The Influence of Pancreatic Ductal Anatomy on the Complications of Pancreatitis

William H. Nealon M.D.

Students and Trainees: Guide to Creativity, Productivity and Innovation in a Clinical Career

- Choose a Field of Focus
- Think creatively About Unresolved Questions
- Do not Waver/The Data Will Accrue Slowly
- Be Prepared to Permit Observations to Customize Your Analysis

Students and Trainees: Choose a Field of Focus

- JOURNEY THROUGH A CAREER
- SERENDIPITY
- LESSONS IN SIMPLE OBSERVATION
- THINK CONCEPTUALLY
- BE PERSISTENT

PREOPERAIVE ENDOSCOPIC RETROGRADE PANCREATOGRAPHY (ERCP) IN PATIENTS WITH PANCREATIC PSEUDOCYST ASSOCIATED WITH RESOLVING ACUTE AND CHRONIC PANCREATITIS (SOUTHERN SURGICAL ASS0C 1988/ANNALS OF SURGERY 1989/NEALON,THOMPSON)

- THUS BEGAN A PROSPECTIVE EVALUATION OF ROUTINE ERCP IN ALL PATIENTS with COMPLICATIONS OF PANCREATITIS (1985)
- THE INITIAL FOCUS WAS TO IDENTIFY PREVIOUSLY UNRECOGNIZED/UNDIAGNOSED CHRONIC PANCREATITIS

ERCP PAPER

- ONE BASIS FOR THIS ANALYSIS WAS THE CLINICAL STUDIES IN THE LATE 1980'S WHICH DOCUMENTED THE FACT THAT PATIENTS WITH CHRONIC PANCREATITIS AND PSEUDOCYST WERE OPTIMALLY MANAGED BY COMBINED PSEUDOCYST DRAINAGE AND PANCREATIC DUCT DRAINAGE (PUESTOW) LOYOLA

ERCP PAPER

- 41 PATIENTS WITH PSEUDOCYST
- BY CLINICAL EVALUATION 17/41 WERE DIAGNOSED AS CHRONIC PANCREATITIS AND 24/41 AS PSEUDOCYSTS ASSOCIATED WITH ACUTE PANCREATITIS
- AFTER ERCP 26/41 WERE DOCUMENTED AS CHRONIC PANCREATITIS
- 9/41 (NEARLY ONE QUARTER) OF PATIENTS WERE NOT RECOGNIZED AS CHRONIC PANCREATITIS AND WITHOUT ERCP LIKELY WOULD HAVE BEEN MANAGED BY PSEUDOCYST DRAINAGE ALONE

ADDITIONAL OBSERVATIONS MADE

- CATEGORIES OF DUCTAL ABNORMALITIES NOTED
  - DUCTAL STONES
  - DUCT STRICTURE
  - DUCT DILATATION
  - COMMUNICATION BETWEEN DUCT AND PSEUDOCYST
  - COMPLETE OCCLUSION OF MPD
- THUS BEGAN A DECADES LONG EXPERIENCE WITH ERCP IN ALL PATIENTS WITH PSEUDOCYST

SERENDIPITY

- AT THIS TIME, CROSS SECTIONAL IMAGING DID NOT CLEARLY DEFINE MPD ANATOMY
- HAD CROSS SECTIONAL IMAGING PROVIDED MORE DETAIL THERE WOULD HAVE BEEN NO NEED TO UTILIZE ERCP SIMPLY TO IDENTIFY CHRONIC PANCREATITIS CHANGES

SIMPLE OBSERVATION

- MEDIASTINAL PSEUDOCYST Beauchamp, Winsett, Nealon Surgery 1989
- 66 YEAR OLD MAN WITH ETHANOL HISTORY, LARGE MEDIASTINAL PSEUDOCYST, PAIN AND WEIGHT LOSS
- MANAGED WITH PUESTOW AND SIMPLE CLOSED SUCTION DRAIN TO PSEUDOCYST WITH PROMPT RESOLUTION

THINK CONCEPTUALLY

- THE SEED WAS PLANTED THAT THE DYNAMICS WITHIN THE MAIN PANCREATIC DUCT PLAY A PIVOTAL ROLE IN THE PERSISTENCE AND NATURAL COURSE OF PSEUDOCYSTS
- IN SIMPLE TERMS, IF ONE IMAGINES A PSEUDOCYST AS A FISTULA BETWEEN PANCREATIC DUCTS AND AN ARTIFICIAL SPACE, THEN PERSISTENCE OF THIS FISTULA MAY BE TRACED TO DISTAL OBSTRUCTION

THE DUCT

- I WILL REVIEW MY SERIES OF STUDIES ALL INTENDED TO CLARIFY THE IMPACT OF DUCTAL ANATOMY ON THE NATURAL HISTORY, BEHAVIOR, COMPLICATIONS AND IMPLICATIONS FOR MANAGEMENT OF THE FLUID COLLECTIONS RESULTING FROM ACUTE AND CHRONIC PANCREATITIS AS WELL AS THE COURSE AND COMPLICATIONS OF ACUTE NECROTIZING PANCREATITIS

BE PERSISTENT

- THERE FOLLOWED 20 YEARS EXPERIENCE WITH OUR CONTINUED PROSPECTIVE EVALUATION OF PANCREATIC DUCTAL ABNORMALITIES ASSOCIATED WITH PANCREATIC PSEUDOCYSTS BY PERFORMING ERCP
- MANY YEARS WILL BE SPENT WONDERING IF THE WORK WILL YIELD RESULTS

Evolution of Peripancreatic Fluid Collections/Pseudocysts

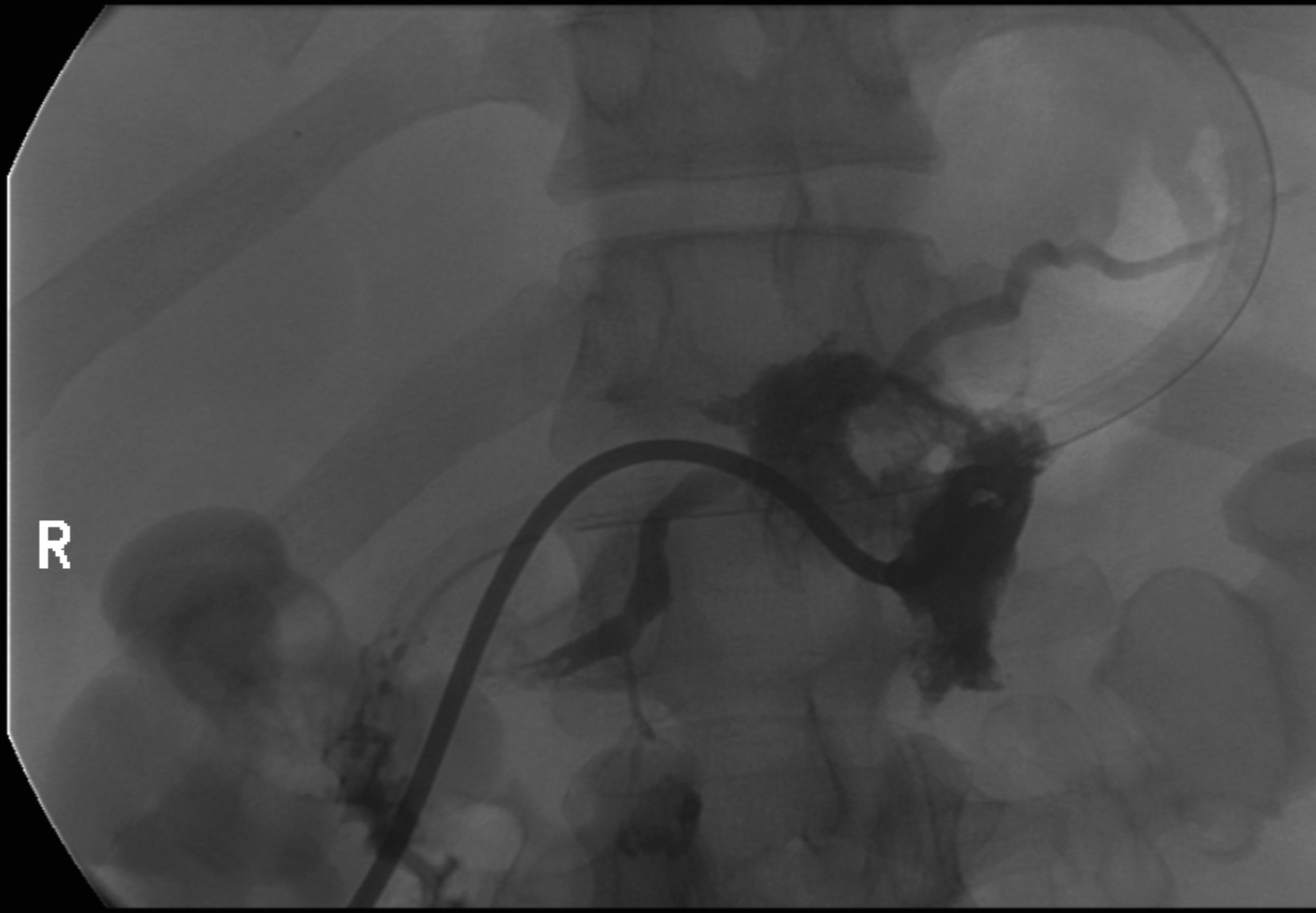
- Disorganized Free Peritoneal Fluid
- May Slowly Organize as a Pseudocyst
- May Spontaneously Resolve
- May Resolve After Nonoperative Measures (Endoscopic or Percutaneous)
- May Fail Nonoperative Measures
- The Gold Standard as Far as Durably Preventing Pseudocyst Recurrence after all forms of Intervention is Surgery

