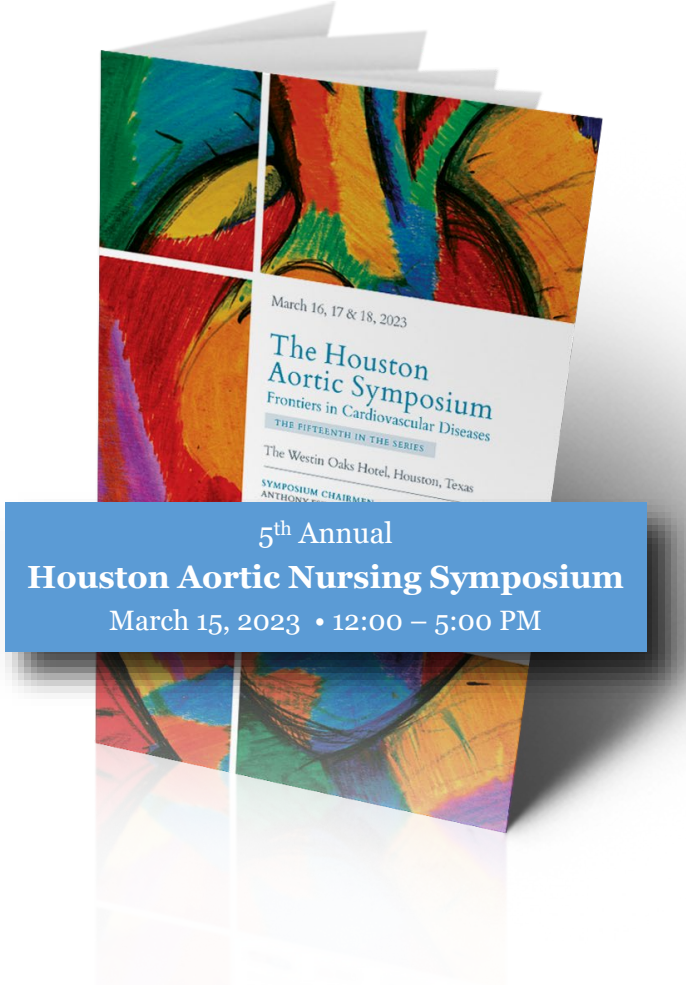
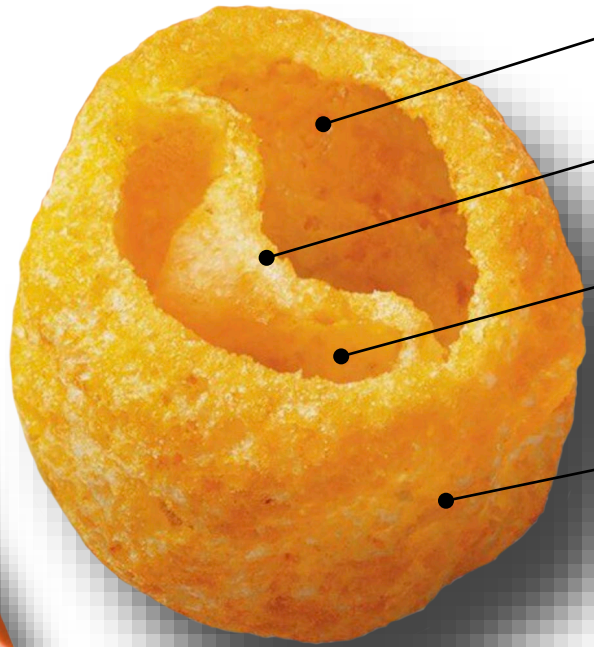
Treatment of Acute Aortic Dissection

Hazim J. Safi, MD





False Lumen

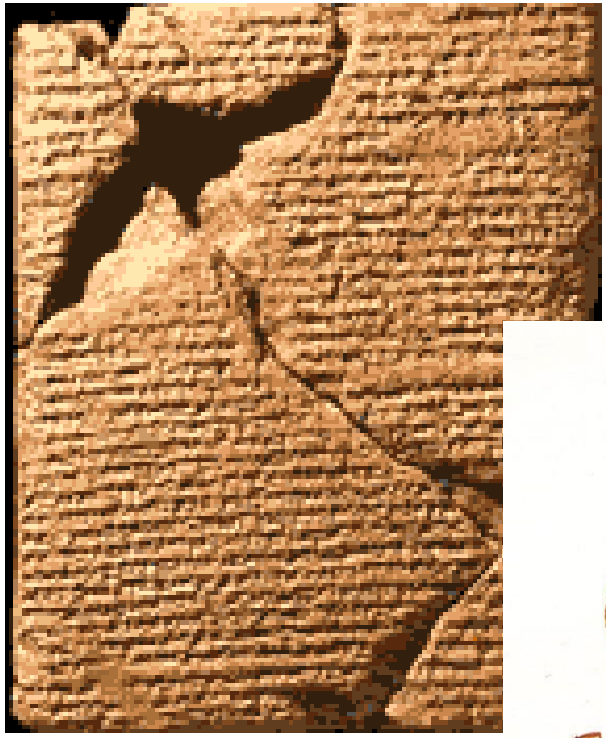
Inner Wall

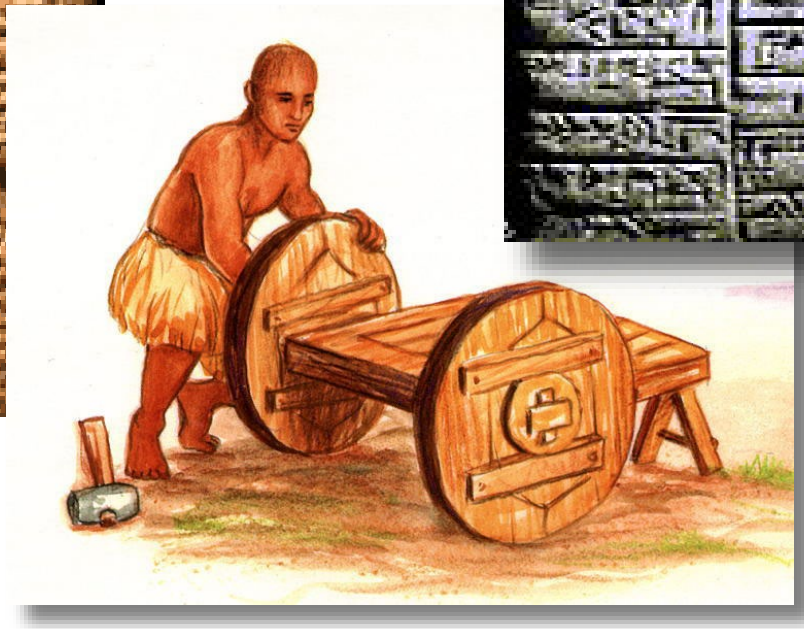
True Lumen

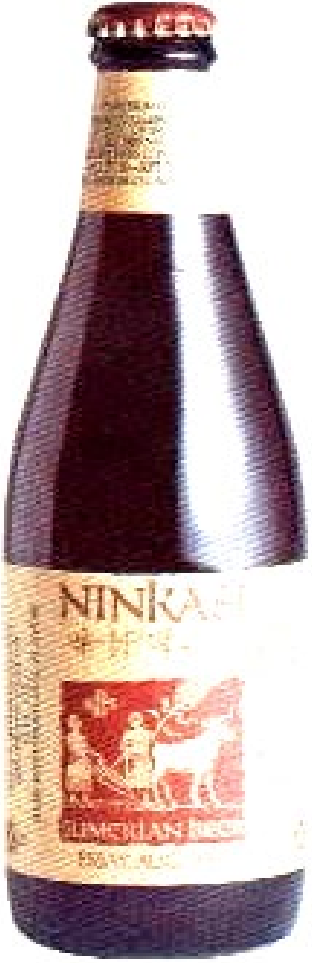
Outer Wall

The author has no financial relationships to disclose

Caspian Sea
ASIA MINOR
FERTILE CRESCENT
ASSYRIA
Nineveh
Assur
Zagros Mountains
IRAN
Çatal Hüyük
Taurus Mts.
Euphrates
Tigris
AKKAD
Ebla
Cyprus
R.
R.
PHOENICIA
Tyre
Babylon
Umma
Lagash
Uruk
SUMER
Syrian Desert
Mediterranean Sea
PALESTINE
Jordan R.
Jericho
Ur
Eridu
Jerusalem
Dead Sea
Arabian Desert
Persian Gulf
LOWER EGYPT
SINAI
R.

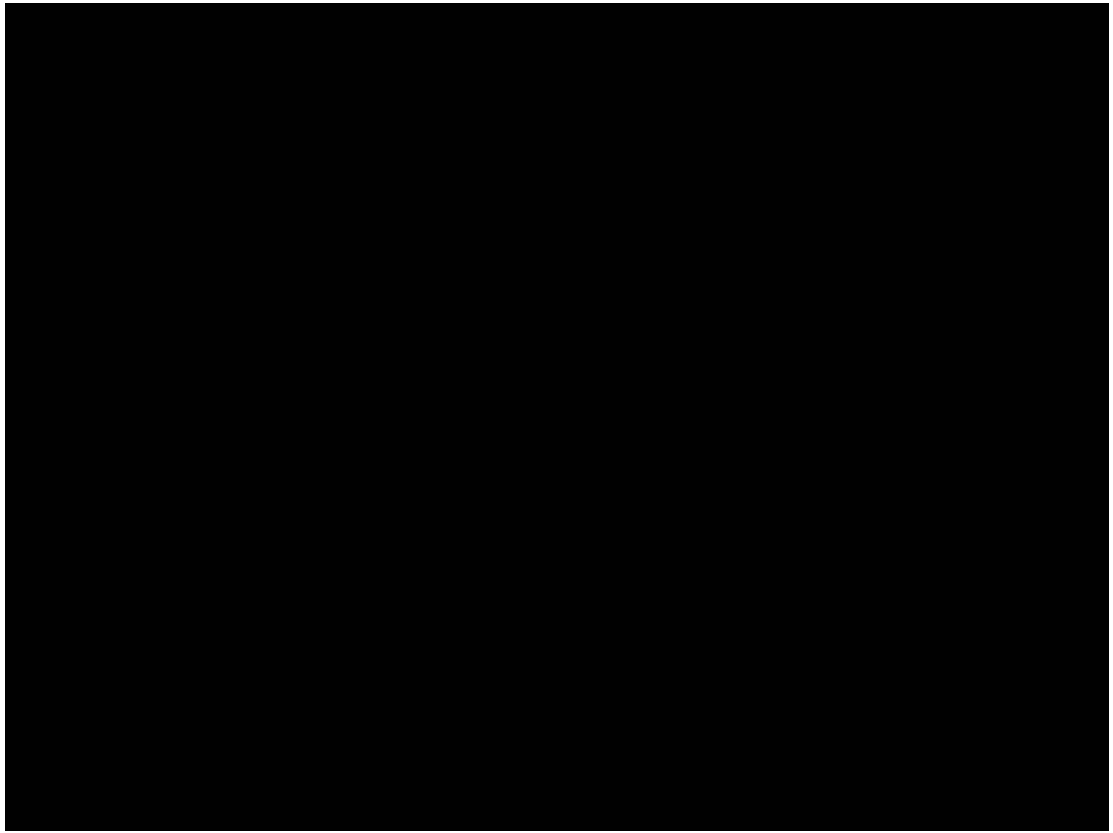






Anchor Brewing Company
San Francisco, CA
1988

Dissection



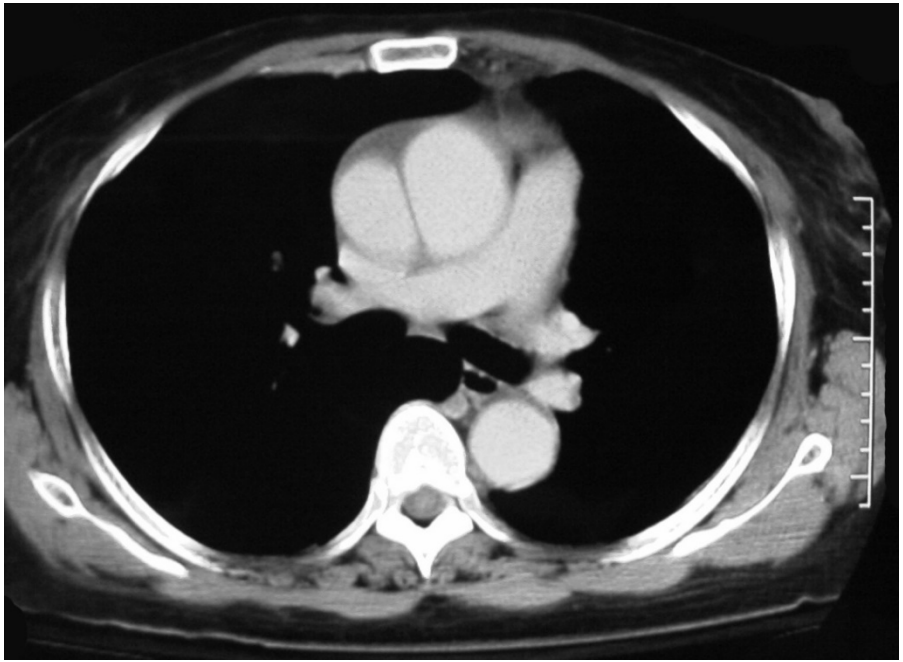
The Passing of King George

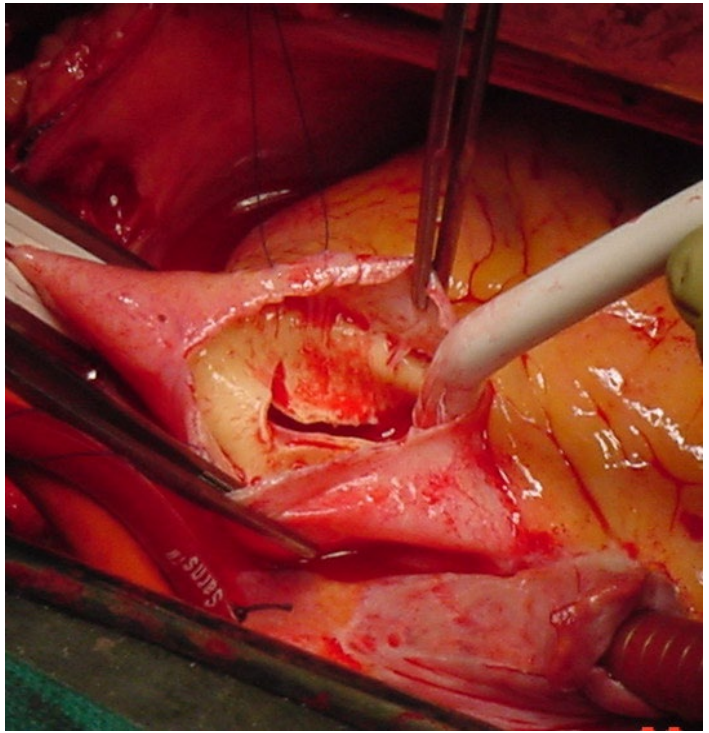
On October 23, 1760 George II rose at 6 am, asked for his chocolate and repaired to his closet-stool. The valet heard a **"noise louder than the royal wind and a groan."** The King was lying on the floor. T[illegible] surgeon Mr. Andrews bled hi[illegible] Majesty [illegible] King w[illegible] dead.

At nec[illegible] pericar[illegible] coagul[illegible] fissure [illegible] ascend[illegible] through which blood had passed to form an ecchymosis, which was interpreted as an incipient

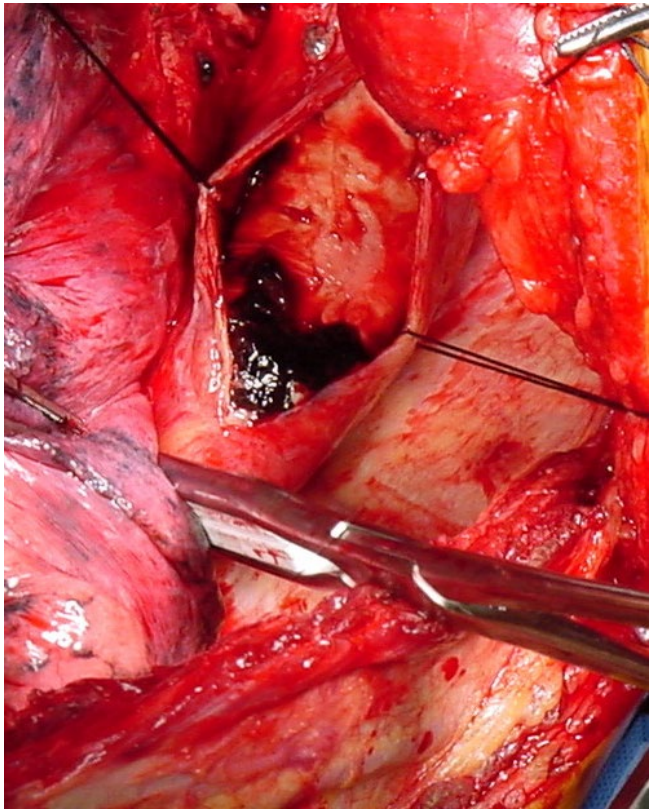
...pericardium extended with coagulated blood and a transverse fissure on the inner side of the ascending aorta 3.75 cm...

