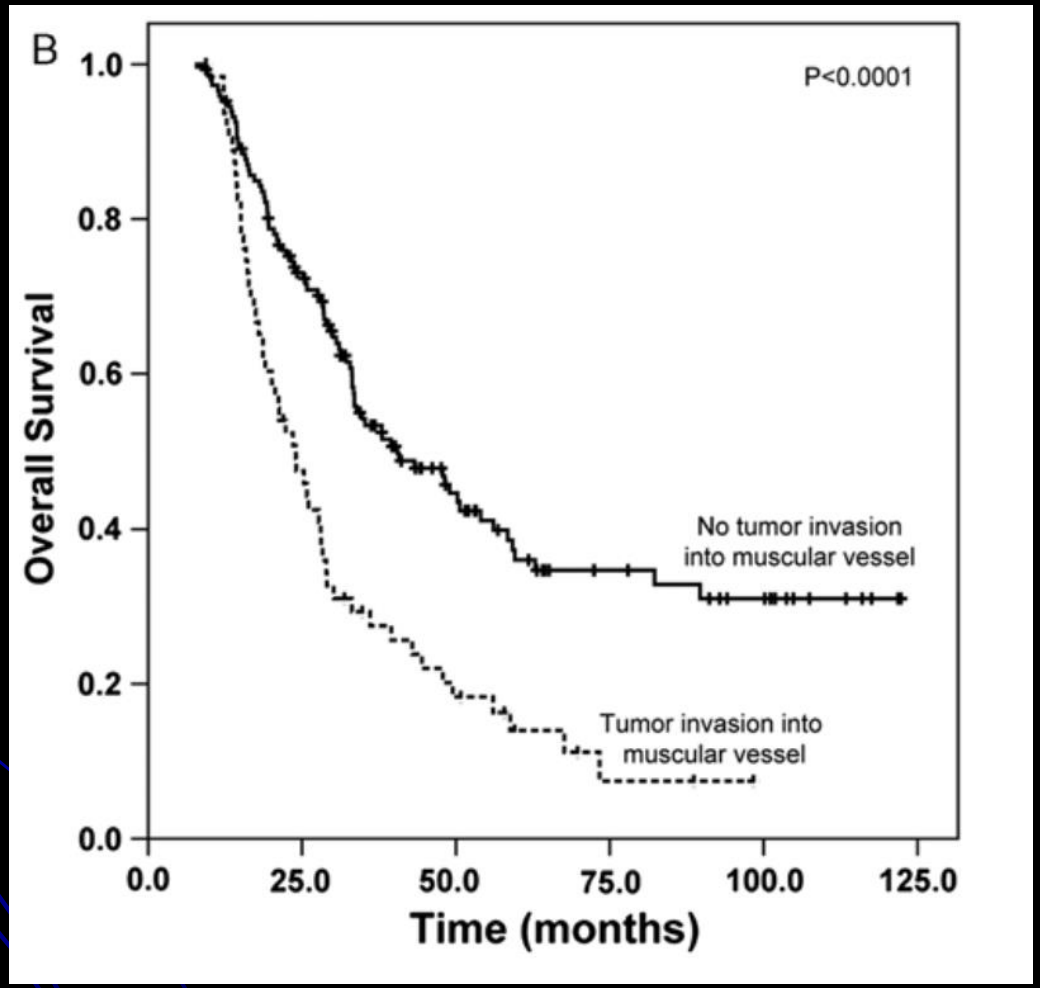
ORIGINAL ARTICLE

Tumor Invasion of Muscular Vessels Predicts Poor Prognosis in Patients With Pancreatic Ductal Adenocarcinoma Who Have Received Neoadjuvant Therapy and Pancreaticoduodenectomy