MANAGEMENT OF PSEUDOCYSTS

- QUERIES
  - Why do some pseudocysts persist and some spontaneously resolve
  - Why are some successfully managed with nonoperative measures and some not (65%)
    - Size? No
    - Severity of Pancreatitis No
    - Etiology No
    - Location of Pseudocyst No
    - Communication with PD Not really

Quality of Evidence

- The Studies We will Review are Prospectively Collected but there were no Randomized Controlled Trials.
- Where Comparisons of Treatment were Analyzed these were not Randomized and thus the Conclusions may be Vulnerable to Selection Bias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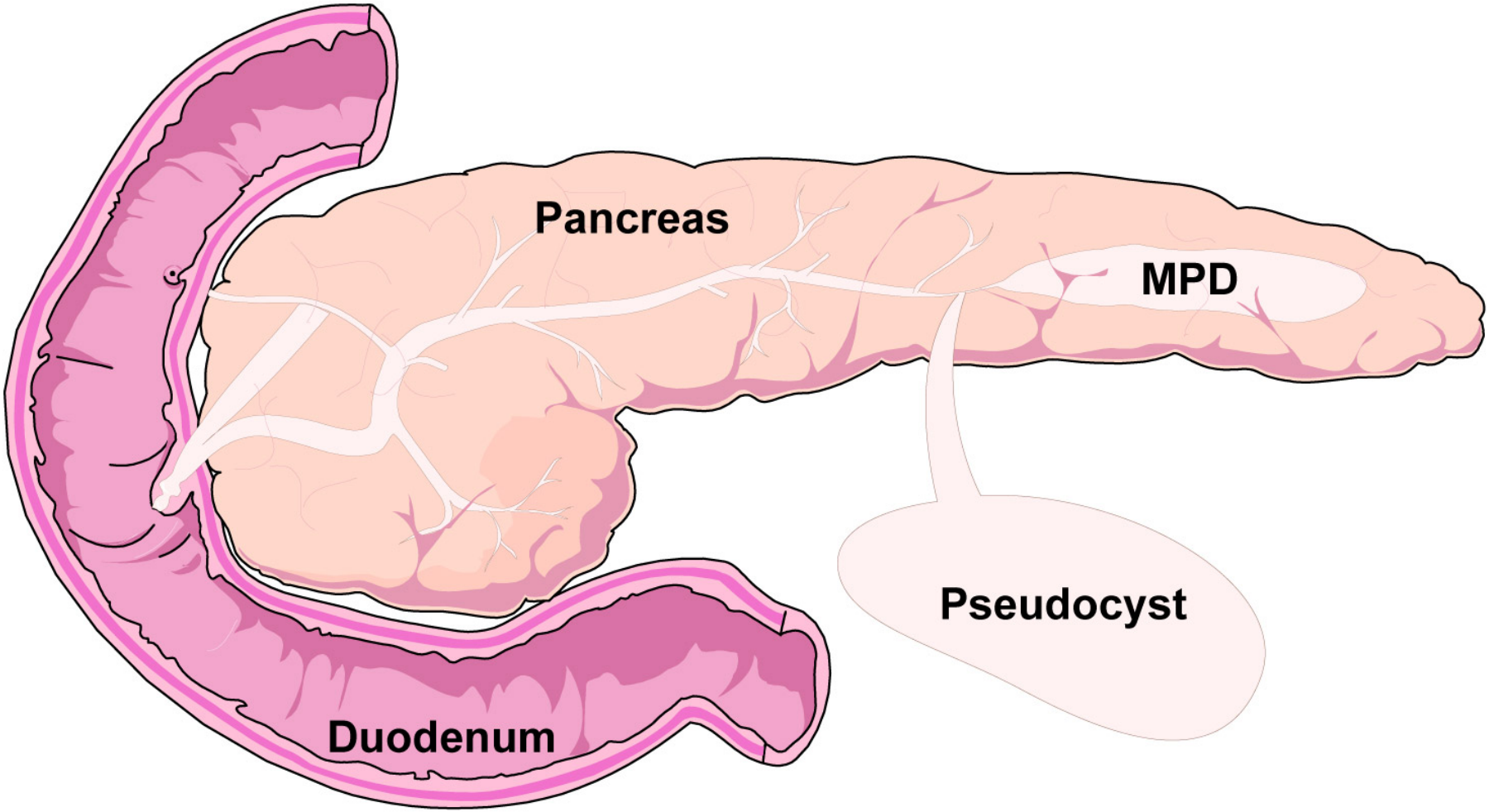
Isolated Pancreatic Segment



Main Pancreatic Ductal Anatomy Can Direct Choice of Modality for Treating Pancreatic Pseudocysts (Surgery vs Percutaneous Drainage)

NEALON WH, WALSER E;

Annals of Surgery 2002
SOUTHERN SURGICAL ASSOCIATION 2001

Study Design

- 253 Pseudocysts Included in the Analysis
- ERCP Performed on All Patients
- 68 Patients Had Spontaneous Resolution
- 50 Patients Had Percutaneous Drainage
- 148 Patients Had Operative Drainage
- Patients Were Compared for LOS, Length of Drainage Catheter, Success of Operative or Percutaneous Management and Complications