Aortic Dissection





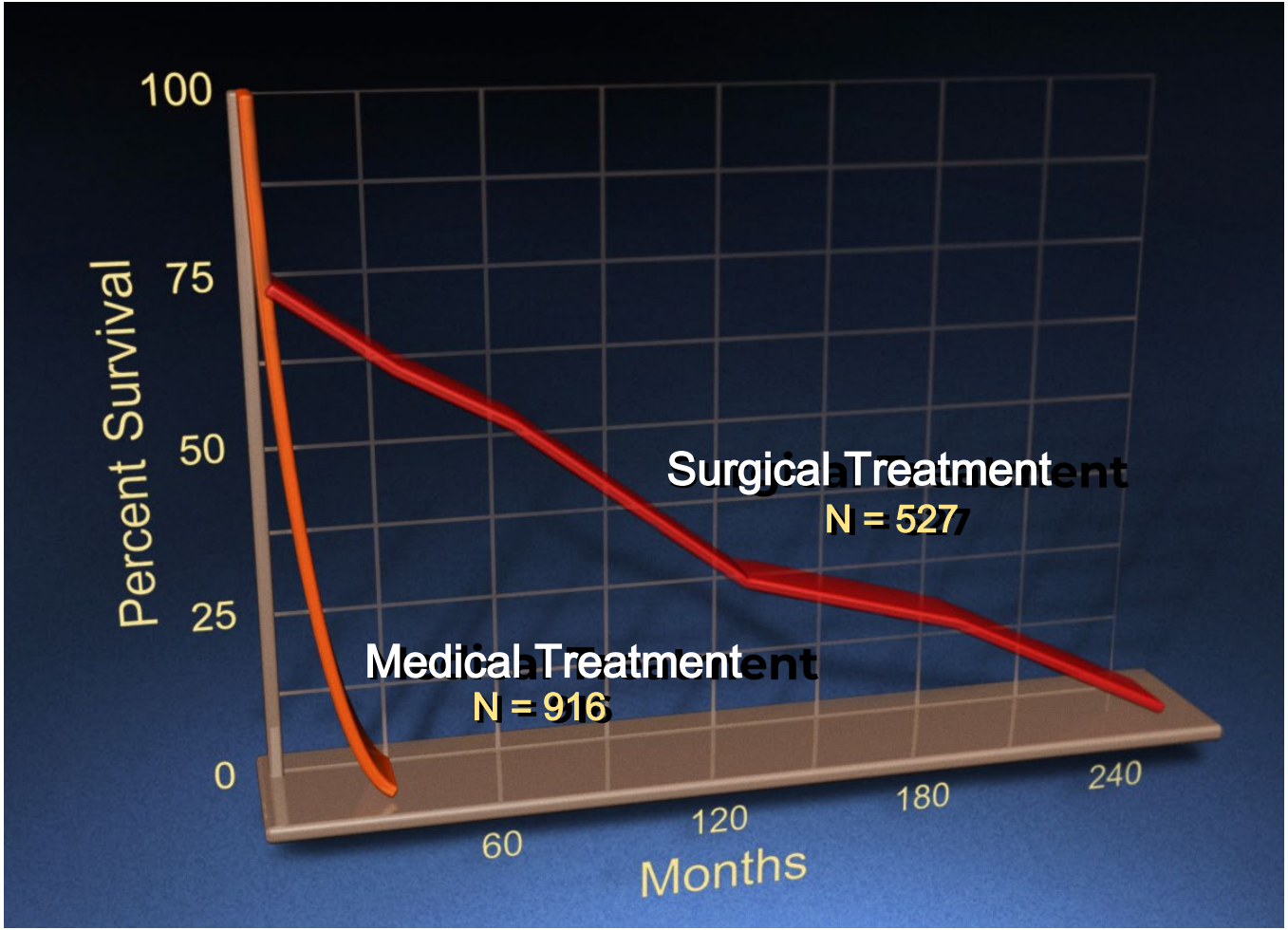
Aortic Dissection



History

Necropsy Series

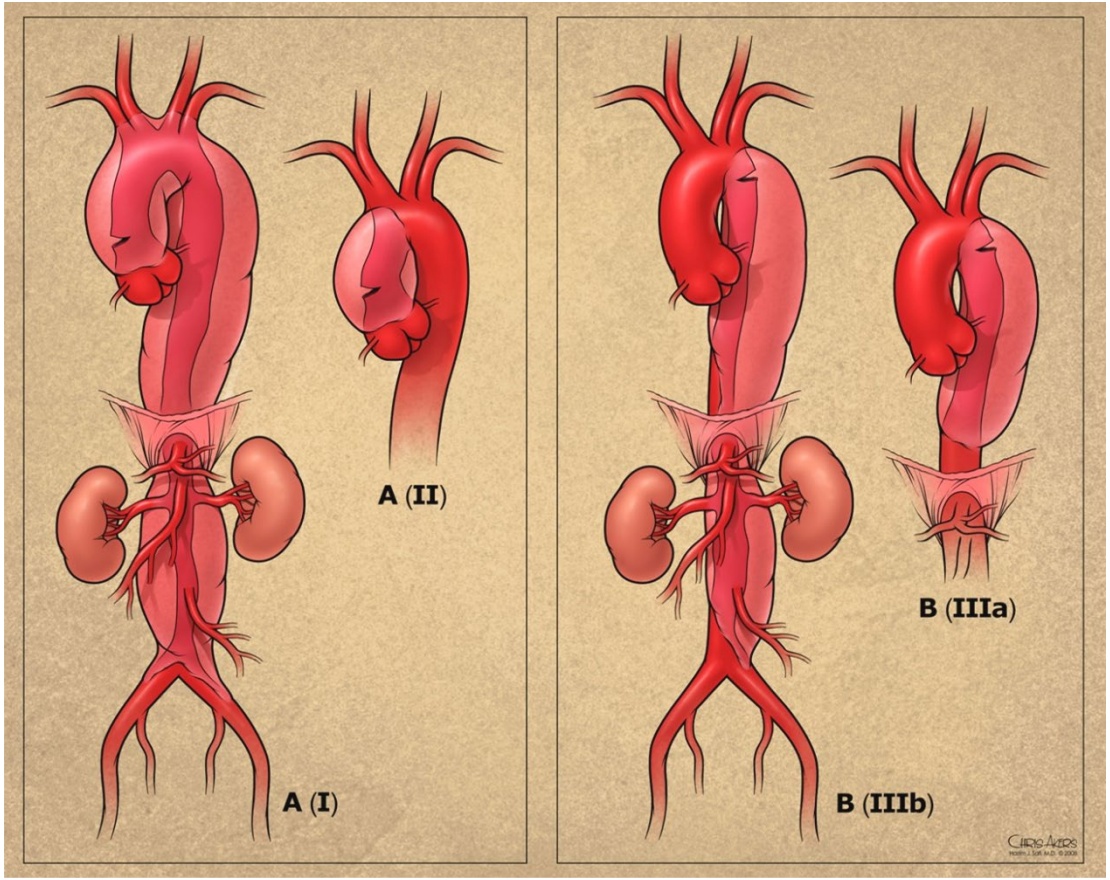
- Morgani (1761)
  - Study of dissecting aneurysm
- René Laennec (1819)
  - Description of chronic aortic dissection
- Shennan (1934) 300 cases
- Hirst (1958) 508 cases
  - Pathologic Entity of Aortic Dessection
  - Acute vs Chronic Aortic Dissection


100
75
50
25
0
Percent Survival
Surgical Treatment
N = 527
Medical Treatment
N = 916
60
120
180
240
Months

Classification

Type A (I, II)	Type B (III)
Anterior	Posterior
Ascending	Descending

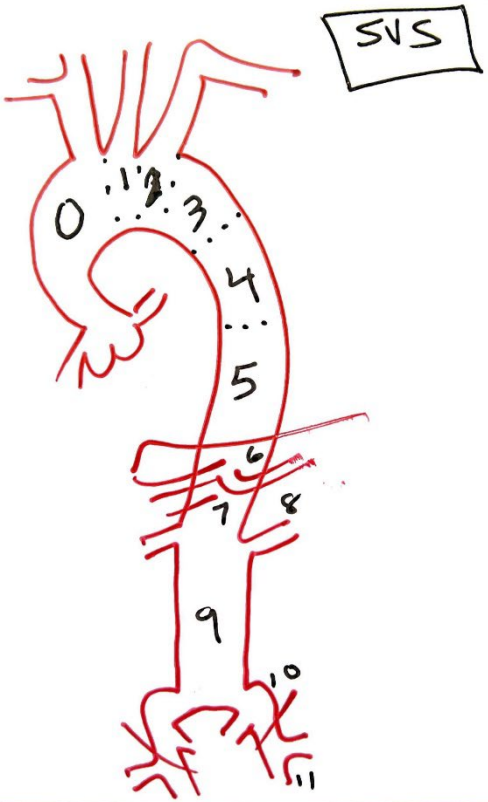
Dissection Classification



HCA Houston Healthcare
Medical Center

Houston Heart

Hazim J. Safi, M.D.
Chief of Aortic Surgery



Museum District 1200 Binz Street,
Suite 900 Houston, TX 77004
Tel: 713-522-0220 | Cel: 713-828-0091

Aortic Dissection

< 2 weeks = Acute

> 2 weeks = Chronic

Aortic Dissection

Type A (I + II)

SURGERY

Aortic Dissection

Type B (III)

SURGERY
(selective)

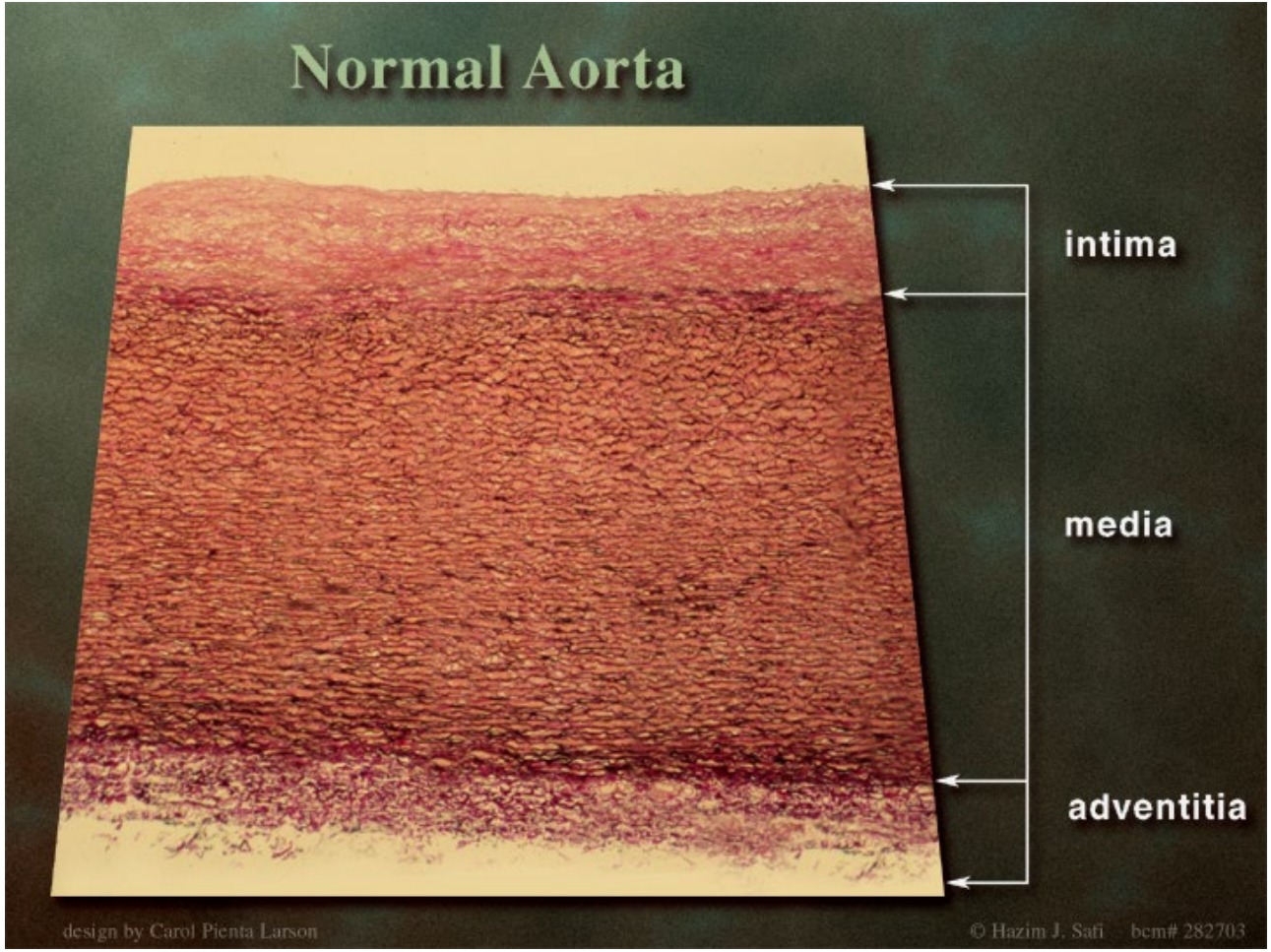
Aortic Dissection

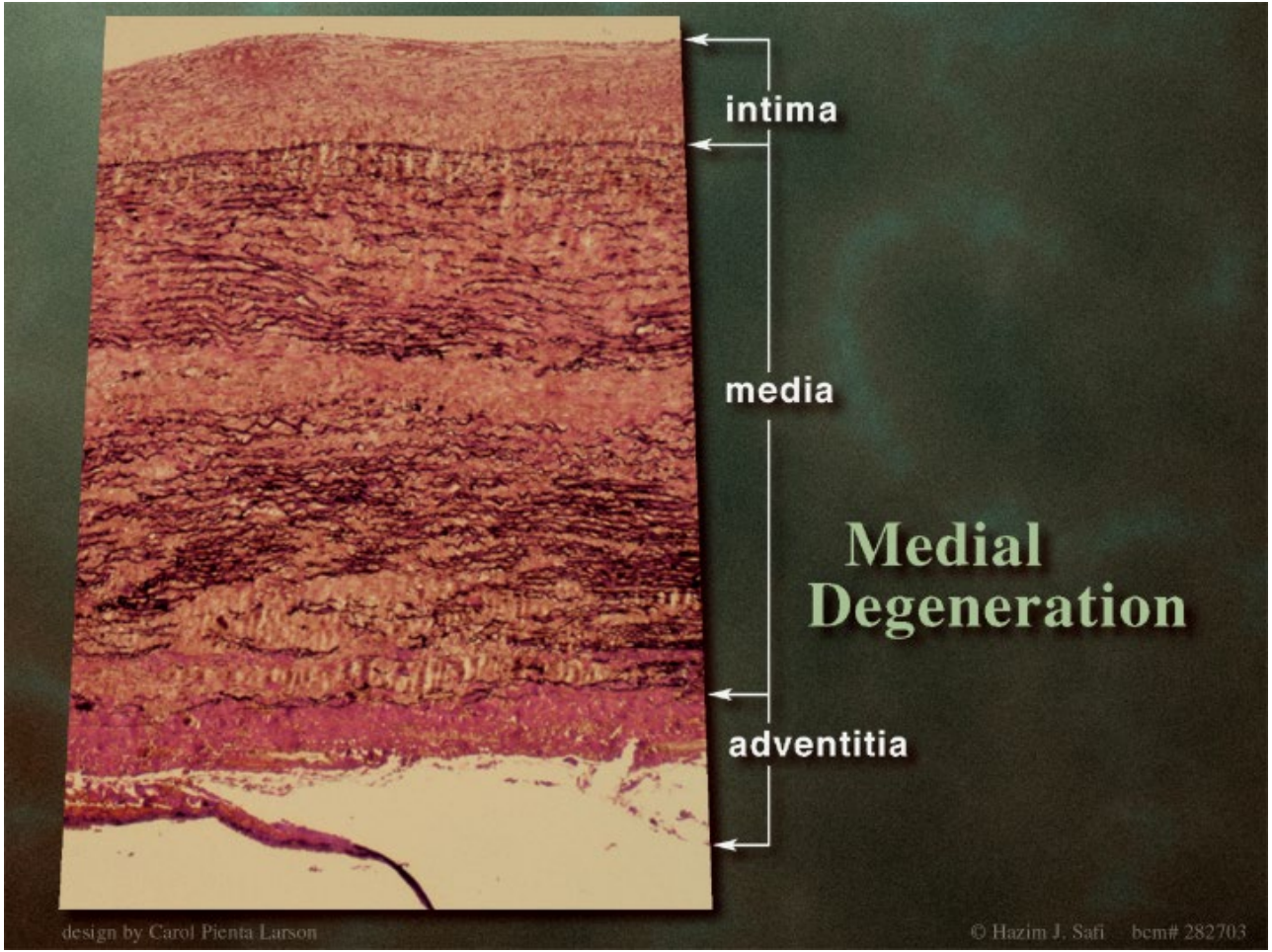
Type B → Indications SURGERY

- Persistent pain
- Aneurysm size increase (>5 cm)
- Loss of vital organ function
- Impending rupture

Associations

- **Congenital Anomalies**
  Marfan's, Ehler's Danlos, Turners
- **Medial Degeneration**
  Medial necrosis
- **Pregnancy**
  HTN, hormonal
- **Hypertension**
  Mech strain
- **Inflammatory**
  Syphilis, Arteritis
- **Trauma**
  Latrogenic