Deyali Chatterjee, MD, Asif Rashid, MD, PhD,† Hua Wang, MD, PhD,‡ Matthew H. Katz, MD,* Robert A. Wolff, MD,‡ Gauri R. Varadhachary, MD,‡ Jeffrey E. Lee, MD,* Peter W. Pisters, MD,* Henry F. Gomez, MD,* James L. Abbruzzese, MD,‡ Jason B. Fleming, MD,* and Huamin Wang, MD, PhD†*

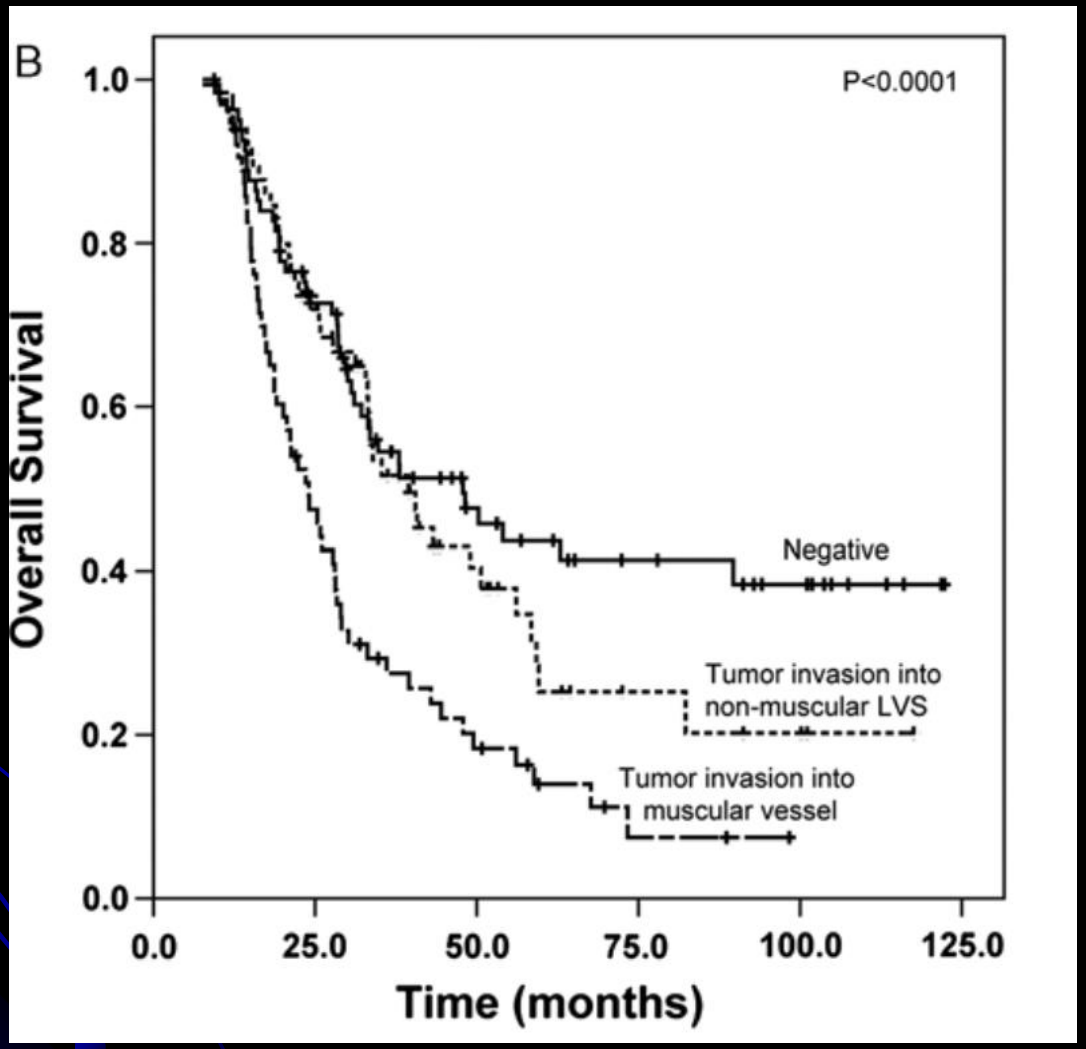
Chatterjee D et al Am J Surg Path 2012; 36:552-559.