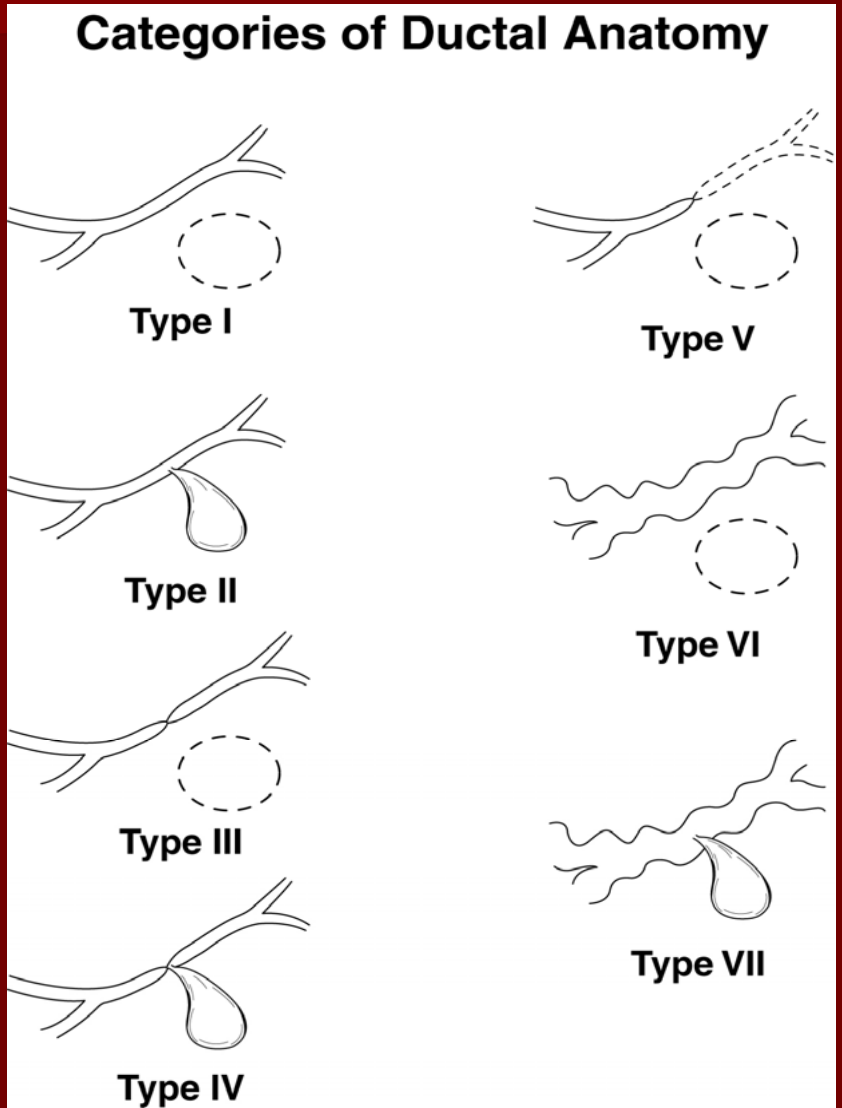
Study Design

- As Data Accrued it Became Apparent that there were a limited Number of Ductal Changes one Encountered in these Evaluations
- Thus a System for Categorizing the Ductal Changes Seen in the Patients with Complications of Pancreatitis, Including Pseudocyst Was Undertaken

Pancreatic Ductal Changes

- Type I Normal Duct/No Communication Between the Duct and the Cyst
- Type II Normal Duct/Communicates
- Type III Normal Duct with Stricture/No Communication
- Type IV Normal Duct/Stricture/Communication
- Type V Normal Duct Complete Obstruction
- Type VI Chronic Pancreatitis/ No Communication
- Type VII Chronic Pancreatitis/ Communication

SYSTEM TO CATEGORIZE DUCTAL CHANGES SEEN BY ERCP IN PATIENTS WITH PSEUDOCYST



PERCUTANEOUS DRAINAGE

ERCP FINDING	Number of Patients	Length of Hospitalization (days)	Length of Drainage (days)
NL	17	6.1 ± 1.7	4.4 ± 1.1
S-	9	14.2 ± 4.6	26.7 +5.1
S+	13	33.5 ± 5.2	102.7 + 13.1*
C-O	11	39.1 + 7.9*	119.2 + 20.1*

OPERATIVE PATIENTS

ERCP FINDING	Number of Patients	Length of Hospitalization (days)
NL	39	4.2 ± 1.1
S -	32	5.6 ± 1.9
S +	29	8.2 ± 3.1
C - O	39	8.6 ± 2.6

POST PROCEDURE COMPLICATIONS

	Episodes of Sepsis	Subsequent Operation Required	Pseudocyst Recurrence
Operated Patients (143 Patients)	5/143 (3%)	0/143	0/143
Percutaneous Drainage (50 Patients)	16/50 (32%)*	13/50 (26%)*	11/50 (22%)*

Complications in Percutaneous Drainage

Total	37/50 (74%)
Sepsis	16/50 (32%)
Catheter Occlusion	12/50 (24%)
Tract Cellulitis	13/50 (26%)
Pain	16/50 (32%)

Complications in Operated Patients

Total	33/148 (20%)
Wound Infection	5/148 (3%)
Urinary Tract Infection	5/148 (3%)
Delayed Gastric Emptying	21/148 (14%)

CONCLUSION

- BASED UPON OUR DATA WE SOUGHT NOT TO CONDEMN NONOPERATIVE MANAGEMENT OF PSEUDOCYST BUT RATHER TO PROPOSE THAT DUCTAL ANATOMY CAN SERVE TO PREDICT WHICH MODALITY IS BEST SUITED TO INDIVIDUAL PATIENTS

DUCT DRAINAGE ALONE IS SUFFICIENT

IN THE OPERATIVE MANAGEMENT OF PANCREATIC PSEUDOCYST IN PATIENTS WITH CHRONIC PANCREATITIS

NEALON WH, WALSER E; ANNALS OF SURGERY 2003

SOUTHERN SURGICAL ASSOCIATION 2002

Hypothesis

- AS A CONSEQUENCE OF OUR STUDIES ON THE ROLE PLAYED BY DUCTAL ANATOMY IN PANCREATIC PSEUDOCYST WE DEVELOPED A HYPOTHESIS THAT PSEUDOCYSTS BE VIEWED AS A FISTULOUS COMMUNICATION BETWEEN THE MAIN PANCREATIC DUCT AND THE PSEUDOCYST

- AS SUCH WE POSTULATED THAT THE PRECEPTS WHICH GOVERN FISTULA PERSISTENCE LIKELY ARE AT PLAY IN PANCREATIC PSEUDOCYST; SPECIFICALLY THAT DISTAL OBSTRUCTION OF THE DUCT LARGELY EXPLAINS THE PERSISTENCE OF THE PSEUDOCYST.

Study Design

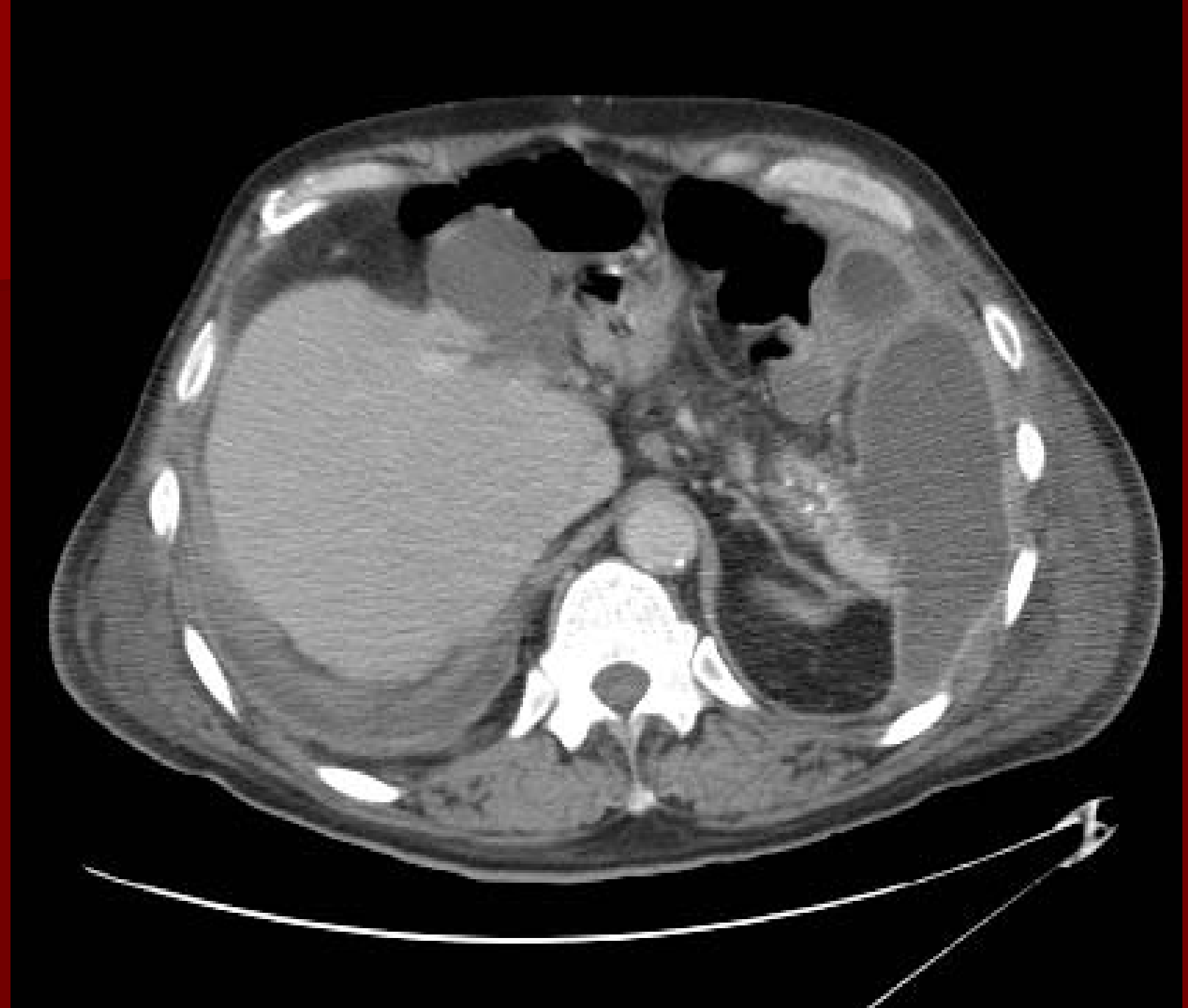
- Patients were Assigned to Either Pseudocyst-Jejunostomy Combined With Pancreatico-Jejunostomy or to Pancreatico-Jejunostomy and Simple Aspiration Drainage of Pseudocyst
- This Study was Based Upon the Observation Made on Mediastinal Pseudocyst