Normal Aorta
intima
media
adventitia
design by Carol Pienta Larson
© Hazim J. Safi bcm# 282703


intima
media
adventitia
Medial Degeneration
design by Carol Pienta Larson
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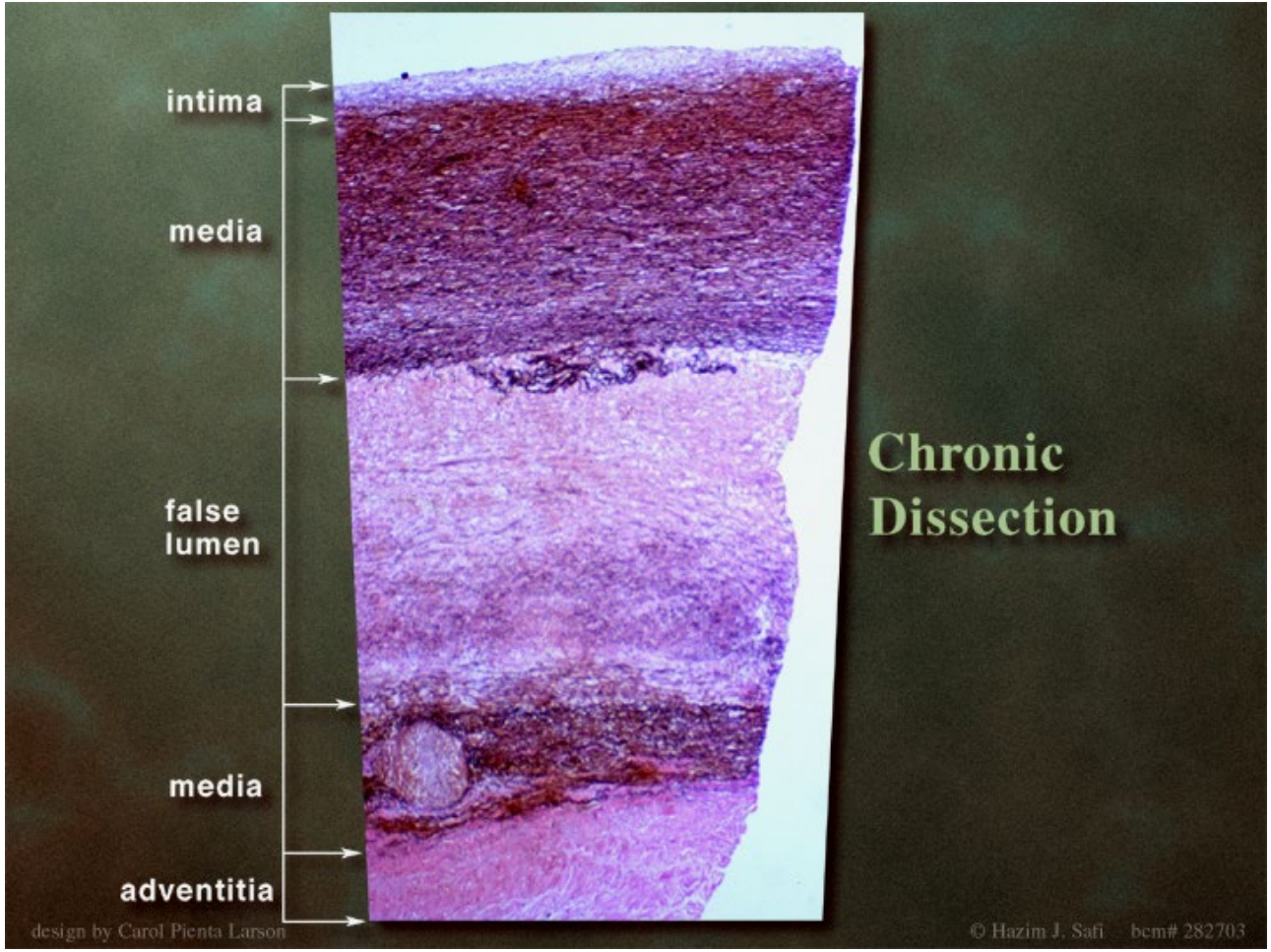

intima
media
false
lumen
media
adventitia
Chronic
Dissection
design by Carol Pienta Larson
© Hazim J. Safi bcm# 282703

Inflamation

He R, Guo D -C, Estrera AL, Safi HJ, Huynh TT, Cao S-N, Kurian T, Buja LM, Geng Y-J, Milewicz DM: Inflammation associated with apoptosis and loss of smooth muscle cells in patients w

Inflammatory component related to the smooth muscle cells medicated by both T-cells and Macrophages

He R, Guo LM, Geng Y-J, Milew apoptosis and loss of smooth muscle cells in the aortas of patients with ascending thoracic aortic aneurysms and dissections with medial degeneration. Circulation

American Journal of Medical Genetics Part C (Semin. Med. Genet.) 139C:10–16 (2005)

ARTICLE

Genetic Basis of Thoracic Aortic Aneurysms and Aortic Dissections

HARIYADARSHI PANNU, VAN TRAN-FADULU, AND DIANNA M. MILEWICZ*

Ascending thoracic aortic aneurysms leading to type A dissections (TAAD) can occur in association with a genetic syndrome, such as Marfan syndrome (MFS), or as an autosomal dominant disorder in the absence of syndromic features, termed familial TAAD. Familial TAAD demonstrates genetic heterogeneity, and linkage studies have identified three TAAD loci at 5q13-14 (*TAAD1*), 11q23 (*FAA1*), and 3p24-25 (*TAAD2*). The underlying genetic heterogeneity of TAAD is reflected in the phenotypic variation associated with familial TAAD with respect to age of onset, progression, penetrance, and association with additional cardiac and vascular features. Recently, mutations in the *TGFBR2* gene have been identified as the cause of disease linked to the *TAAD2* locus, supporting the hypothesis that dysregulation of TGFβ signaling is a mechanism leading to aneurysms and dissections. The recent identification of the TGFβ pathway as a key target in the molecular pathogenesis of TAAD has opened new avenues for future genetic and therapeutic research. © 2005 Wiley-Liss, Inc.

KEY WORDS: aneurysms; dissections; aorta; aortic disease; transforming growth factor β; *TGFBR1*; *TGFBR2*; *FBN1*

Genetics

TAAD1, 5q 13-14

Guo D, Hasham S, Kuang SQ, Vaughan CJ, Boerwinkle E, Chen H, Abuelo D, Dietz HC, Basson CT, Shete SS, Milewicz DM. Familial thoracic aortic aneurysms and dissections: genetic heterogeneity with a major locus mapping to 5q13 -14. Circulation. 2001

TAAD2, 3p 2

Hasham SN, Willing MC,
Mapping a locus fo

Thoracic Aortic Aneurysms & Dissections are familial in 20% of cases

TGFB2 recep

Hariyadarshi Pannu , Van ... Safi; Marcia C. Willing; Dianna M. Milewicz Mutations in Transforming Growth Factors Beta Receptor 2 Cause Familial Thoracic Aortic Aneurysms and Dissections. NEJM. 2005

MYH11 mutation (in press Human Molecular Genetics)

Pathogenesis

- Medial degeneration
- Repeated Flexion stress
  - 37 million / year
- Pulse wave propagation (contractile)
- Increased Afterload (BP)

IRAD

Demographics

Acute Aortic Dissection

Age, Mean	63.1 (14%)
Male Gender	303 (65.3%)

The International Registry of Acute Aortic Dissection (IRAD): new insights into an old disease. JAMA. 2000 Feb 16

Patient History

Acute Aortic Dissection

Marfan Syndrome	22/449 (5%)
Hypertension	326/452 (72%)
Atherosclerosis	140/452 (31%)
Known Aortic Aneurysm	73/453 (16%)
Prior Aortic Dissection	29/453 (6%)
Diabetes Mellitus	23/451(5%)

Symptoms

Acute Aortic Dissection

Any Reported Pain	443/464 (96%)
Abrupt Onset	379/447 (85%)
Chest Pain	331/455 (73%)
Anterior Chest Pain	262/430 (61%)
Posterior Chest Pain	149/415 (36%)
Back Pain	240/451(53%)
Abdominal Pain	133/449 (30%)

IRAD

Physical Examination

Acute Aortic Dissection

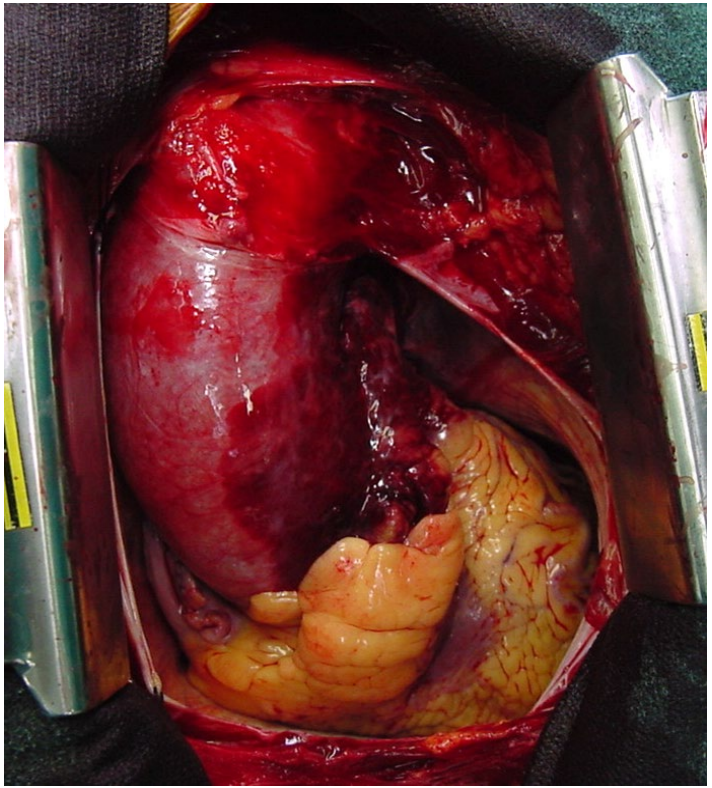
Hypotensive	36 (8%)
Shock or Tamponade	38 (8.4%)
Auscultated Murmur	137/434 (32%)
Pulse Deficit	69/457 (15%)
Cerebrovascular Accident	21/447 (5%)
Congestive Heart Failure	29/440 (7%)

Diagnostic Imaging

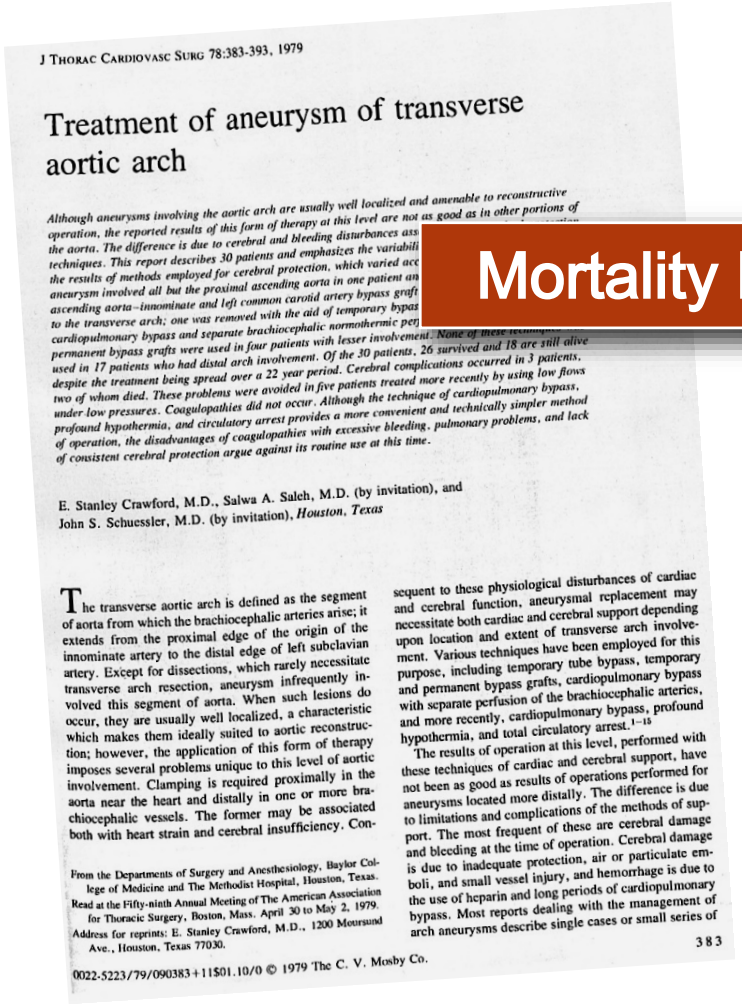
Acute Aortic Dissection

Initial Modality	
CT	277 (62%)
Echocardiogram	148 (32%)
Aortography	20 (4%)
MRI	8 (2%)

Type A



- Initial Stabilization
- CPB
- Profound Hypothermia
- Circulatory Arrest
- RCP
- Open Technique



J Thorac Cardiovasc Surg 78:383-393, 1979

Treatment of aneurysm of transverse aortic arch

Although aneurysms involving the aortic arch are usually well localized and amenable to reconstructive operation, the reported results of this form of therapy at this level are not as good as in other portions of the aorta. The difference is due to cerebral and bleeding disturbances ass... techniques. This report describes 30 patients and emphasizes the variabili... the results of methods employed for cerebral protection, which varied acc... aneurysm involved all but the proximal ascending aorta in one patient an... ascending aorta–innominate and left common carotid artery bypass graft... to the transverse arch; one was removed with the aid of temporary bypas... cardiopulmonary bypass and separate brachiocephalic normothermic per... permanent bypass grafts were used in four patients with lesser involvement. None of these tech... used in 17 patients who had distal arch involvement. Of the 30 patients, 26 survived and 18 are still alive despite the treatment being spread over a 22 year period. Cerebral complications occurred in 3 patients, two of whom died. These problems were avoided in five patients treated more recently by using low flows under low pressures. Coagulopathies did not occur. Although the technique of cardiopulmonary bypass, profound hypothermia, and circulatory arrest provides a more convenient and technically simpler method of operation, the disadvantages of coagulopathies with excessive bleeding, pulmonary problems, and lack of consistent cerebral protection argue against its routine use at this time.

E. Stanley Crawford, M.D., Salwa A. Saleh, M.D. (by invitation), and John S. Schuessler, M.D. (by invitation), *Houston, Texas*

The transverse aortic arch is defined as the segment of aorta from which the brachiocephalic arteries arise; it extends from the proximal edge of the origin of the innominate artery to the distal edge of left subclavian artery. Except for dissections, which rarely necessitate transverse arch resection, aneurysm infrequently involved this segment of aorta. When such lesions do occur, they are usually well localized, a characteristic which makes them ideally suited to aortic reconstruction; however, the application of this form of therapy imposes several problems unique to this level of aortic involvement. Clamping is required proximally in the aorta near the heart and distally in one or more brachiocephalic vessels. The former may be associated both with heart strain and cerebral insufficiency. Consequent to these physiological disturbances of cardiac and cerebral function, aneurysmal replacement may necessitate both cardiac and cerebral support depending upon location and extent of transverse arch involvement. Various techniques have been employed for this purpose, including temporary tube bypass, temporary and permanent bypass grafts, cardiopulmonary bypass with separate perfusion of the brachiocephalic arteries, and more recently, cardiopulmonary bypass, profound hypothermia, and total circulatory arrest.[1–15]

The results of operation at this level, performed with these techniques of cardiac and cerebral support, have not been as good as results of operations performed for aneurysms located more distally. The difference is due to limitations and complications of the methods of support. The most frequent of these are cerebral damage and bleeding at the time of operation. Cerebral damage is due to inadequate protection, air or particulate emboli, and small vessel injury, and hemorrhage is due to the use of heparin and long periods of cardiopulmonary bypass. Most reports dealing with the management of arch aneurysms describe single cases or small series of

From the Departments of Surgery and Anesthesiology, Baylor College of Medicine and The Methodist Hospital, Houston, Texas.

Read at the Fifty-ninth Annual Meeting of The American Association for Thoracic Surgery, Boston, Mass. April 30 to May 2, 1979.

Address for reprints: E. Stanley Crawford, M.D., 1200 Moursund Ave., Houston, Texas 77030.

0022-5223/79/090383+11$01.10/0 © 1979 The C. V. Mosby Co.