Neoadjuvant Treatment and Histopathology



Chatterjee D et al Am J Surg Path 2012; 36:552-559.

Neoadjuvant Treatment and Histopathology



Chatterjee D et al Am J Surg Path 2012; 36:552-559.

Neoadjuvant Treatment and Histopathology

ORIGINAL ARTICLE

Validation of a Proposed Tumor Regression Grading Scheme for Pancreatic Ductal Adenocarcinoma After Neoadjuvant Therapy as a Prognostic Indicator for Survival

Sun Mi Lee, MD, Matthew H.G. Katz, MD,† Li Liu, MD, PhD,* Manonmani Sundar, MD,‡ Hua Wang, MD, PhD,§ Gauri R. Varadhachary, MD,§ Robert A. Wolff, MD,§ Jeffrey E. Lee, MD,† Anirban Maitra, MD, PhD,*‡ Jason B. Fleming, MD,† Asif Rashid, MD, PhD,* and Huamin Wang, MD, PhD*‡*

Lee SM et al Am J Surg Path 2016; ePub

Neoadjuvant Treatment and Histopathology

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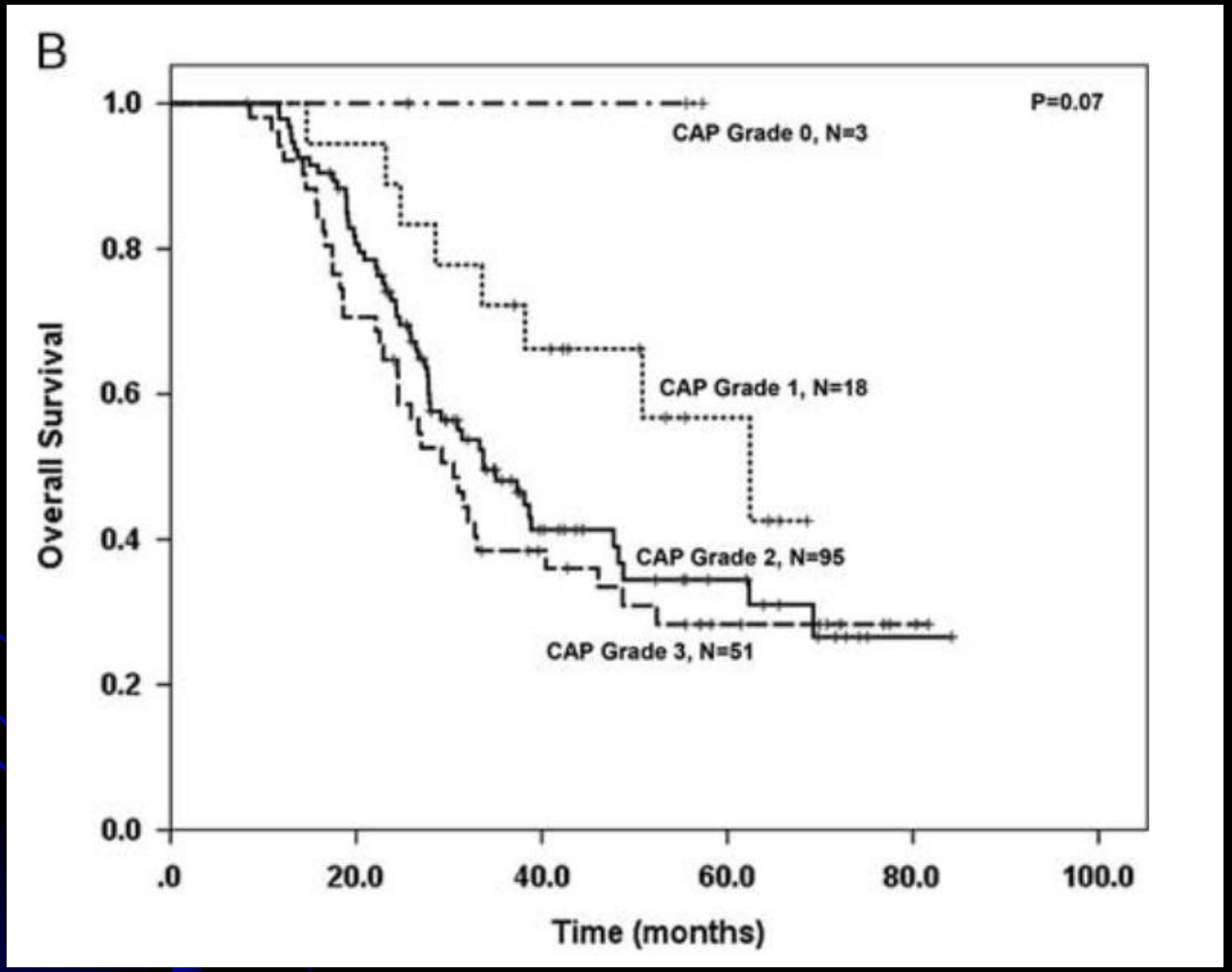
Washington K et al Northfied, IL: College of American Pathologists 2010