Methods

- DUCTAL IMAGING ESTABLISHED THE DIAGNOSIS OF CHRONIC PANCREATITIS
- IN ALL PATIENTS WITH MPD DILATATION A PUESTOW PROCEDURE WAS PERFORMED
- PSEUDOCYSTS WERE MANAGED BY EITHER SIMULTANEOUS CYST-JEJUNOSTOMY OR BY SIMPLE ASPIRATION OF THE PSEUDOCYST AT THE TIME OF OPERATION
- PATIENTS WHO HAD PUESTOW PROCEDURE AND SIMPLE DRAINAGE WERE COMPARED TO PATIENTS WHO HAD SIMULTANEOUS CYST-JEJUNOSTOMY

VARIABLES MEASURED

- LENGTH OF OPERATION
- LENGTH OF HOSPITALIZATION
- TRANSFUSIONS REQUIRED
- COMPLICATIONS
- PSEUDOCYST RESOLUTION
- SUCCESSFUL RELIEF OF PAIN



Results

- STUDY PERIOD 1985-2001
- TOTAL PSEUDOCYST PATIENTS 253
- ERCP SHOWING DILATED DUCT CHRONIC PANCREATITIS 103/253
- PUESTOW ALONE 47/103
- PUESTOW/CYST-JEJUNOSTOMY 56/103

Results

	Operative Time (Minutes)	Length of Hospitalization (Days)
PUESTOW/PS Drainage(N=56)	147.3+/- 19.2	9.3+/-1.1
PUESTOW ALONE(N=47)	* 94.7+/- 27.2	8.7+/- 1>6

Results

	Transfusion Requirements (Units/Pts)	Complications (%)
PUESTOW/PS DRAINAGE (N=56)	0.7+/- 0.2 9/56 Pts (16%)	9/56 (16%)
PUESTOW Alone (N=47)	0.5+/- 0.1 3/47 Pts (6%)	5/47 (11%)

Results

	Pain Relief (%)	Pseudocyst Recurrence (%)
PUESTOW/PS DRAINAGE (N=56)	49/46 (87%)	0/56
PUESTOW ALONE (N=47)	41/47 (89%)	0/47

Summary

- OPERATIVE TIMES WERE SIGNIFICANTLY SHORTER FOR PUESTOW ALONE COMPARED TO COMBINED PUESTOW/ CYST DRAINAGE
- RELIEF OF PAIN AND RESOLUTION OF PSEUDOCYST WERE HIGHLY SUCCESSFUL AND IDENTICAL IN THE TWO GROUPS

Conclusion

- ON THE BASIS OF THESE DATA WE CONCLUDED THAT PUESTOW ALONE IS SUFFICIENT IN THE MANAGEMENT OF PSEUDOCYSTS IN PATIENTS WITH CHRONIC PANCREATITIS WHOSE DUCTS ARE SUITABLE FOR DRAINAGE
- BASED UPON THESE DATA ONE MAY INFER THAT PERSISTENCE OF PSEUDOCYST IS ENTIRELY DEPENDENT UPON THE DYNAMICS WITHIN THE PANCREATIC DUCT

TIMING OF CHOLECYSTECTOMY AFTER NECROTIZING BILIARY PANCREATITIS

- Observation
  - Patients With Moderate to Severe Acute Gallstone Pancreatitis often Underwent Early Cholecystectomy and then Were Referred for Management of Pseudocyst
  - Patients were Thus Required to Undergo Two Separate Procedures and Often Two Separate General Anesthetics

APPROPRIATE TIMING OF CHOLECYSTECTOMY IN PATIENTS WHO PRESENT WITH MODERATE TO SEVERE GALLSTONE ASSOCIATED ACUTE PANCREATITIS WITH PERIPANCREATIC FLUID COLLECTIONS

NEALON, WH BAWDUNIAK J, WALSER E

ANNALS OF SURGERY 2004
SOUTHERN SURGICAL ASSOCIATION 2003

- A POLICY OF DELAYING CHOLECYSTECTOMY IN PATIENTS WITH BILIARY PANCREATITIS AND PERIPANCREATIC FLUID COLLECTIONS WAS INITIATED IN 1987
- CHOLECYSTECTOMY WAS PERFORMED AFTER 6 WEEKS AND COMBINED WITH DEFINITIVE TREATMENT OF THE PSEUDOCYST IF ONE PERSISTED
- RESULTS OF THESE PATIENTS WERE COMPARED TO PATIENTS REFERRED FOR CARE WHO HAD ALREADY HAD EARLY CHOLECYSTECTOMY

TIMING OF CHOLECYSTECTOMY

- TIME PERIOD 1987-2002
- TOTAL PATIENTS WITH MODERATE/SEVERE AP 187
- PERIPANCREATIC FLUID 151/187
- EARLY CHOLECYSTECOMY 78/187
  - FLUID COLLECTIONS 62/78
  - SPONANEOUS RESOLUTION 13/62 (21%)
- DELAYED CHOLECYSTECTOMY 109/187
  - FLUID COLLECTIONS 89/109
  - SPONTANEOUS RESOLUTION 36/89 (40%)

TIMING OF CHOLECYSTECTOMY

- FINDINGS INCLUDED:
  - SEPTIC COMPLICATIONS WERE COMMON IN THE CHOLECYSTECTOMY WHEN PERFORMED EARLY (c/w PREVIOUSLY REPORTED BY Buchler)
  - DELAYED OPERATION AVOIDED THE NEED FOR A SECOND OPERATIVE PROCEDURE
  - NO RECURRENT EPISODES OF ACUTE PANCREATITIS WERE SEEN IN THE DELAYED CHOLECYSTECTOMY PATIENTS
  - EARLY RECOGNITION OF DUCTAL ANATOMY MAY PREDICT PATIENTS WHO NEED NOT DELAY CHOLECYSTECTOMY

TIMING OF CHOLECYSTECTOMY

- CHOLECYSTECTOMY SHOULD BE DELAYED UNTIL FINAL STATUS OF ANY PERIPANCREATIC FLUID COLLECTIONS CAN BE ASSESSED (4-6 WEEKS)