Mortality Rate: 25%

1979

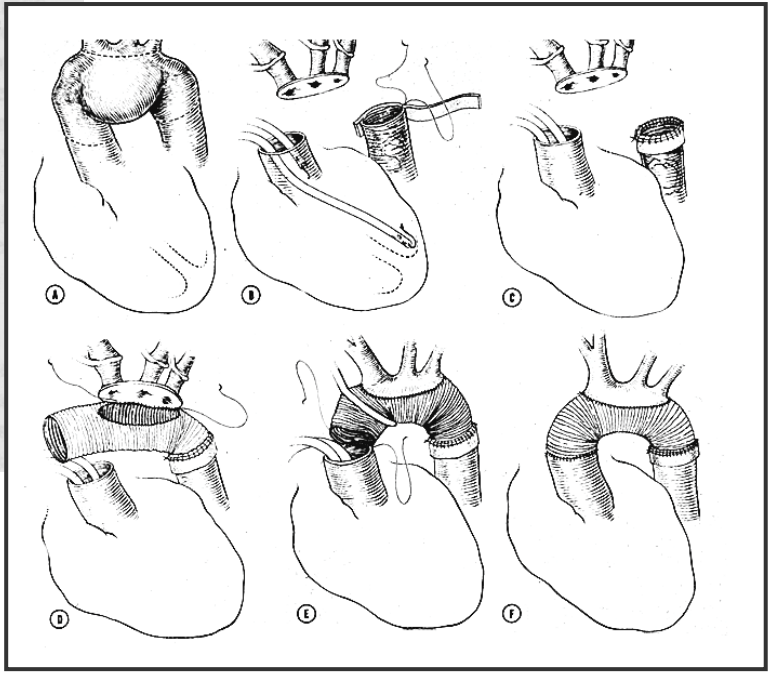
The Iceman, ca 4000 BC (Copper Age)

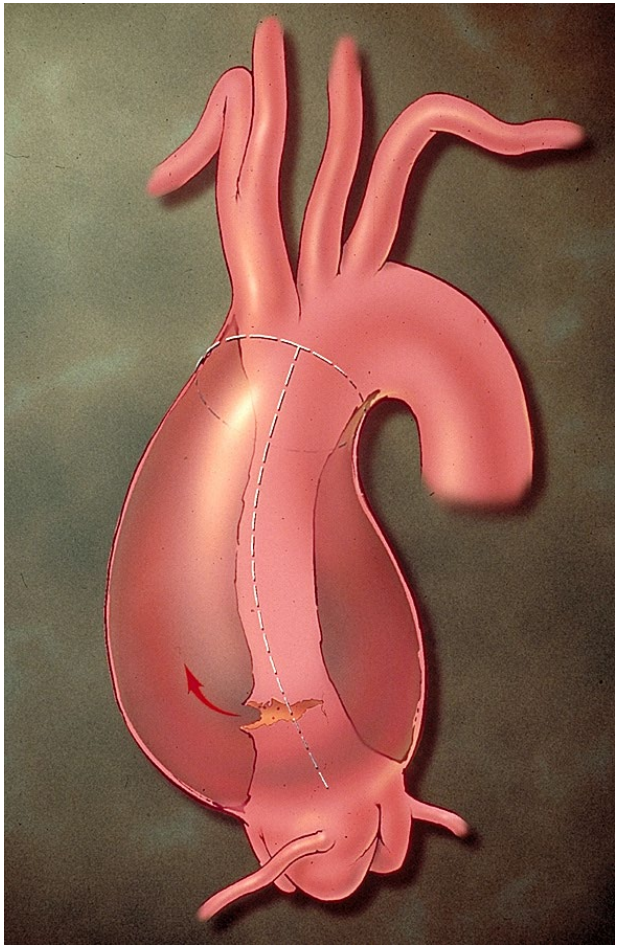
National Geographic

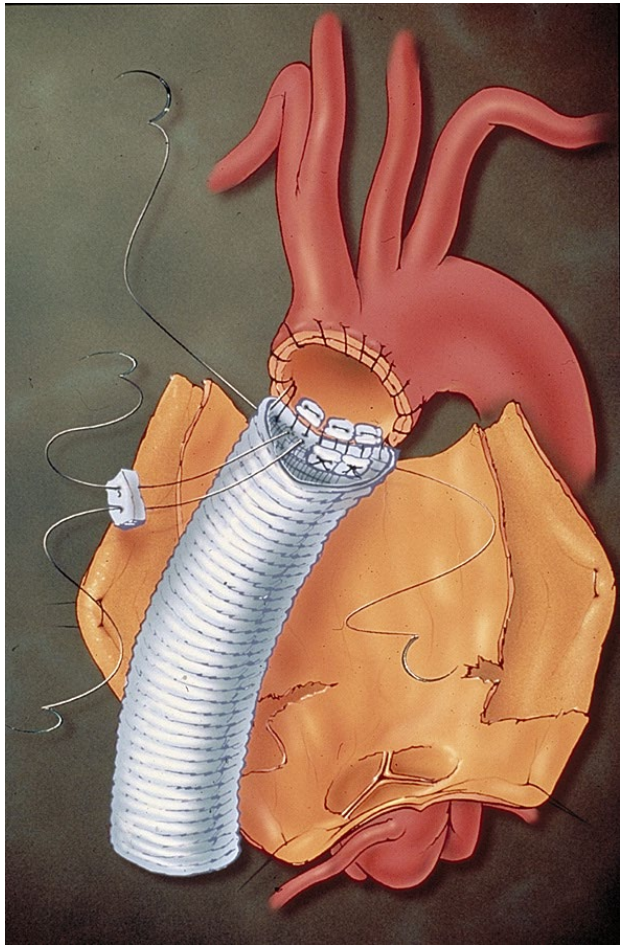
Prosthetic replacement of the aortic arch

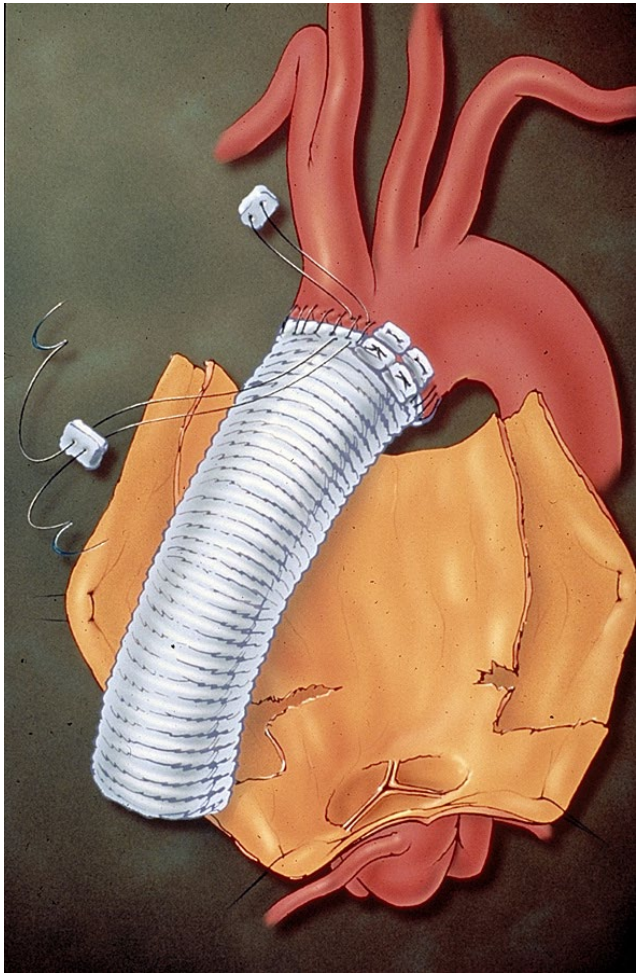
Four patients are reported in whom the aortic arch and variable portions of the ascending and descending aorta were replaced with a prosthesis. In three patients the preoperative diagnosis was dissecting aneurysm of the aortic arch and in one an arteriosclerotic aneurysm of the aortic arch was present. A combination of surface cooling and cardiopulmonary bypass was utilized to produce total body hypothermia. Arch replacement was carried out during a period of total circulatory arrest. Cardiopulmonary bypass was then utilized to warm the patient and resuscitate the heart. The average duration of cerebral ischemia was 43 minutes and the average duration of myocardial ischemia was 74 minutes. The average lowest esophageal temperature was 14° C., and the average lowest rectal temperature was 18° C. Three patients are alive and well 4 to 13 months following surgery. One patient died 4 days postoperatively of pulmonary insufficiency. This experience indicates that by utilizing total body hypothermia and circulatory arrest aortic arch replacement can be carried out with an acceptable mortality rate. Corrective surgery should be offered to patients with life-threatening enlarging aneurysms of the aortic arch.

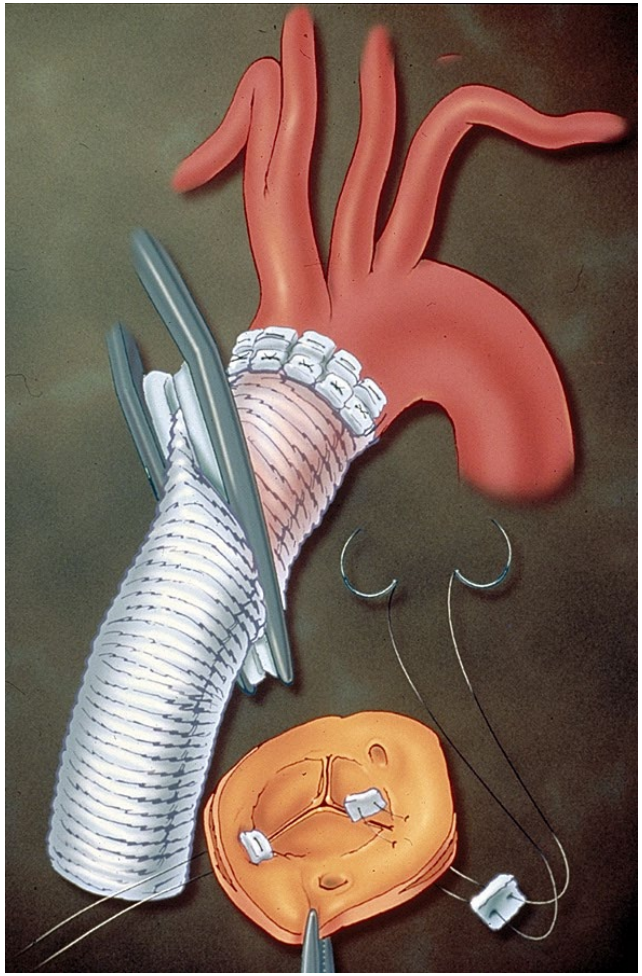
Randall B. Griepp, M.D., Edward B. Stinson, M.D., Jefferson F. Hollingsworth, M.D., and Donald Buehler, M.D., *Stanford, Calif.*