Neoadjuvant Treatment and Histopathology



Lee SM et al Am J Surg Path 2016; ePub

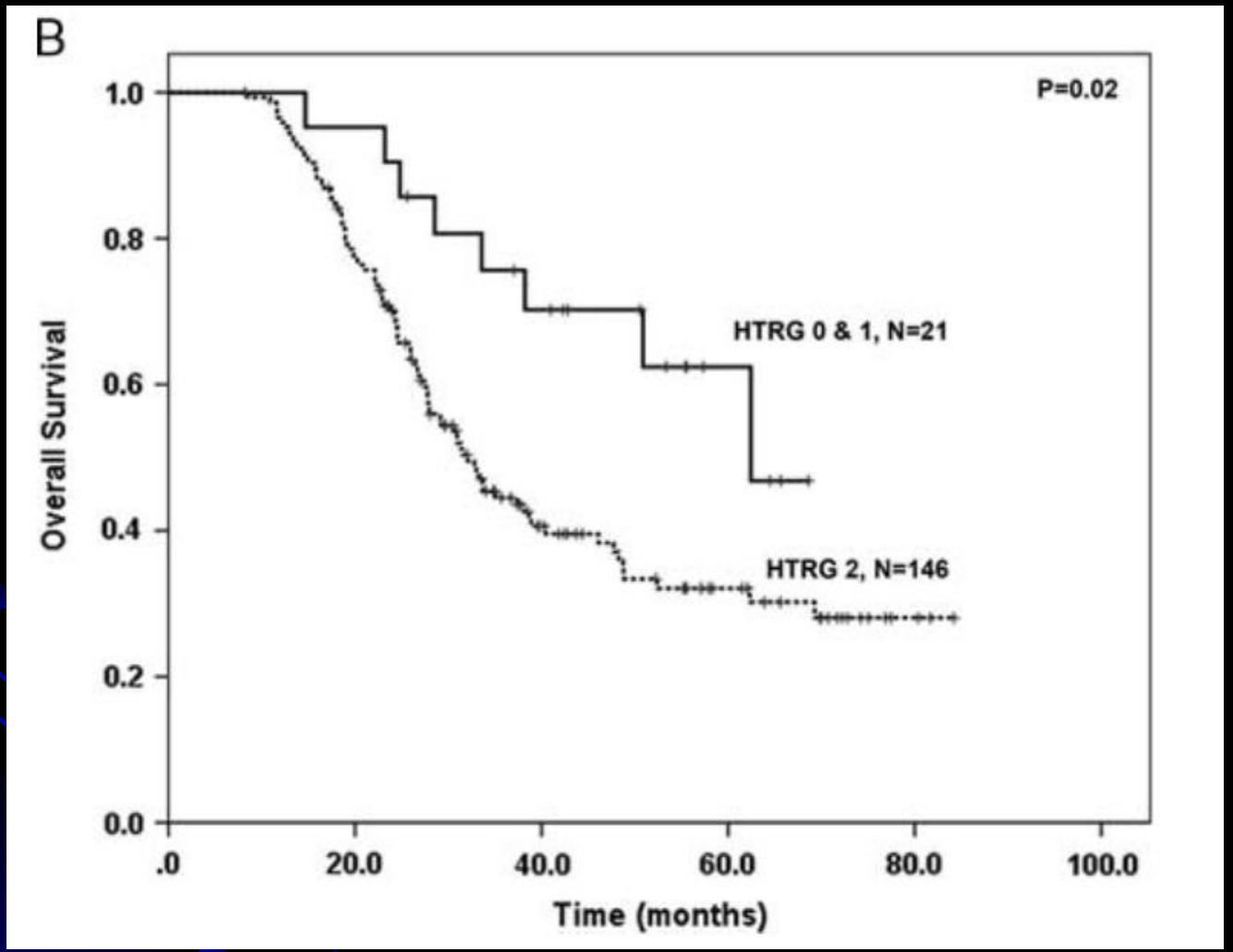
Neoadjuvant Treatment and Histopathology