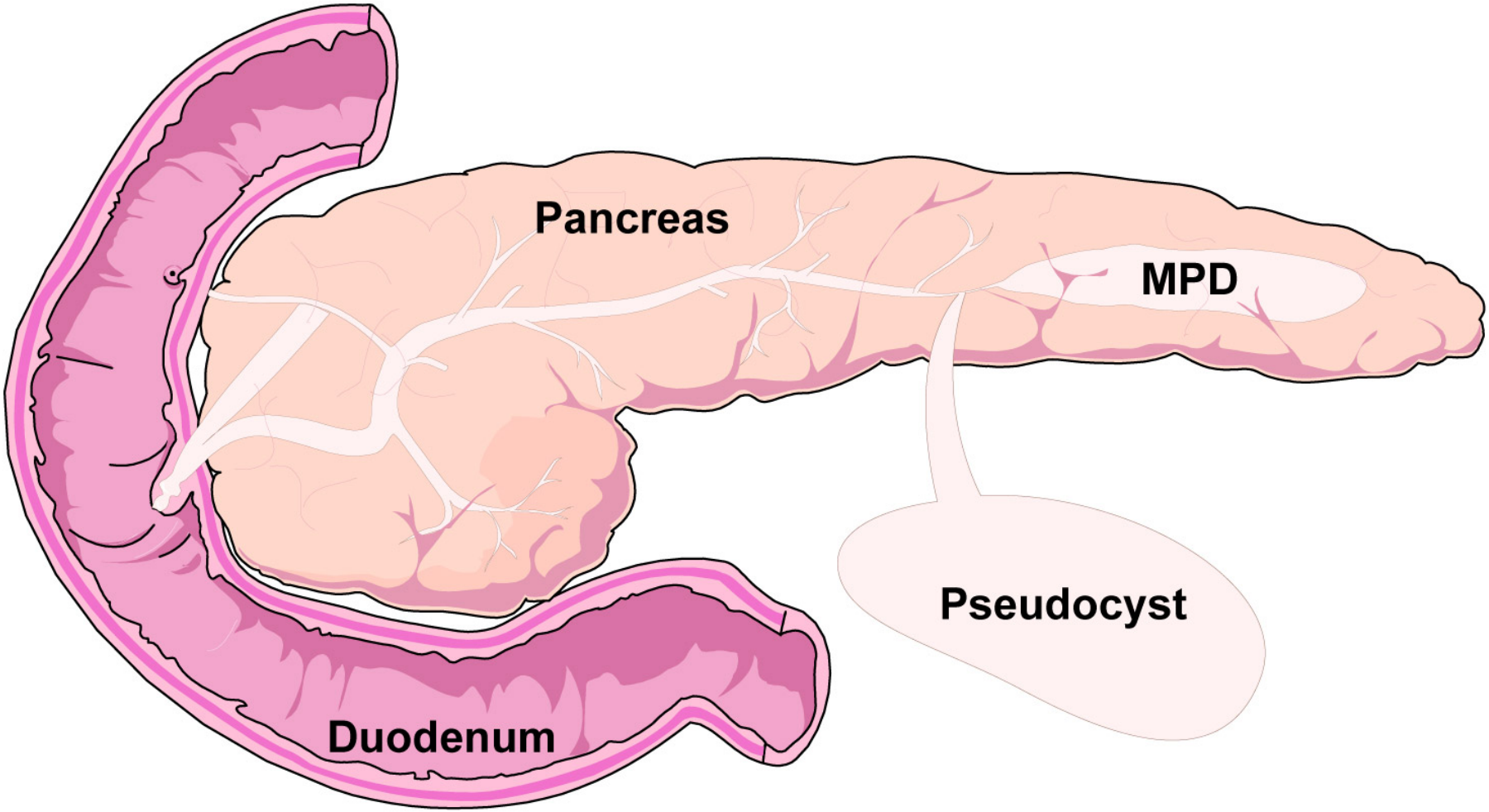
- DUCTAL ANATOMY SHOULD BE USED TO JUDGE LIKELY RESOLUTION

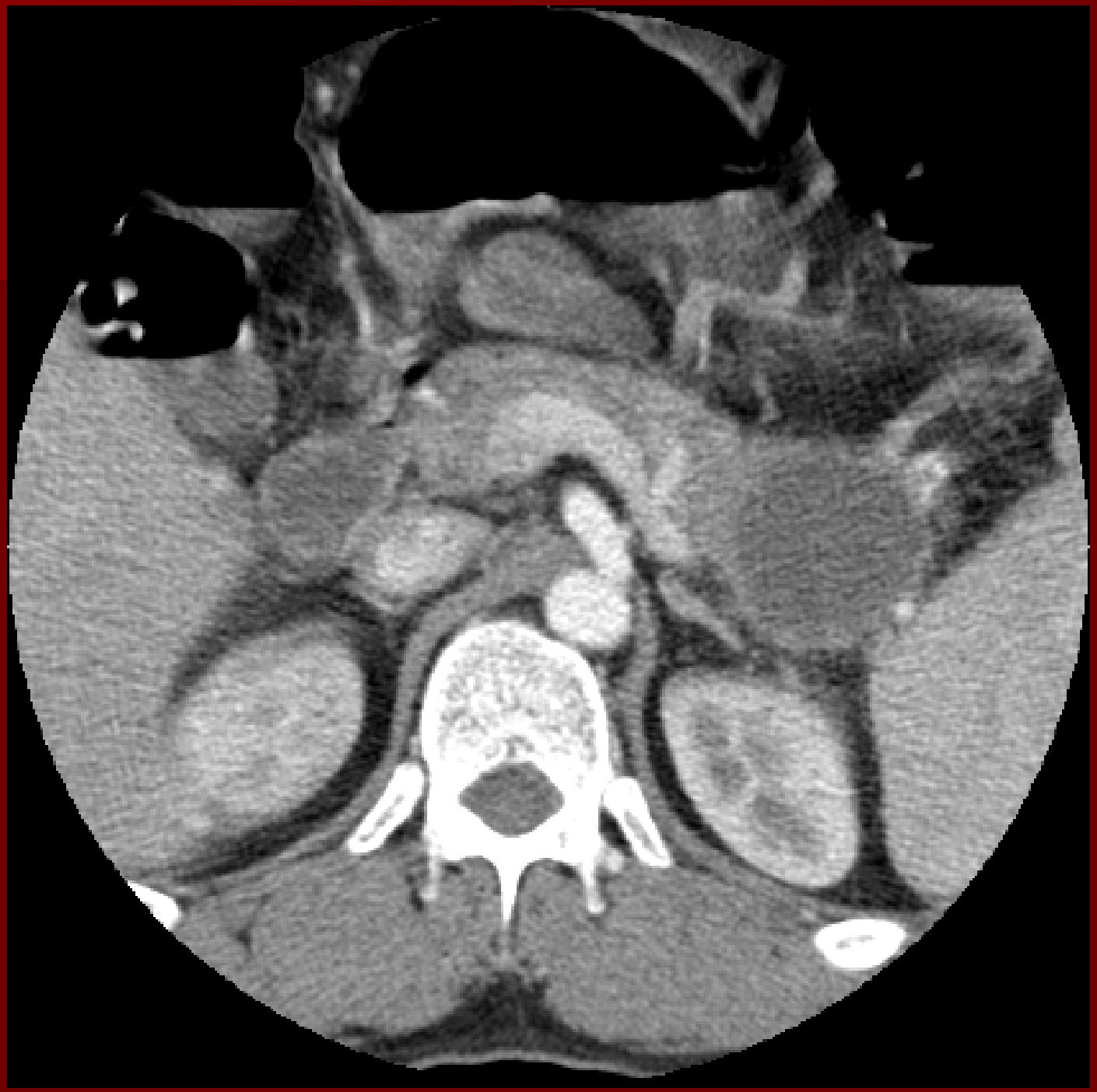
DISCONNECTED DUCT SYNDROME

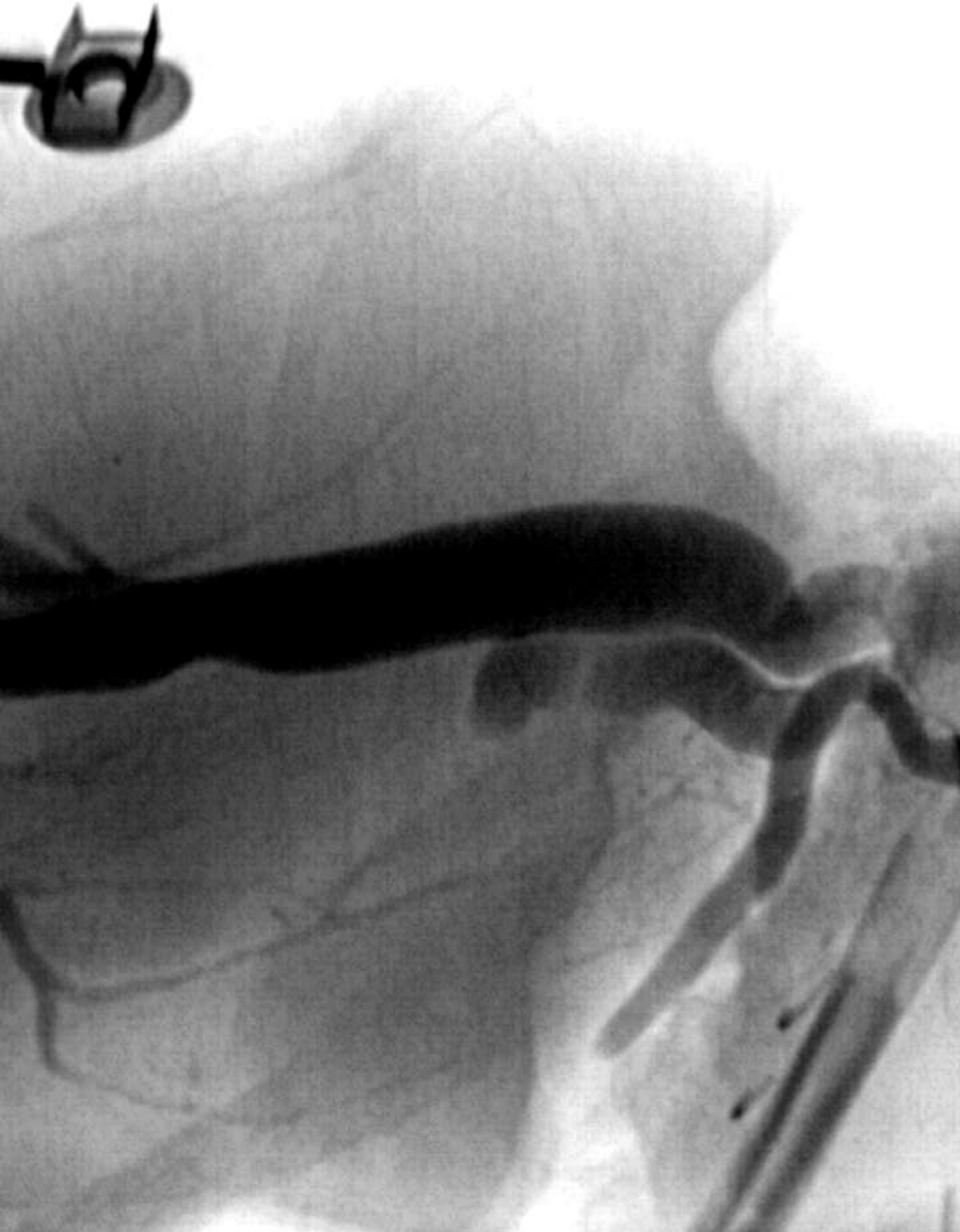
- ONE YEAR AFTER REPORTING OUR CATEGORIES OF