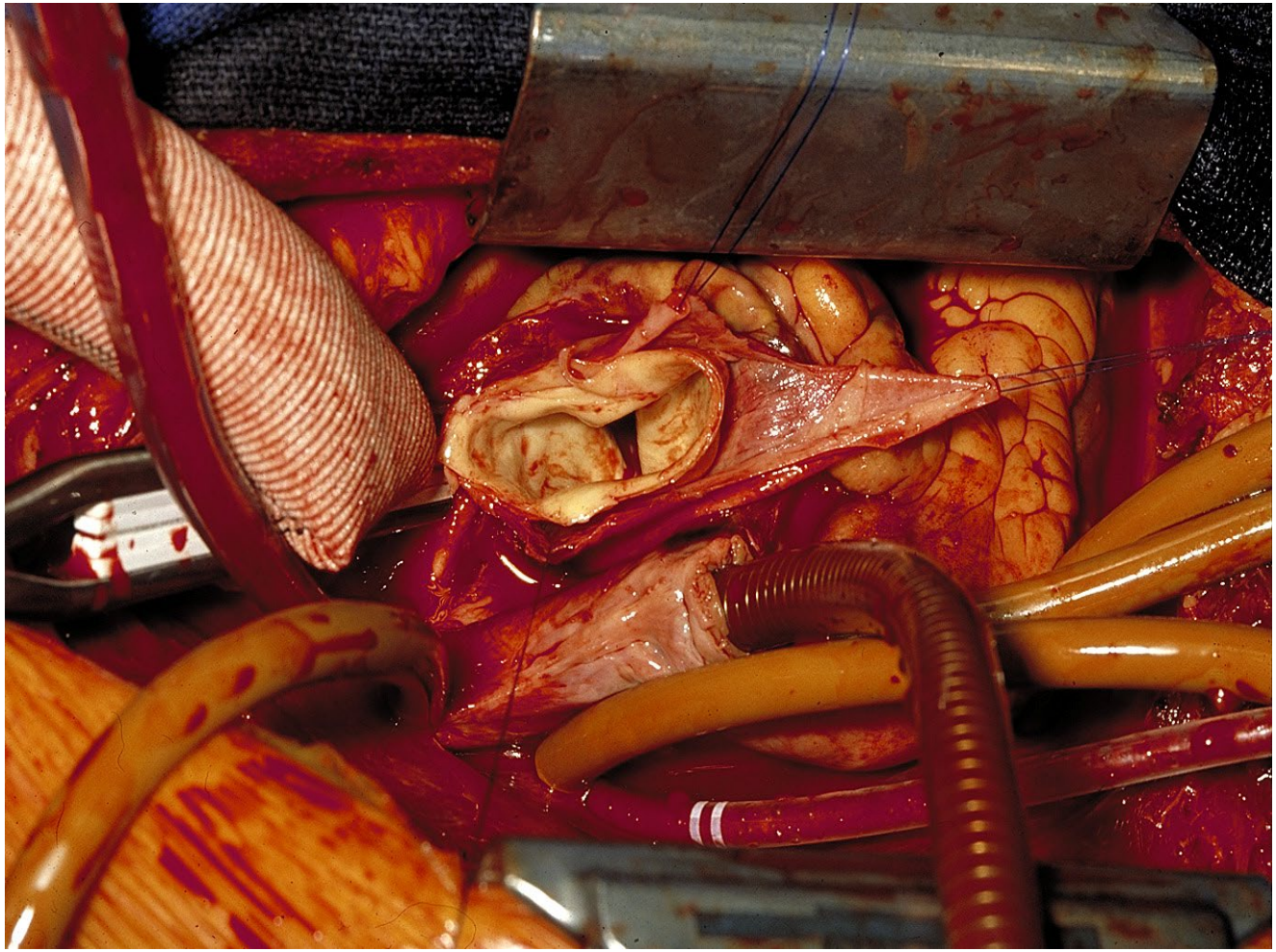


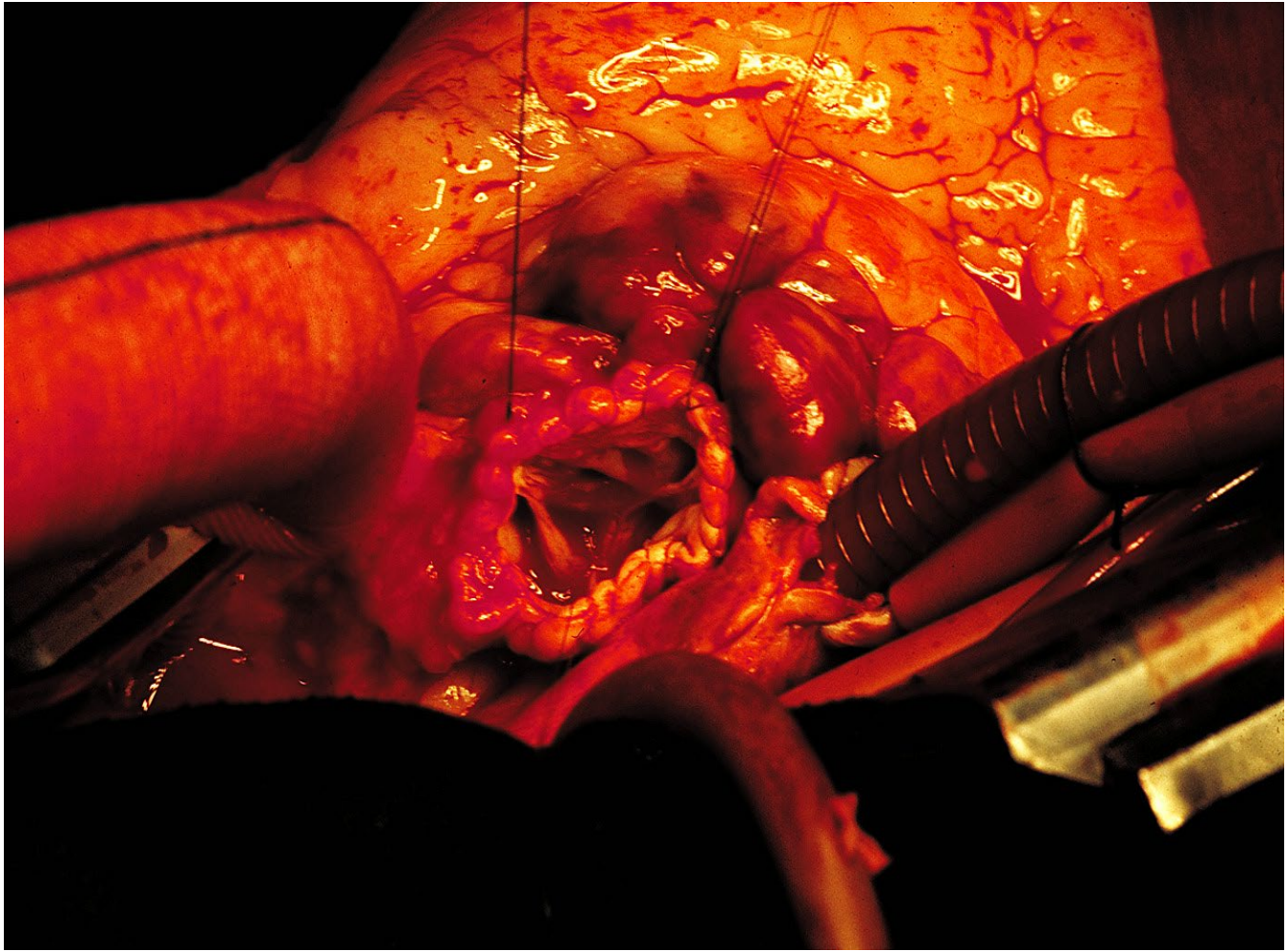


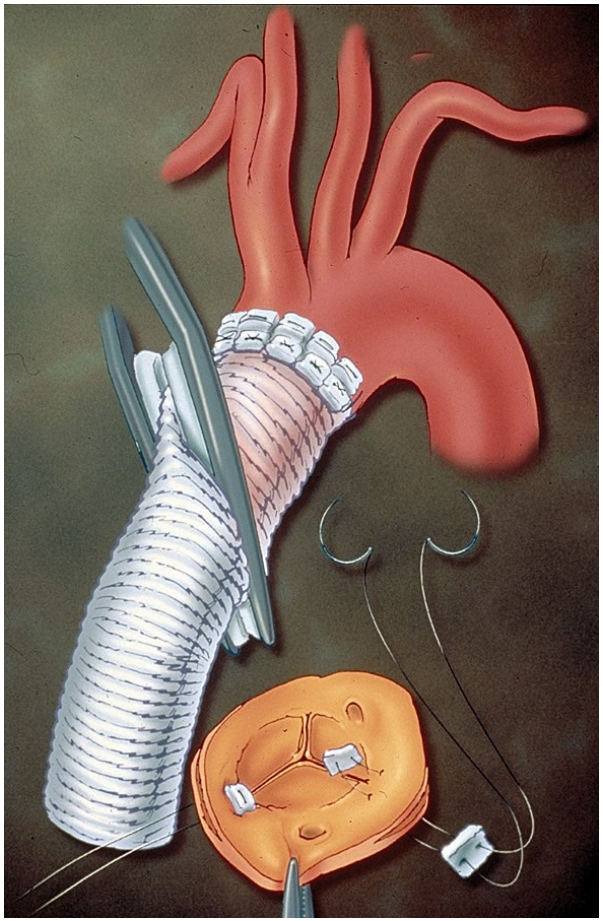


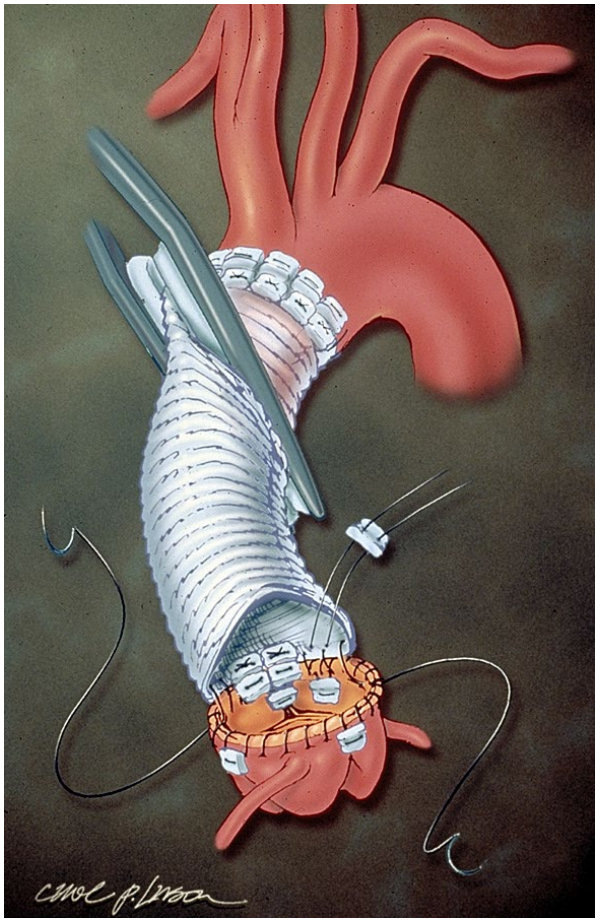


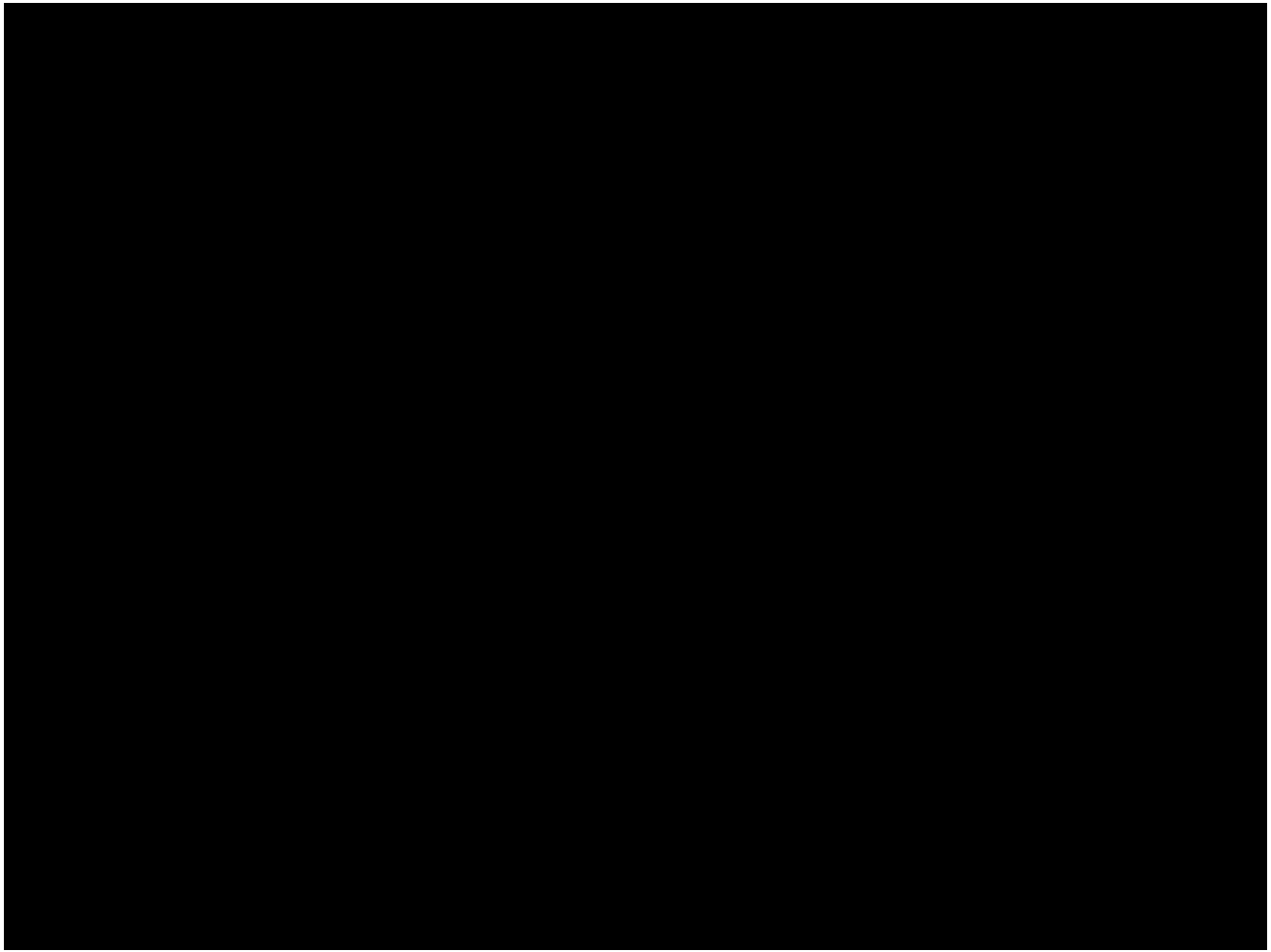


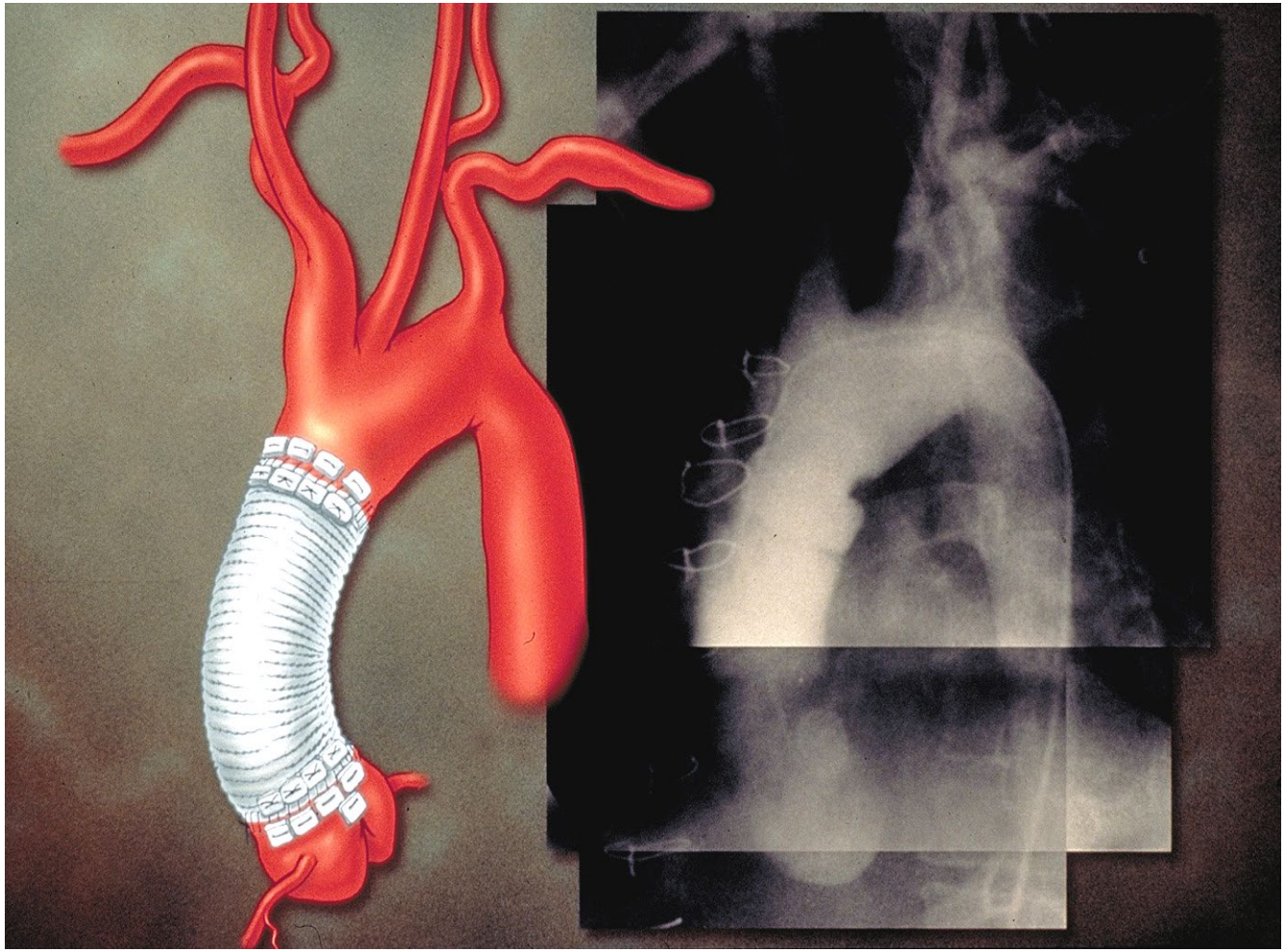


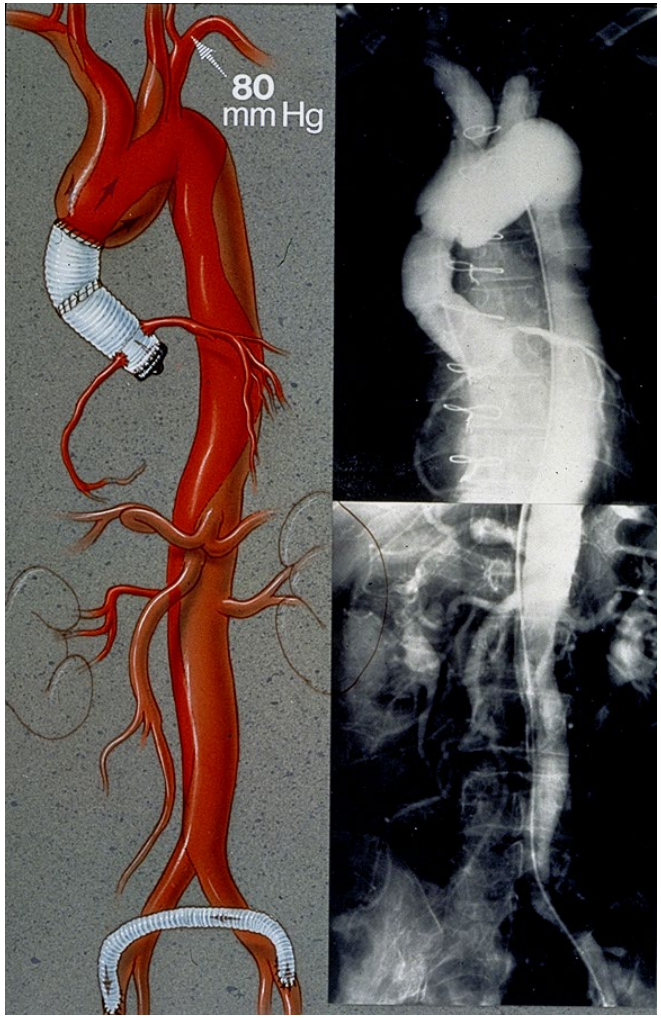


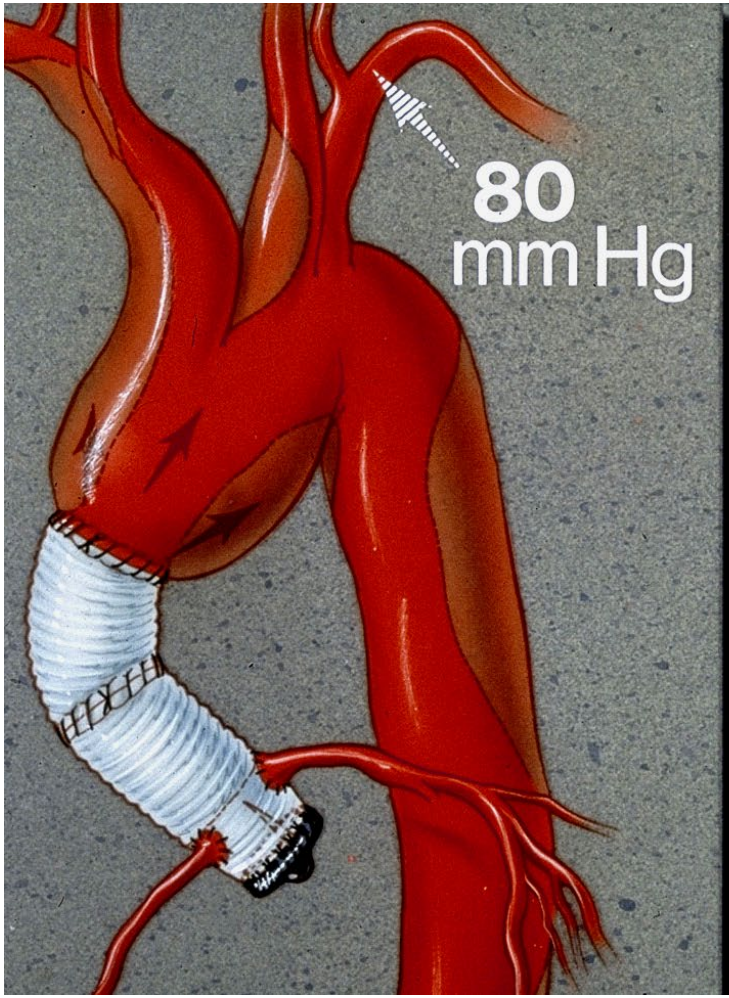


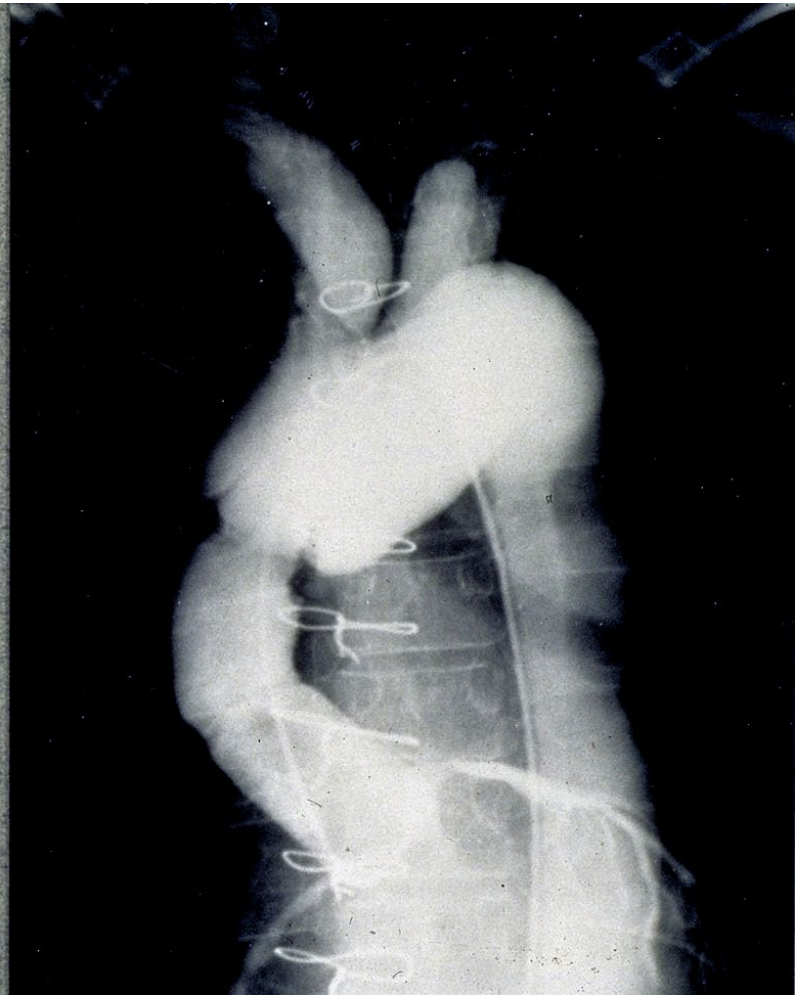


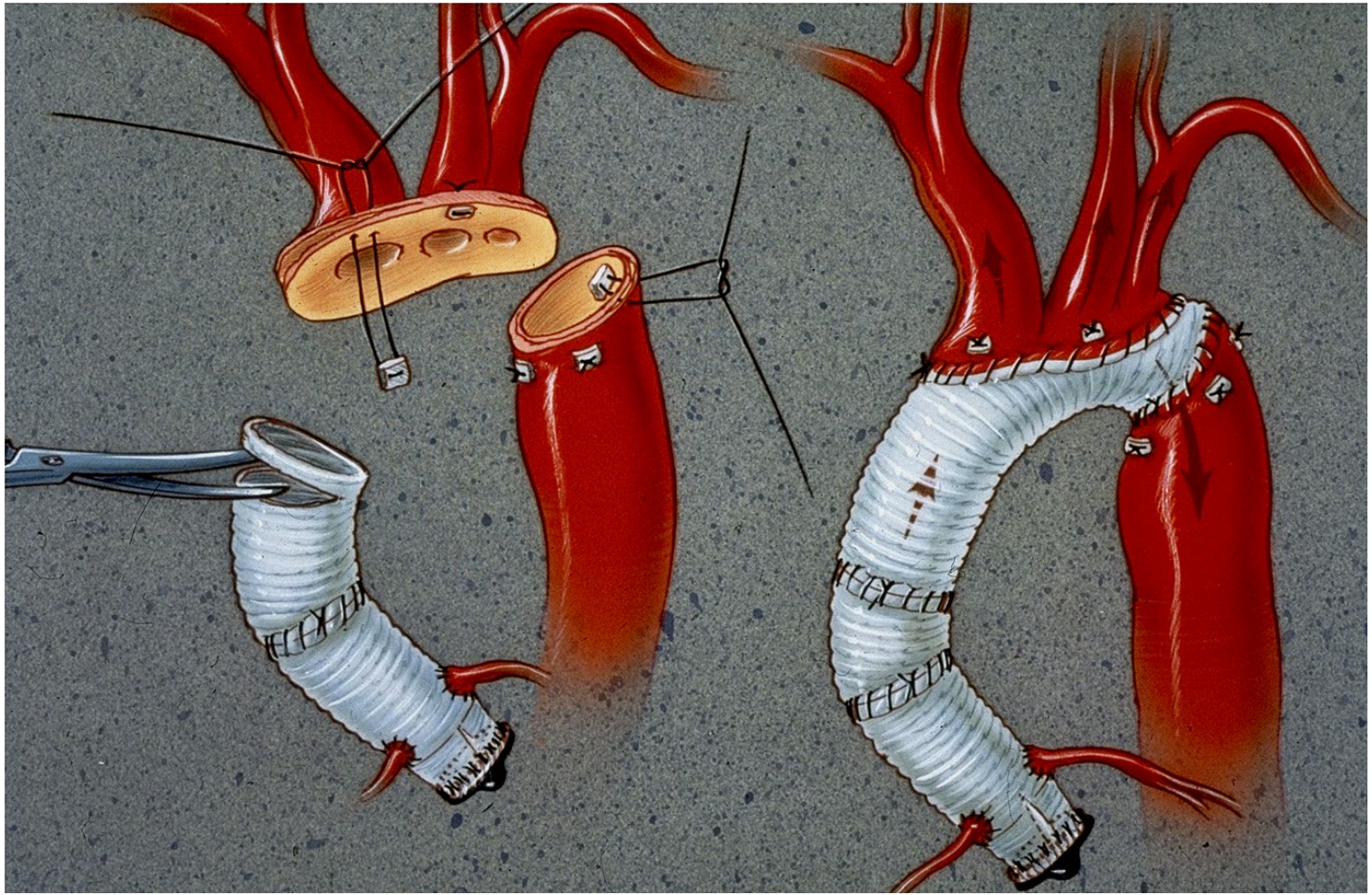





80
mm Hg


80
mm Hg





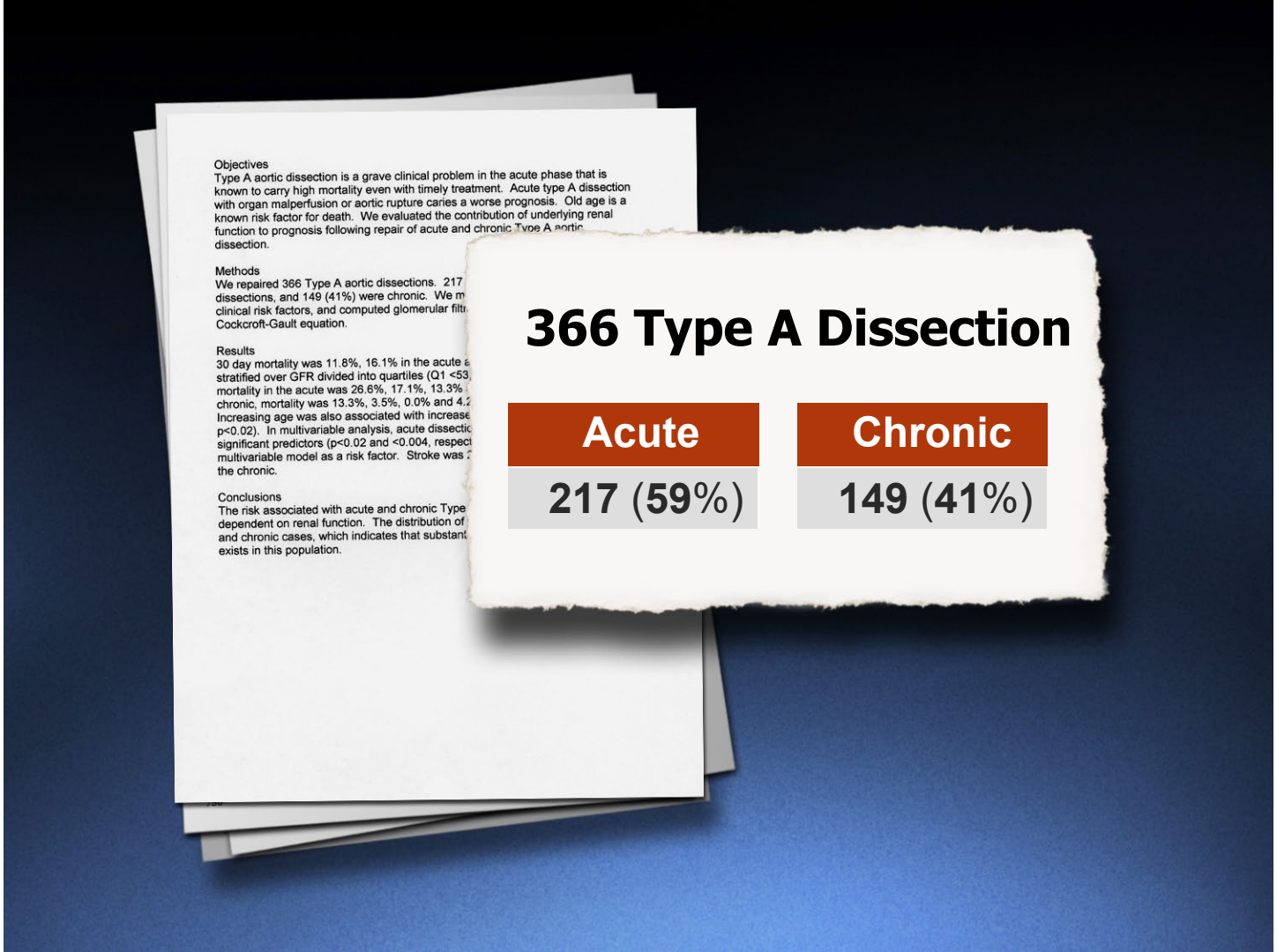
IRAD

Acute Type A Aortic Dissection

(n=289)

	Surgical	Medical
No.	208 (72%)	81 (28%)
In Hospital Mortality	54 (26%)	47 (58%)
Total In Hospital*	**101 (35%)**	

* Total mortality for both A and B dissections was 127 (27.4%)


Objectives
Type A aortic dissection is a grave clinical problem in the acute phase that is known to carry high mortality even with timely treatment. Acute type A dissection with organ malperfusion or aortic rupture caries a worse prognosis. Old age is a known risk factor for death. We evaluated the contribution of underlying renal function to prognosis following repair of acute and chronic Type A aortic dissection.
Methods
We repaired 366 Type A aortic dissections. 217