Histological Tumour Regression Grading (HTRG)

HTRG Grade	% Viable tumour cells
0	0
1	<5
2	>5

Lee SM et al Am J Surg Path 2016; ePub

Neoadjuvant Treatment and Histopathology



Lee SM et al Am J Surg Path 2016; ePub

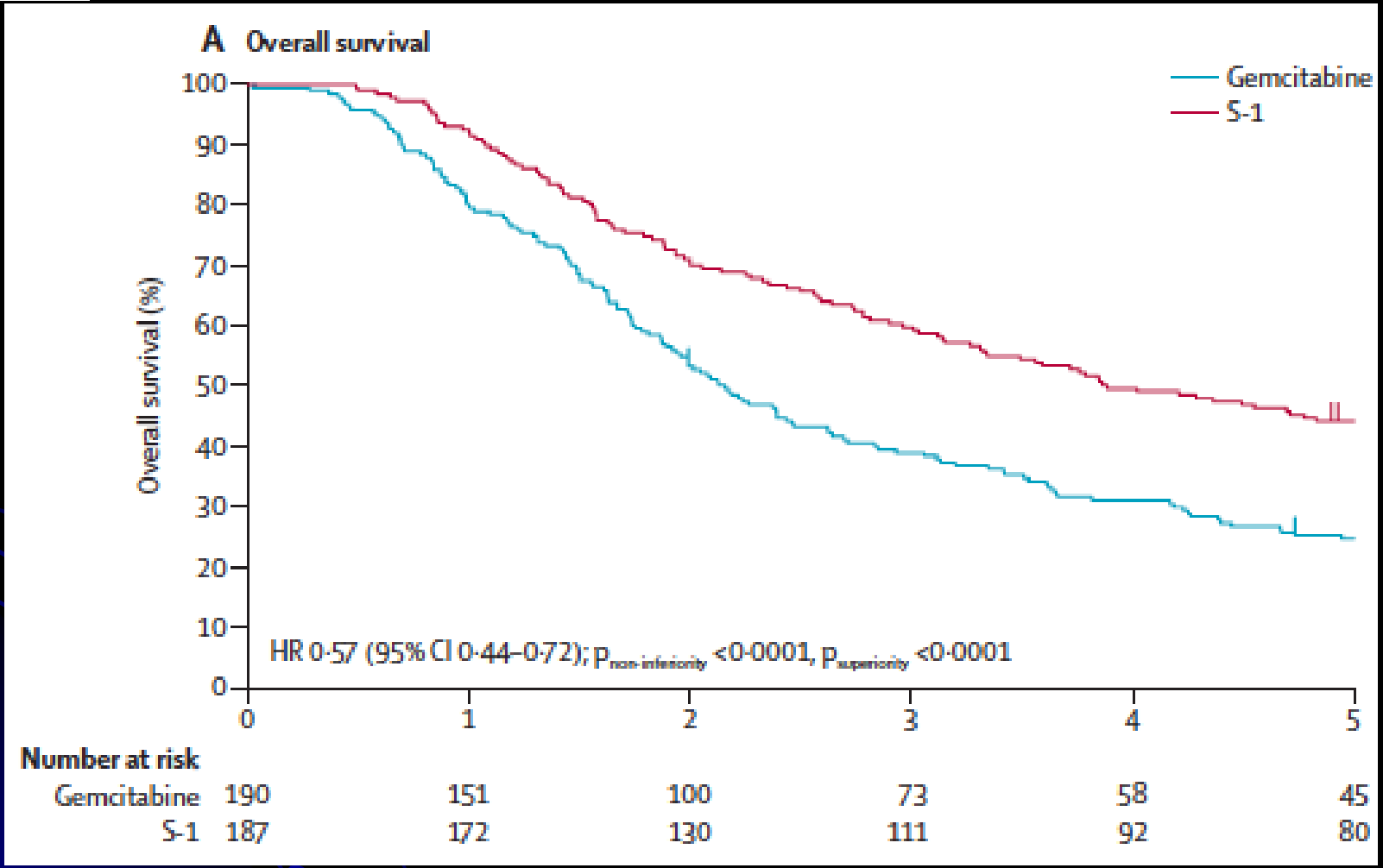
Pancreatic Cancer and Progress

Adjuvant chemotherapy of S-1 versus gemcitabine for resected pancreatic cancer: a phase 3, open-label, randomised, non-inferiority trial (JASPAC 01)

Katsuhiko Uesaka, Narikazu Boku, Akira Fukutomi, Yukiyasu Okamura, Masaru Konishi, Ippei Matsumoto, Yuji Kaneoka, Yasuhiro Shimizu, Shoji Nakamori, Hirohiko Sakamoto, Soichiro Morinaga, Osamu Kainuma, Koji Imai, Naohiro Sata, Shoichi Hishinuma, Hitoshi Ojima, Ryuzo Yamaguchi, Satoshi Hirano, Takeshi Sudo, Yasuo Ohashi, for the JASPAC 01 Study Group

Uesaka K et al Lancet 2016; 388: 248-257.

Pancreatic Cancer and Progress



Uesaka K et al Lancet 2016; 388: 248-257.

Electroporation and Pancreatic Surgery

PAPERS OF THE 135TH ASA ANNUAL MEETING

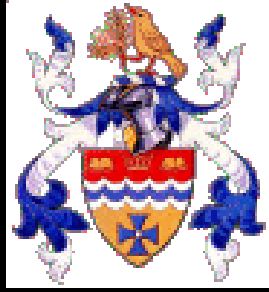
Treatment of 200 Locally Advanced (Stage III) Pancreatic Adenocarcinoma Patients With Irreversible Electroporation

Safety and Efficacy

Robert C. G. Martin, II, MD, PhD, FACS, David Kwon, MD, FACS,† Sricharan Chalikonda, MD, FACS,‡ Marty Sellers, MD, MPH, FACS,§ Eric Kotz, MD,¶ Charles Scoggins, MD, MBA, FACS,* Kelly M. McMasters, MD, PhD, FACS,* and Kevin Watkins, MD, FACS||*

Martin RCG et al Ann Surg 2015;262:486-494.

Survival is determined by Microscopic disease left behind



Thank you