DUCTAL CHANGES SEEN IN PSEUDOCYST THE PHRASE “DISCONNECTED DUCT SYNDROME” WAS COINED (TYPE V IN OUR FORMULA)

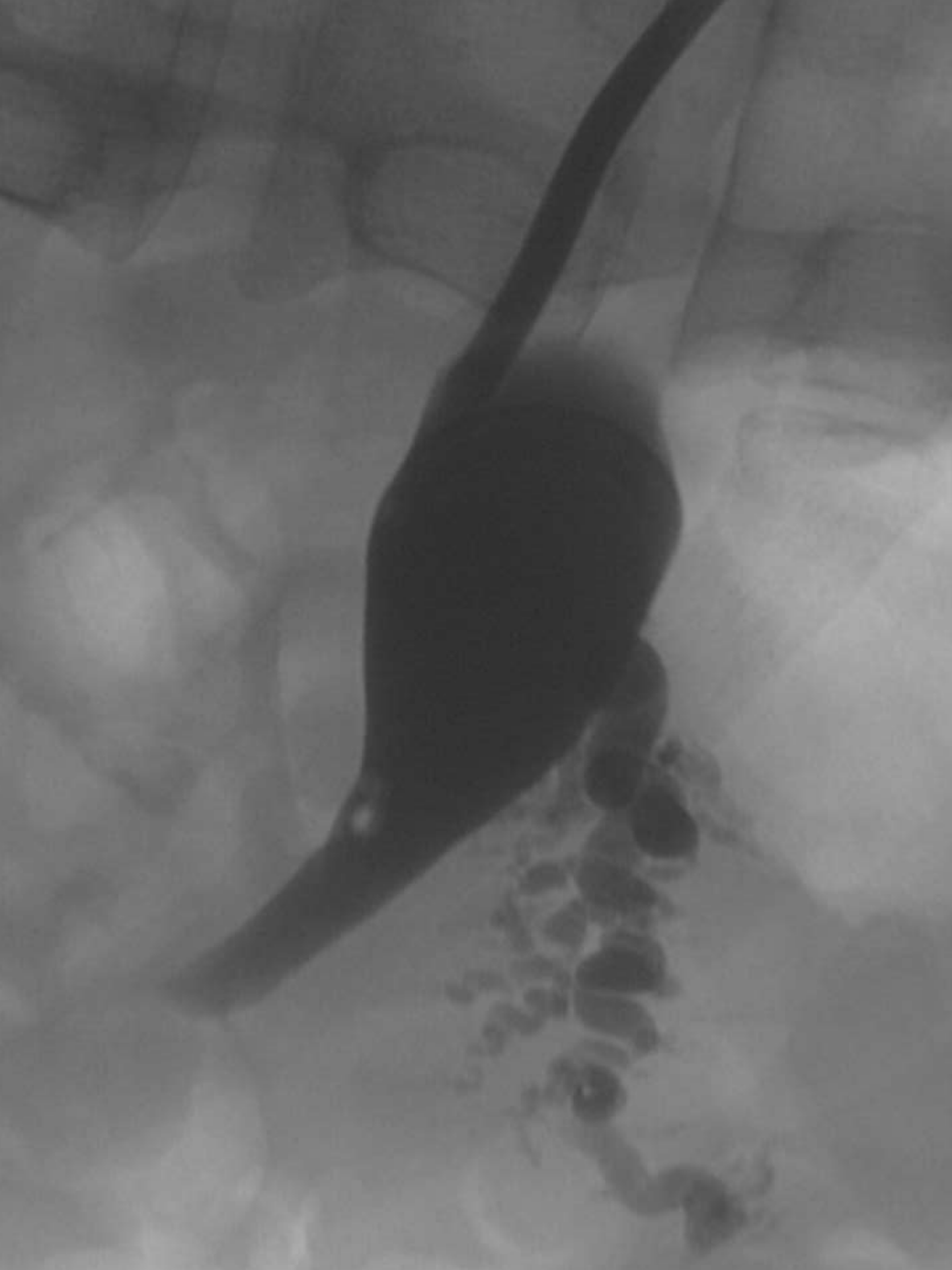
- AMONG ALL DUCTAL MORPHOLGIES IT IS MOST CLEAR WHY THIS ABNORMALITY MUST ALWAYS BE MANAGED OPERATIVELY