dissections, and 149 (41%) were chronic. We m
clinical risk factors, and computed glomerular filtr
Cockcroft-Gault equation.
Results
30 day mortality was 11.8%, 16.1% in the acute a
stratified over GFR divided into quartiles (Q1 <53,
mortality in the acute was 26.6%, 17.1%, 13.3%
chronic, mortality was 13.3%, 3.5%, 0.0% and 4.2
Increasing age was also associated with increase
p<0.02). In multivariable analysis, acute dissectio
significant predictors (p<0.02 and <0.004, respect
multivariable model as a risk factor. Stroke was 2
the chronic.
Conclusions
The risk associated with acute and chronic Type
dependent on renal function. The distribution of
and chronic cases, which indicates that substant
exists in this population.
366 Type A Dissection
Acute
217 (59%)
Chronic
149 (41%)

Adjuncts

Type A Dissection

RCP	205/235 (87%)

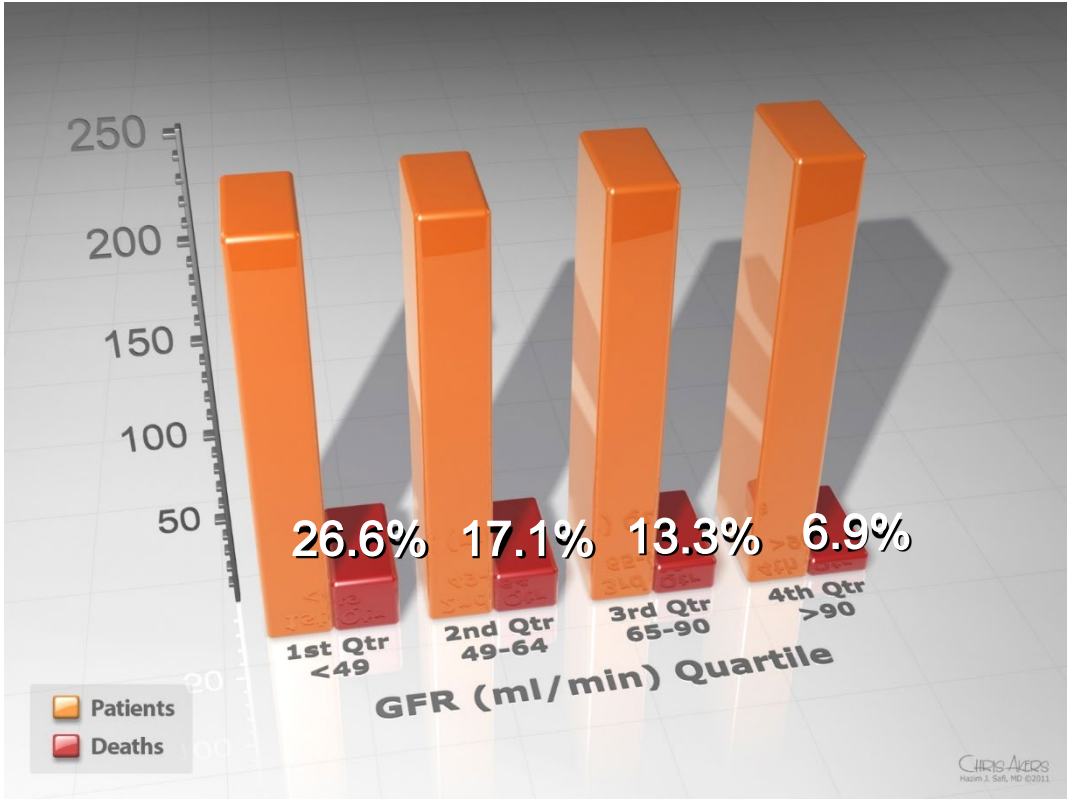
Aortic Type A Dissection

Mortality

Overall	(11.8%)
Acute	(16.1%)
Chronic	(5.2%)

30-Day Mortality

Acute Type A



Mortality *

Acute Dissection ($p<0.02$)

GFR ($p<0.004$)

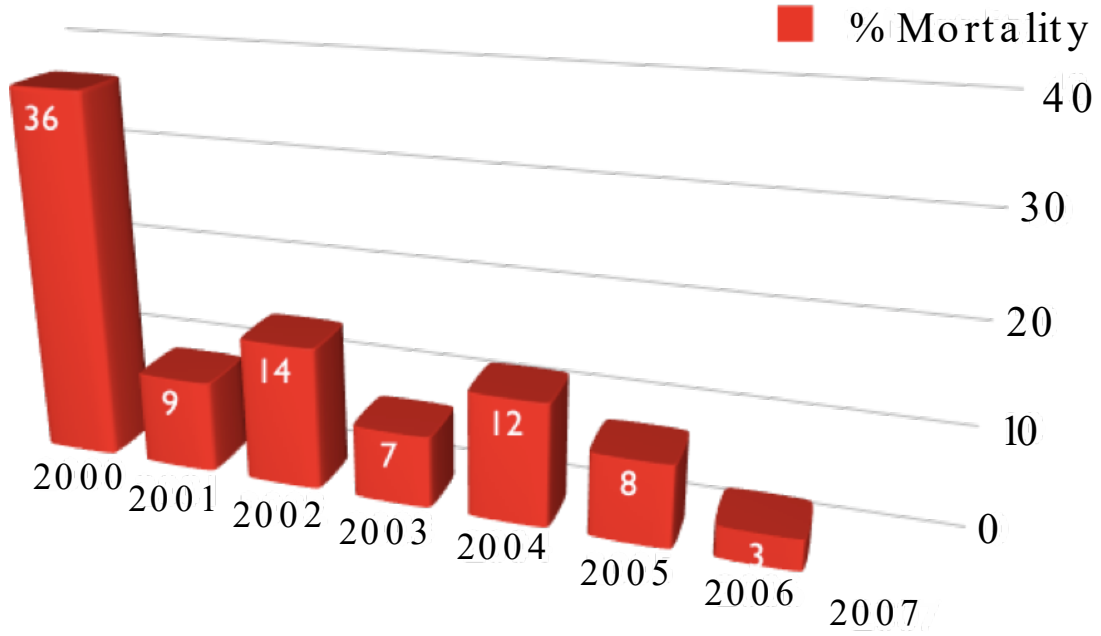
* Multivariable analysis

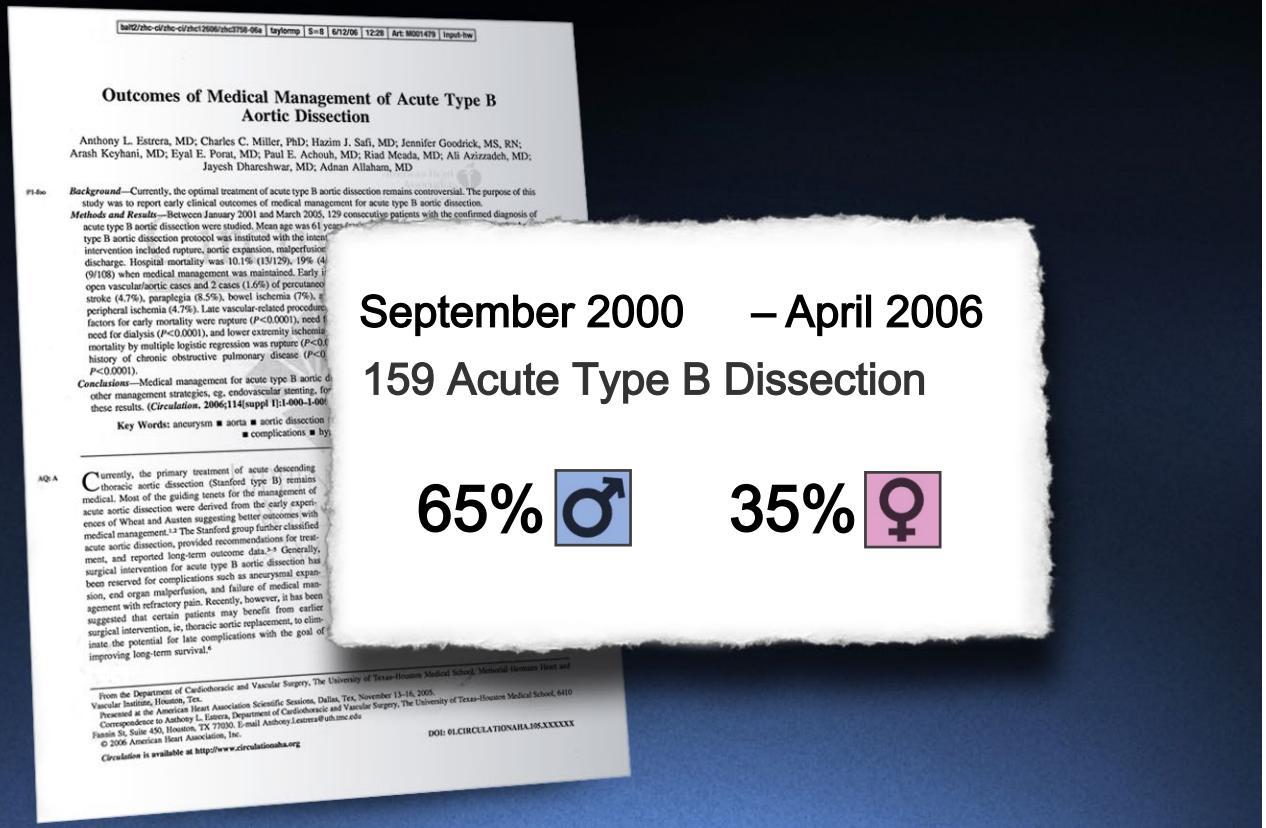
Stroke

Type A Dissection

Overall	(4.1%)
Acute	(1.8%)
Chronic	(2.3%)