Isolated Pancreatic Segment

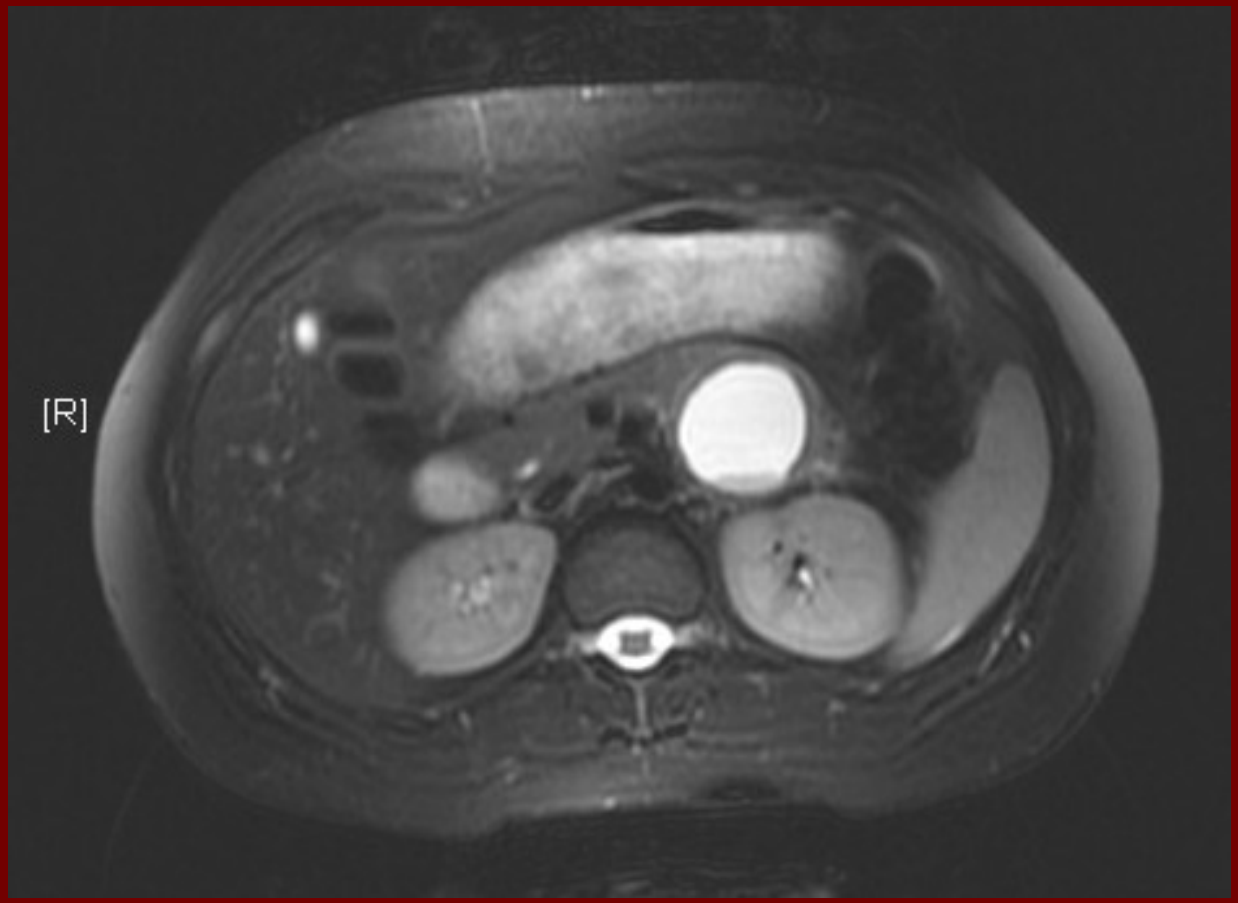








Post-traumatic Duct Disruption



Disconnected Duct Syndrome

- RESULTS IN A SEGMENT OF PANCREAS ISOLATED PERMANENTLY FROM THE REMAINING PANCREAS
- ENDOSCOPIC TRANSPAPILLARY MANAGEMENT WOULD APPEAR TO BE LIMITED BY THE INACCESSABILITY OF THE DUCT BECAUSE THE DUCT IS COMPLETELY OBSTRUCTED
- WE HAVE PUBLISHED DATA CONFIRMING THAT PERCUTANEOUS MANAGEMENT IS ASSOCIATED WITH PERSISTENT FISTULA AND FAILURE

Disconnected Duct Syndrome

- 0CCURS IN 30% OF PATIENTS WITH NECROTIZING PANCREATITIS (Uomo et al)
- SEEN IN AS MANY AS 40% OF PATIENTS WITH PERSISTENT AND/OR SEVERE COMPLICATIONS OF PSEUDOCYST (Nealon 2003 / 2005)
- SEEN IN 50% OF PATIENTS WHO EXPERIENCE RECURRENT PANCREATITIS AFTER AN EPISODE OF NECROTIZING PANCREATITIS
  (Howard 2005)

Isolated Pancreatic Segment

- May be Manifested as a Pseudocyst
- May be Manifested as an Inflammatory Mass
- Although the Main Pancreatic Duct in the Isolated Segment is Typically Dilated Some will have only Ductal Dilatation
- May Present as a Persistent Fistula after Failed Percutaneous Drainage

Methods Continued

- IN AN UNCONTROLLED FASHION SELECTED PATIENTS WITH DISCONNECTED DUCT HAD A TRIAL OF ENDOSCOPIC OR PERCUTANEOUS MANAGEMENT
- A MINIMUM OF 4 WEEKS WAS PERMITTED TO ELAPSE AFTER ENDOSCOPIC OR PERCUTANEOUS MANAGEMENT
- PERSISTENCE OF FLUID COLLECTION, PERSISTENT FISTULA OR RECURRENT ACUTE PANCREATITIS/SEPSIS REPRESENTED FAILURE

Isolated Pancreatic Segment

Endoscopic Management:

Total	29 patients	Success
Transgastric Stents	3 patients	0/3
Transpapillary Stent	29 patients	0/29
Stent Occlusion / Sepsis	6/29 (21%)	
Procedure Induced Pancreatitis	8/29 (28%)	

Isolated Pancreatic Segment Percutaneous Management

Total	49 Patients	
		Success
Pseudocyst Drainage	41 patients	0
Main Pancreatic Duct Drainage	8 patients	0

Conclusion

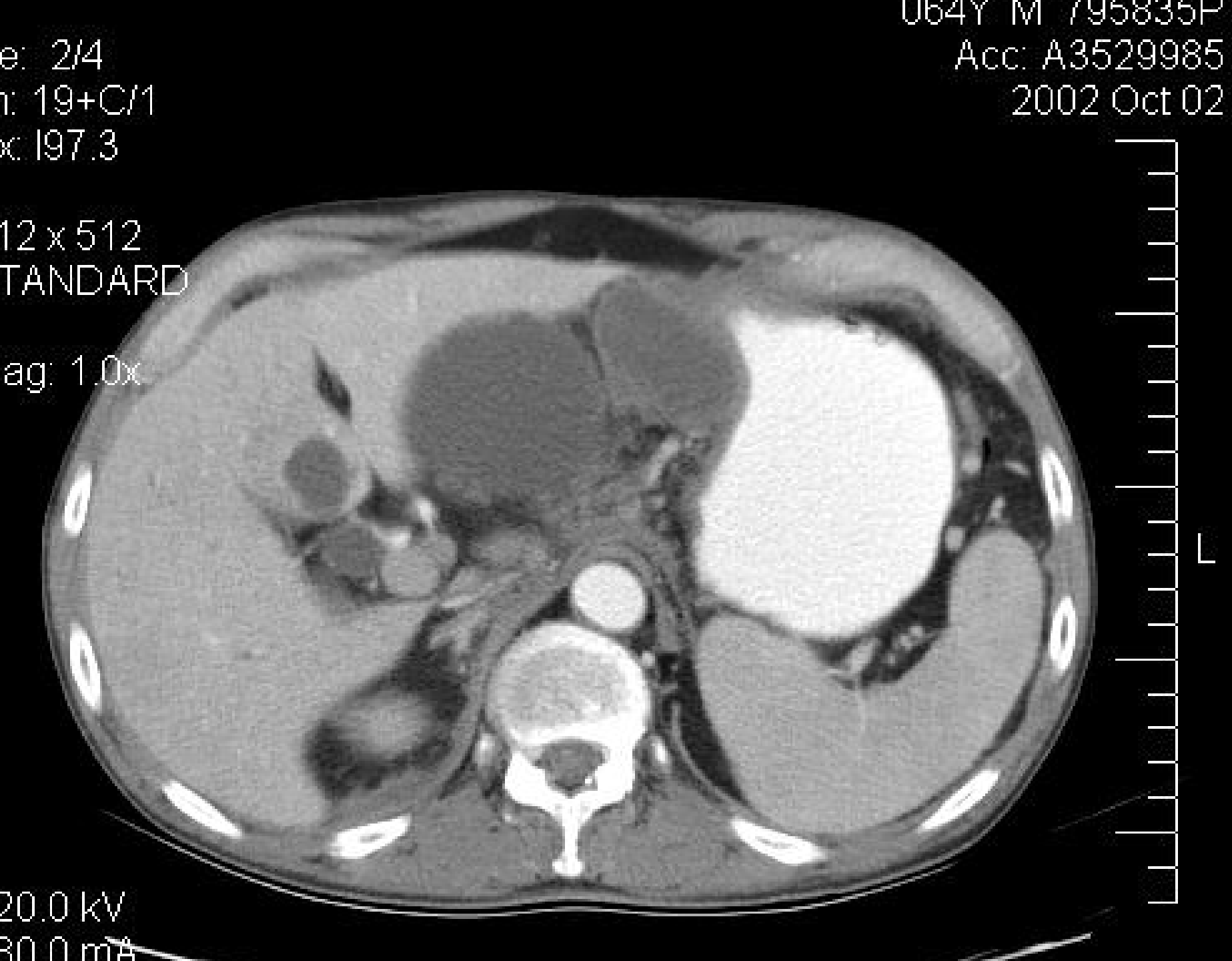
- Disconnected Duct Syndrome and Isolated Pancreatic Segment Specifically Dictate Operative Management
- One can anticipate good operative outcomes in this subset of patients

- Once Again Ductal Anatomy is the Dominant Determinant of Therapeutic Decision Making

Necrotizing Pancreatitis

- Patients with Persistent Fistula after Operative Debridement and Drainage have Type 3-5 changes in 84% (Nealon 2006)

- Patients who Require Re-hospitalization for Sepsis, Pain, Recurrent Pancreatitis or Persistent Cyst have Type 3-5 in 89% (Nealon 2007/Howard 2005)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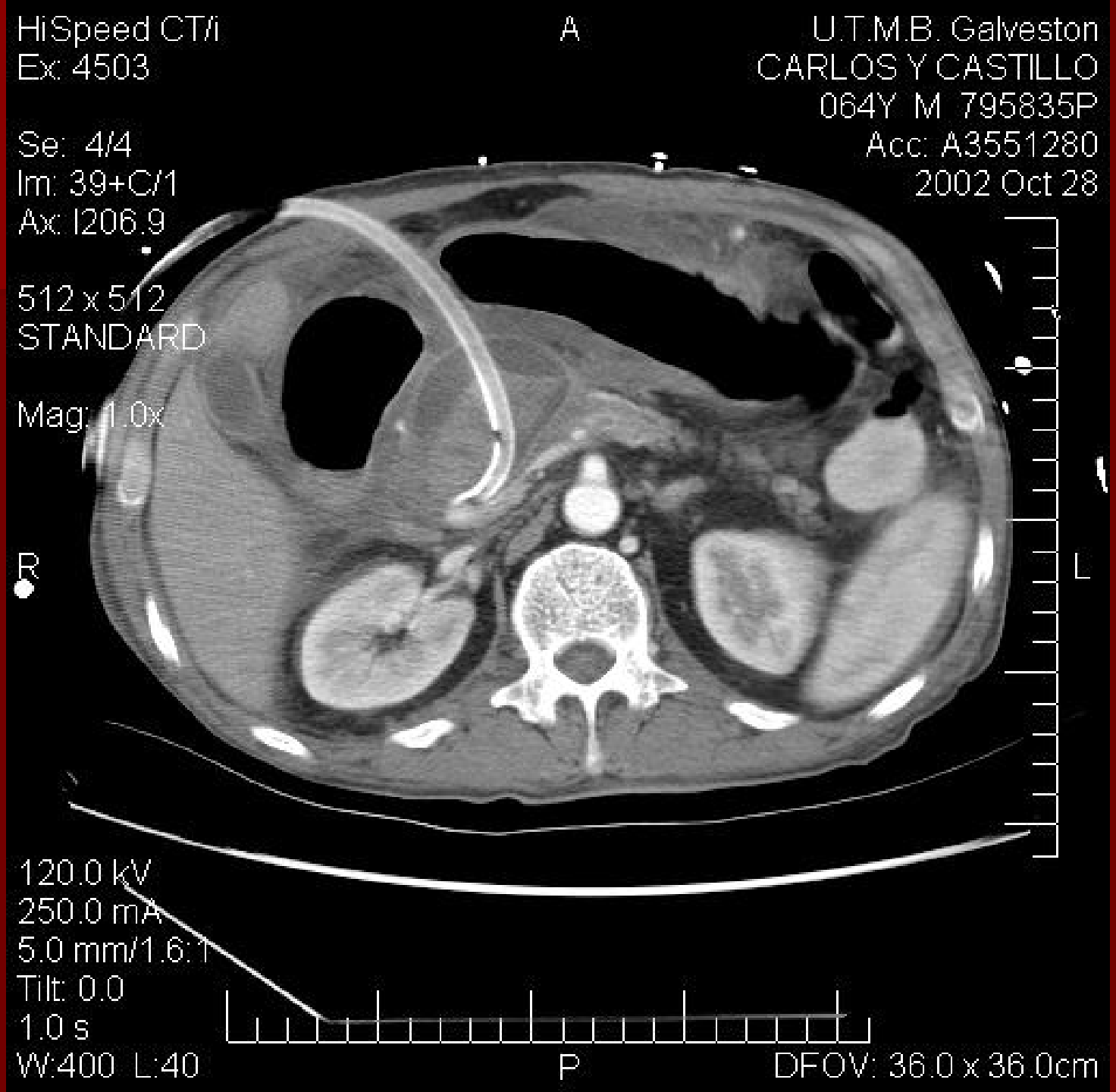
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A Unifying Concept: Pancreatic Ductal Anatomy Both Predicts and Determines the Major Complications of Pancreatitis

William H. Nealon M.D.

Southern Surgical Association 12/2008

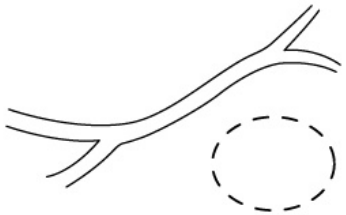
JACS 2009

REVISED CLASSIFICATION SYSTEM

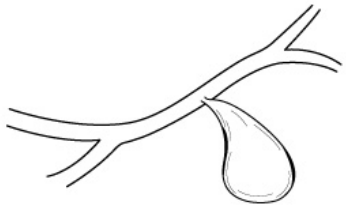
TYPE I-A or I-B	NORMAL DUCT
TYPE II-A OR II-B	DUCT STRICTURE
TYPE III-A OR III-B	DUCT OCCLUSION
TYPE IV-A OR IV-B	CHRONIC PANCREATITIS

NOTE:"A" DENOTES NO COMMUNICATION BETWEEN PSEUDOCYST AND DUCT/"B" DENOTES COMMUNICATION

Categories of Ductal Anatomy



Type Ia



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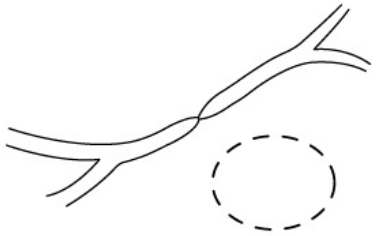
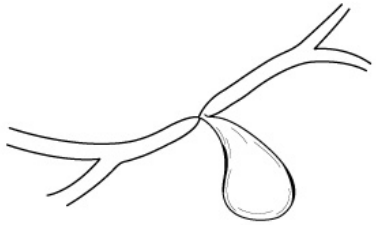


Type IIa



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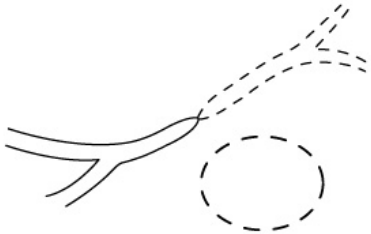

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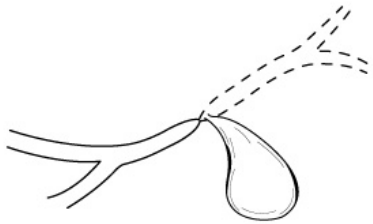

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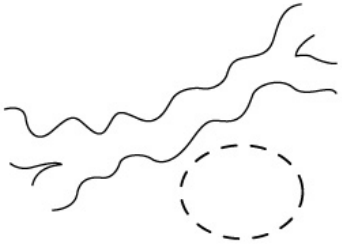

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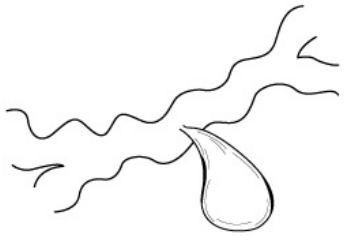

Type IVb

OBSESSION OR MISSION

- Even Without Randomization these Kinds of Studies require Considerable Endurance and Persistence
- These Studies Were All Commenced Before Computer Data-bases Even Existed as a Term
- With the Support at this Institution for Gaining Skills and IT Support for Prospective Analyses I Encourage All Students and Trainees to Begin Your Journey with a Plan to Focus and Follow Some Category of Patients Through Your Careers