MHH -Type A Repair

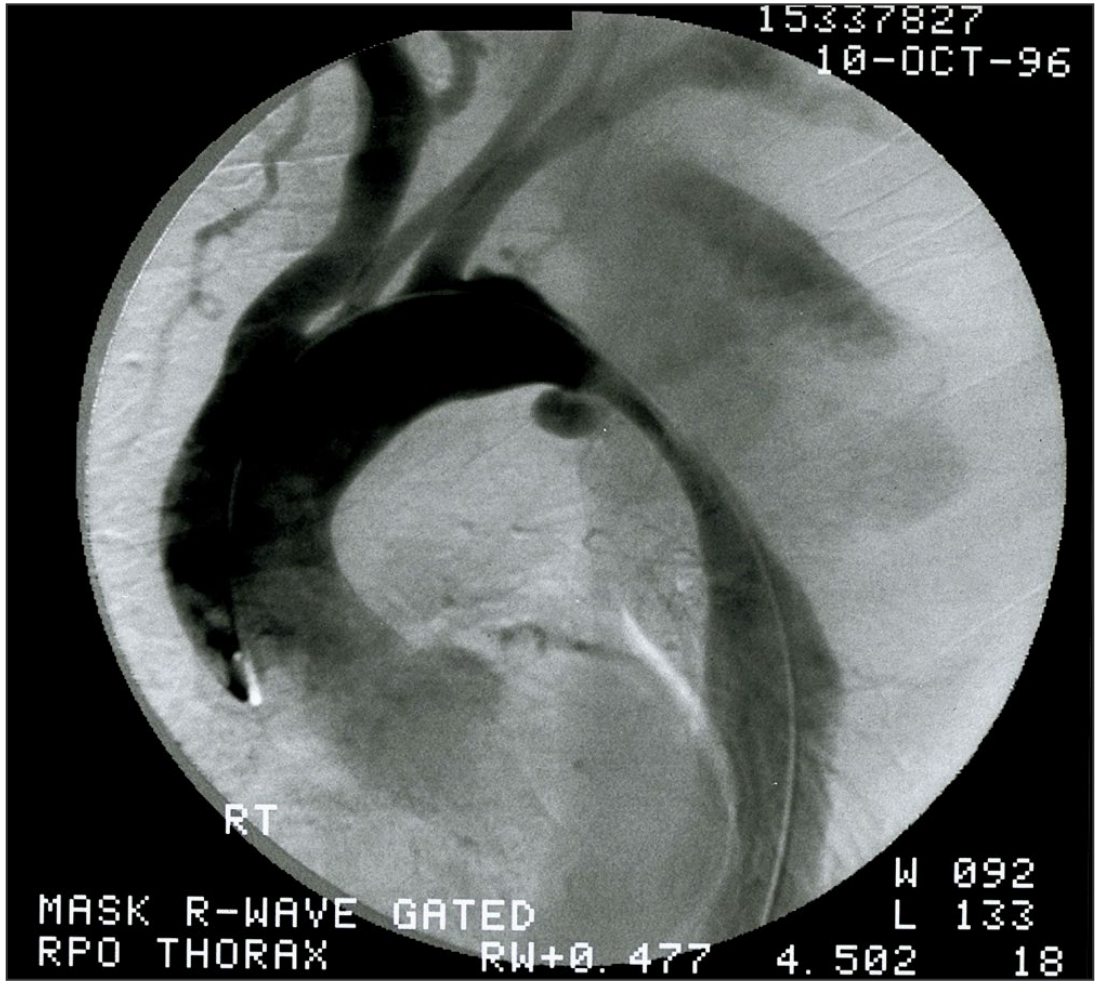


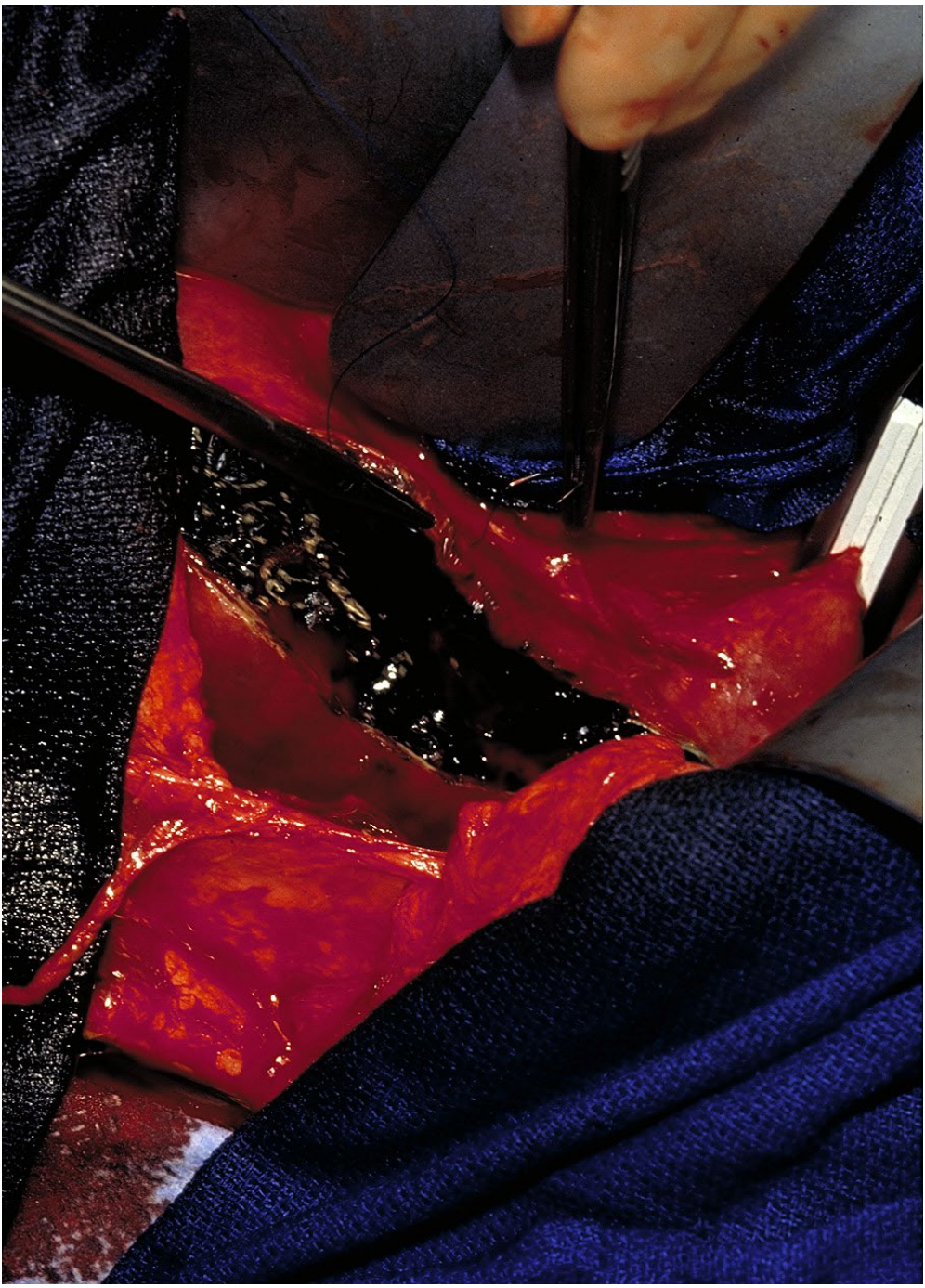

Outcomes of Medical Management of Acute Type B Aortic Dissection
Anthony L. Estrera, MD; Charles C. Miller, PhD; Hazim J. Safi, MD; Jennifer Goodrick, MS, RN; Arash Keyhani, MD; Eyal E. Porat, MD; Paul E. Achouh, MD; Riad Meada, MD; Ali Azizzadeh, MD; Jayesh Dhareshwar, MD; Adnan Allaham, MD
September 2000 – April 2006
159 Acute Type B Dissection
65%
35%

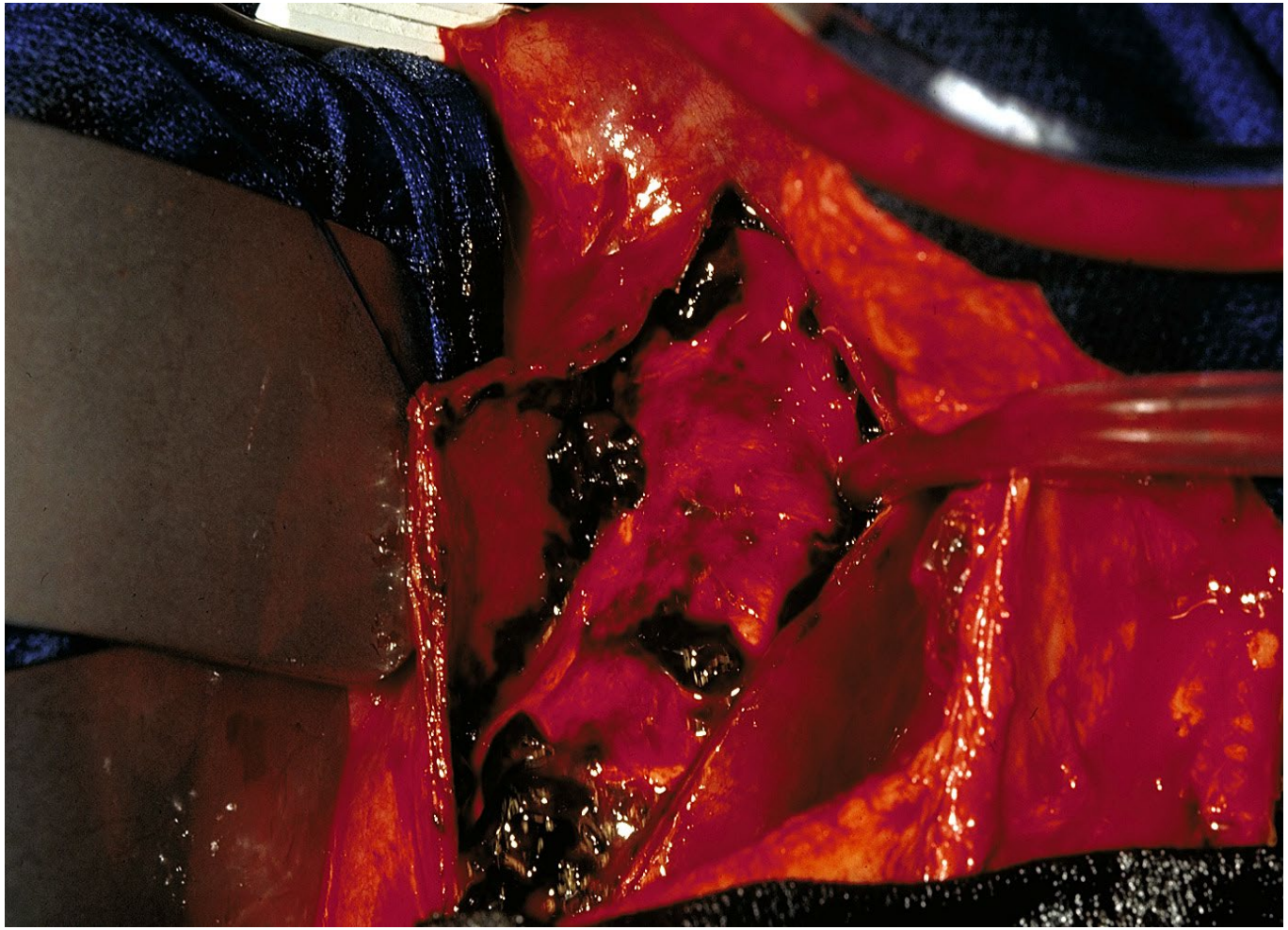
Diagnosis

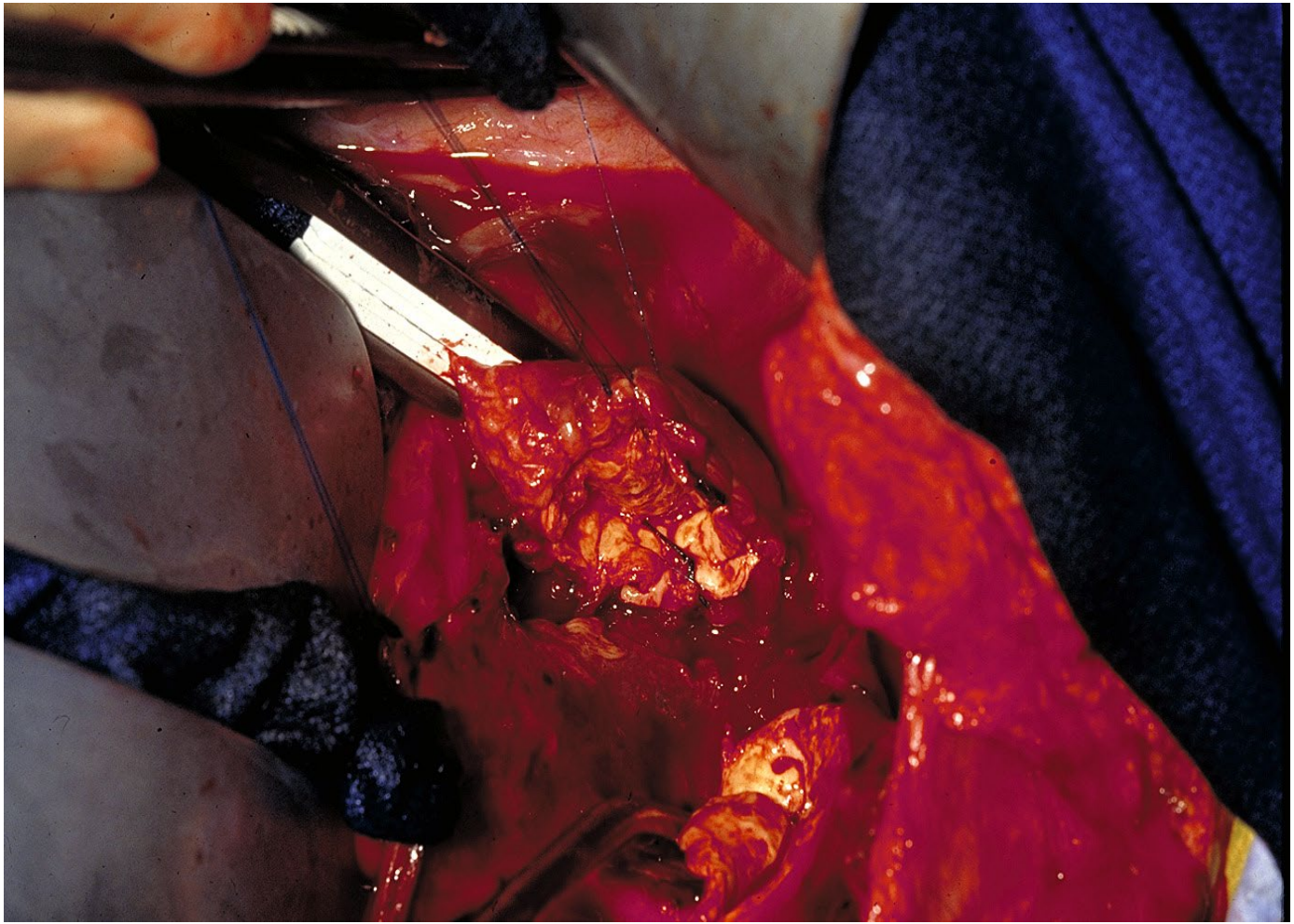
Type B Dissection:

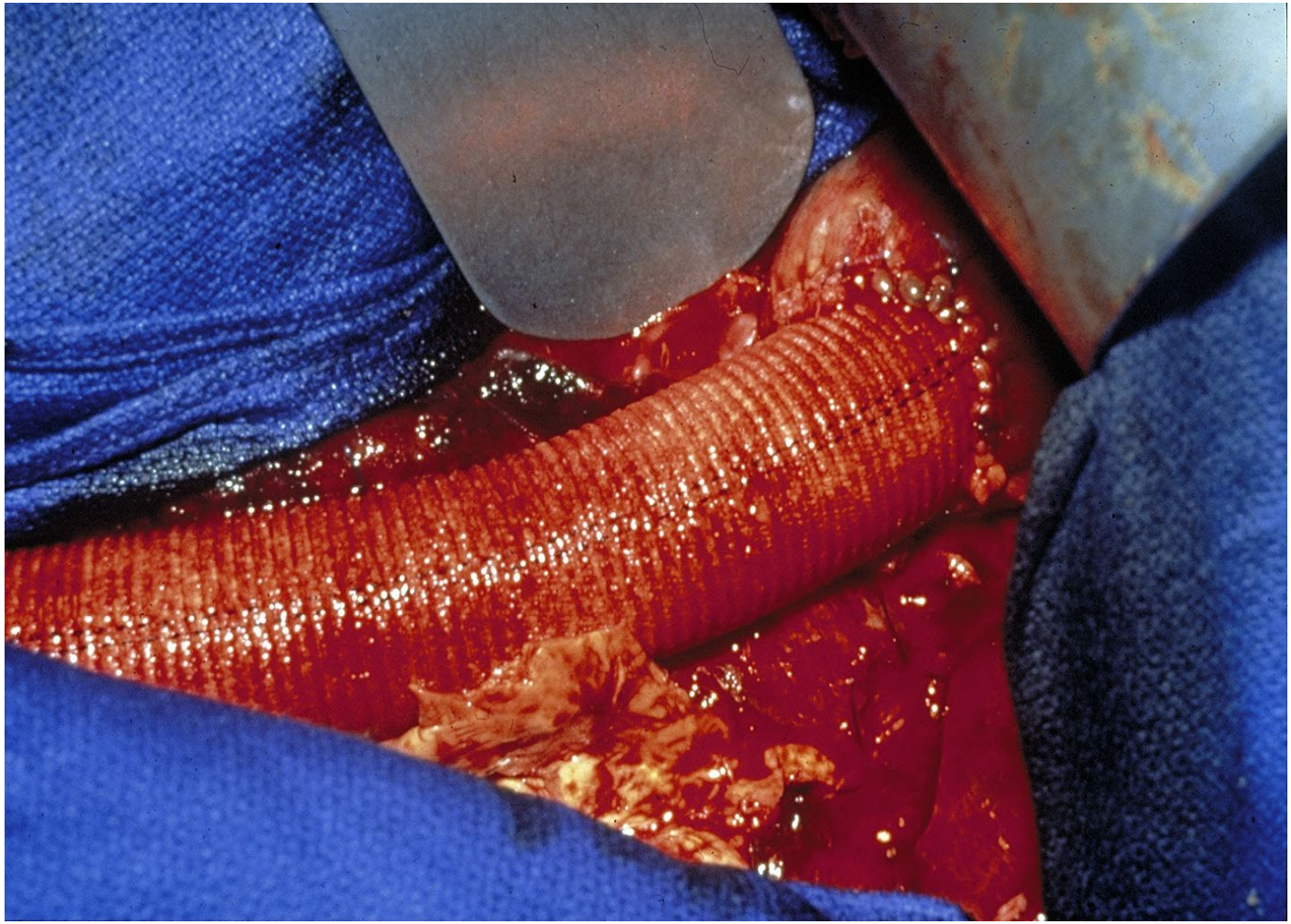
- CTA (98%)
- TEE (95%)
- MRI (5%)
- Angio (3%)


15337827
10-OCT-96
RT
W 092
L 133
MASK R-WAVE GATED
RPO THORAX
RW+0.477
4.502
18

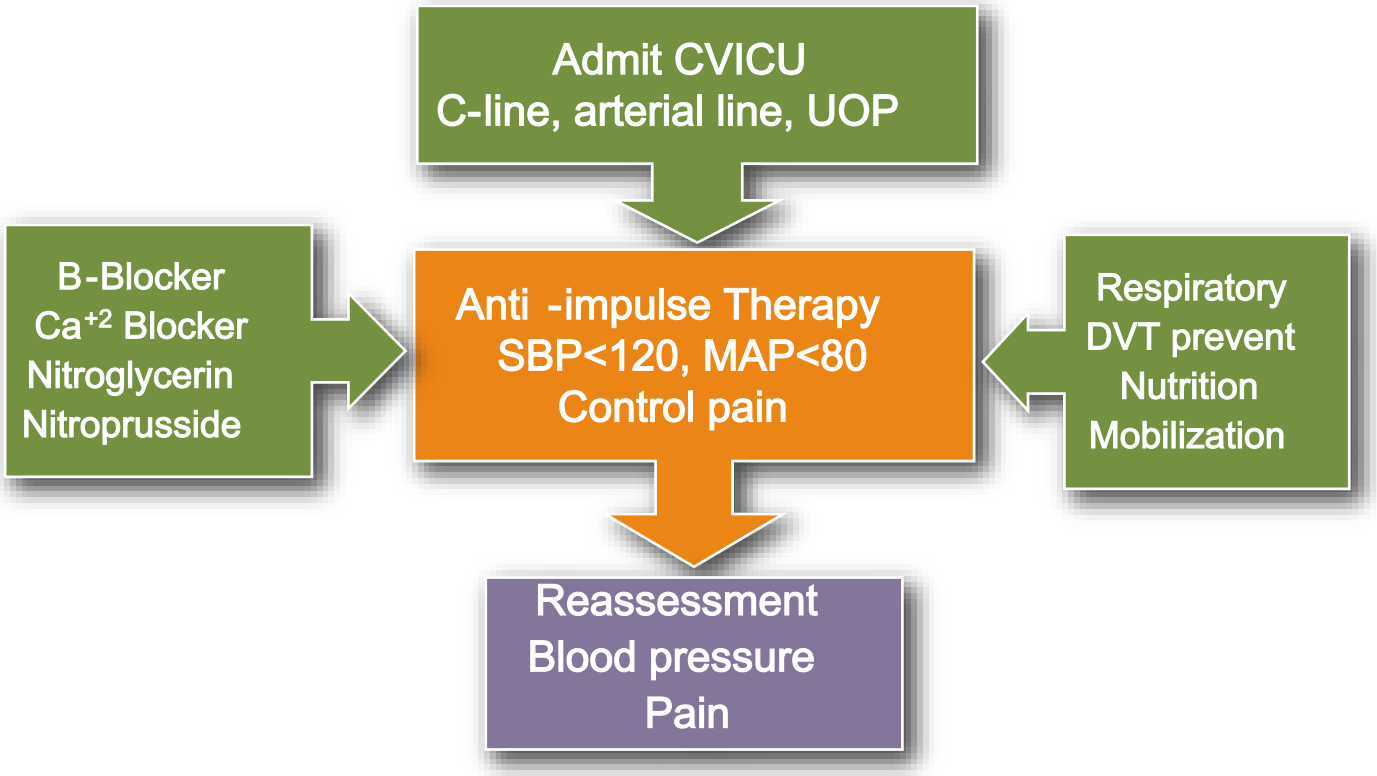




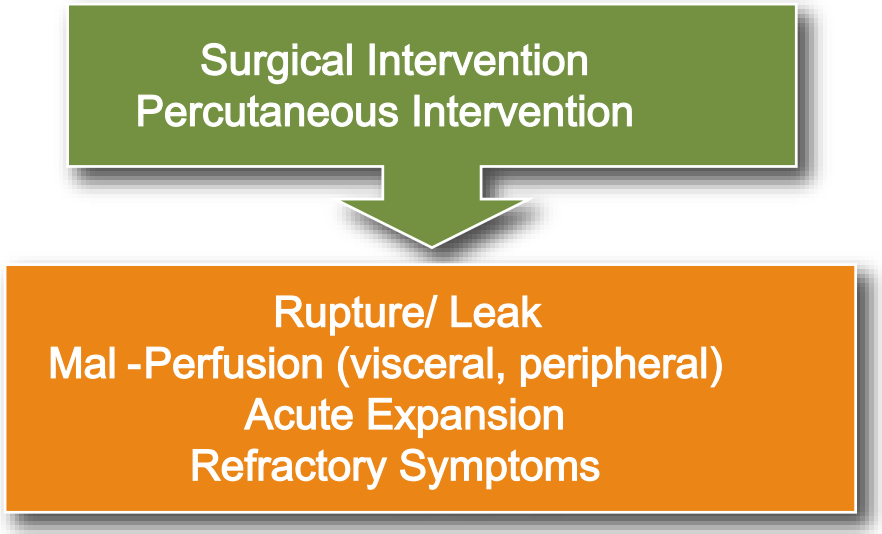




Protocol


Admit CVICU
C-line, arterial line, UOP
B-Blocker
Ca+2 Blocker
Nitroglycerin
Nitroprusside
Anti -impulse Therapy
SBP<120, MAP<80
Control pain
Respiratory
DVT prevent
Nutrition
Mobilization
Reassessment
Blood pressure
Pain

Protocol


Surgical Intervention
Percutaneous Intervention
Rupture/ Leak
Mal -Perfusion (visceral, peripheral)
Acute Expansion
Refractory Symptoms

Presentation

Variable	n	(n/159)
Chest pain	124	78%
Back pain	129	81%
Abdominal pain	54	34%
Neck pain	7	4%
Lower extremity pain	16	10%
Dyspnea	40	25%
Diaphoresis	19	12%
Encephalopathy	21	13%
Hypotension (<90)	10	6%
Hypertension (>140)	119	76%
Hypertension (>200)	32	20%

Rationale for Medical Tx

- Dissection
- SBP = 220 - 300
- Reserpine
  - 0.1 ppmillion

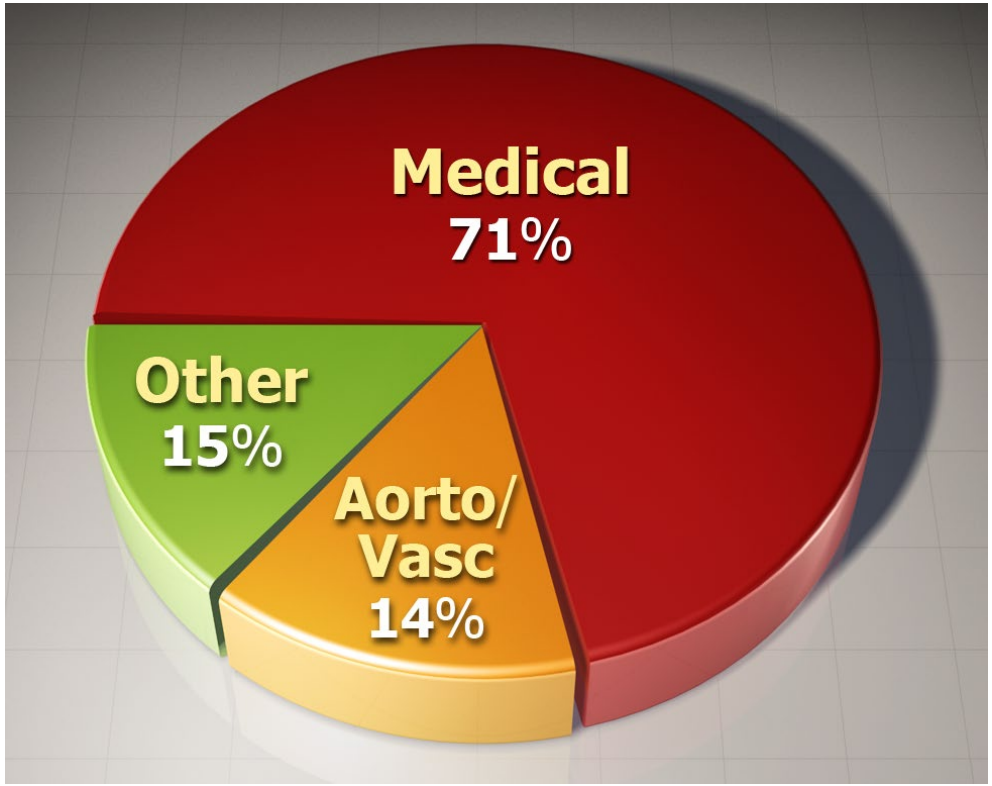
Ringer R. Influence of Reserpine, Early growth, blood pressure and dissecting aneurysms.
Summit on Poultry Production. New Brunswick, N.J. 1959

IV Medications

Medication	n (%)	Median (Range)
B-blocker	135 (85%)	4 days (1-32)
Calcium Channel Blocker	127 (80%)	4 days (1-26)
Nitroglycerin	44 (28%)	2 days (1-17)
Nitroprusside	19 (12%)	1 days (1-3)

Results

Interventions



Vascular Procedures

Procedures	n	(n/23)
Asc/Arch	3	13%
DTAA	12	52%
TAAA	2	9%
AAA	1	4%
Fem -fem	2	9%
Ax-fem	1	4%
Perc. Fenes	2	9%

Procedures (other)

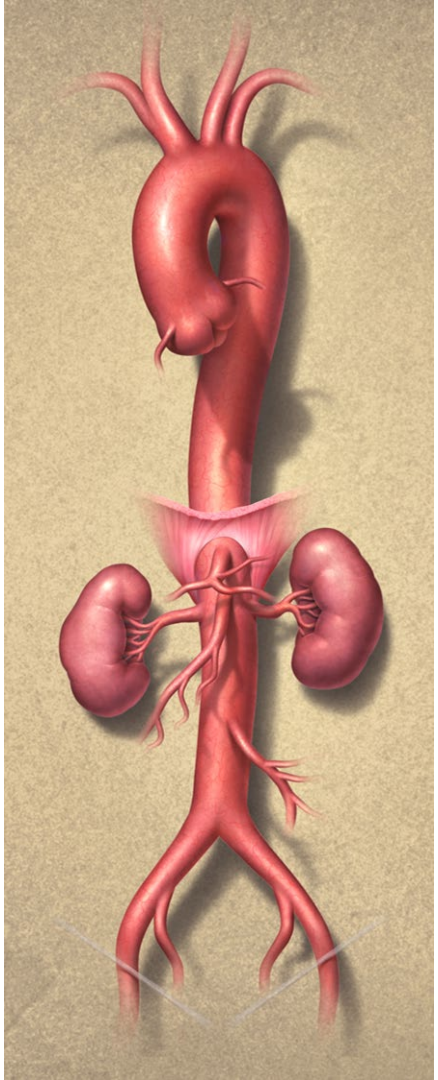
Procedures	n	(n/24)
Chest tube/ thoracot	8	33%
Laparotomy	4	17%
Pericardial	3	13%
PCI	3	13%
Tracheostomy	3	13%
Cholecystectomy	1	4%
Pacemaker	1	4%
Craniotomy	1	4%

Cerebral 11 (7%)
- Stroke 8 (5%)
- Intracranial
  - Hemorrhage 3 (2%)

Pulmonary
- Pneumonia 20 (13%)
- ARDS 20 (13%)
- PE 2 (1.3%)
- Effusions 37 (23%)
  - Right 5 (3%)
  - Bilateral 8 (5%)
  - Left 24 (15%)

Peripheral 7 (4.4%)
- Right (2)
- Left (2)
- Bilateral (3)

Procedure (3/7)
- Ax-Fem (1)
- Fem-Fem (2)



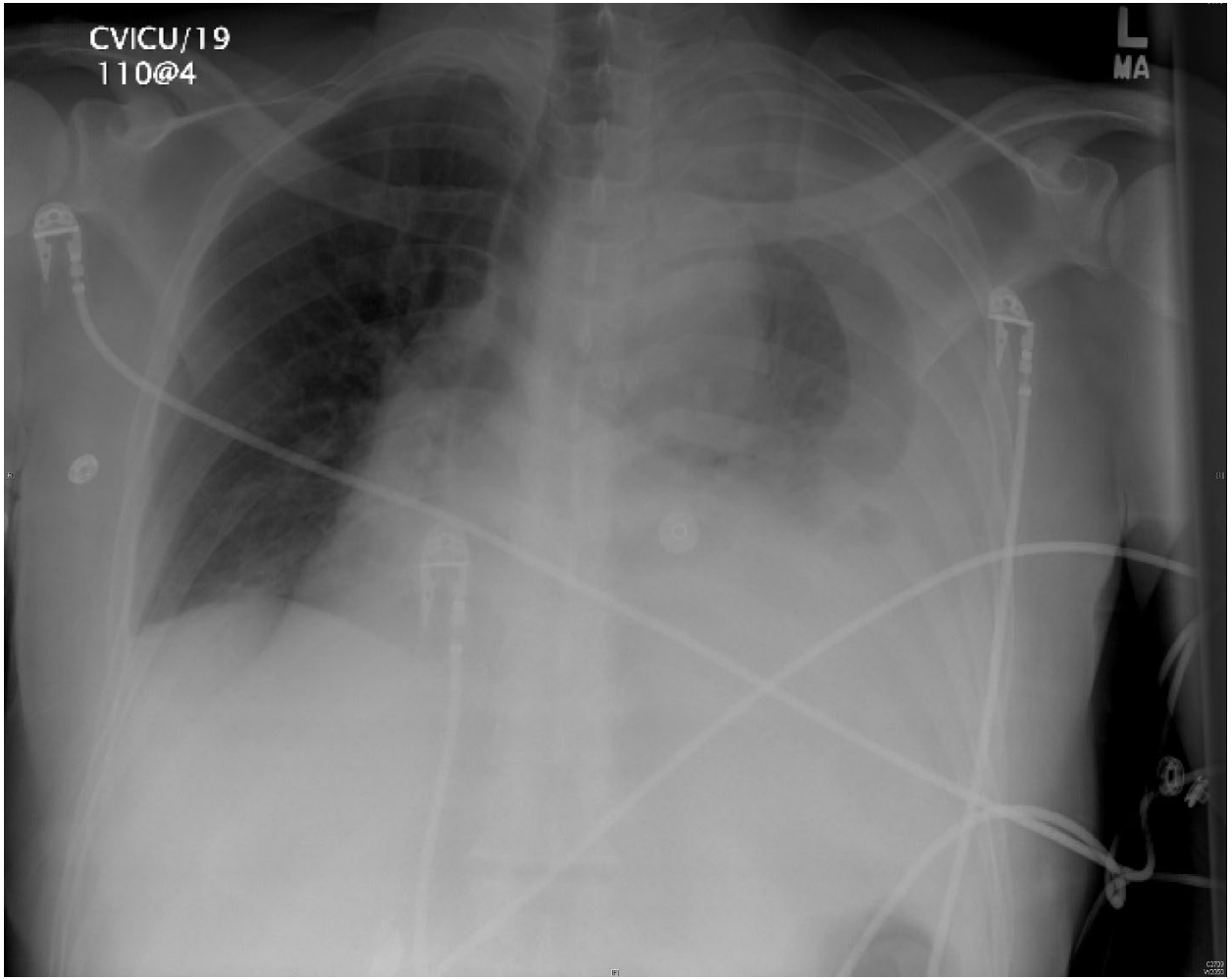
Cardiac
- MI 2 (1.3%)
- A-Fib 24 (15%)

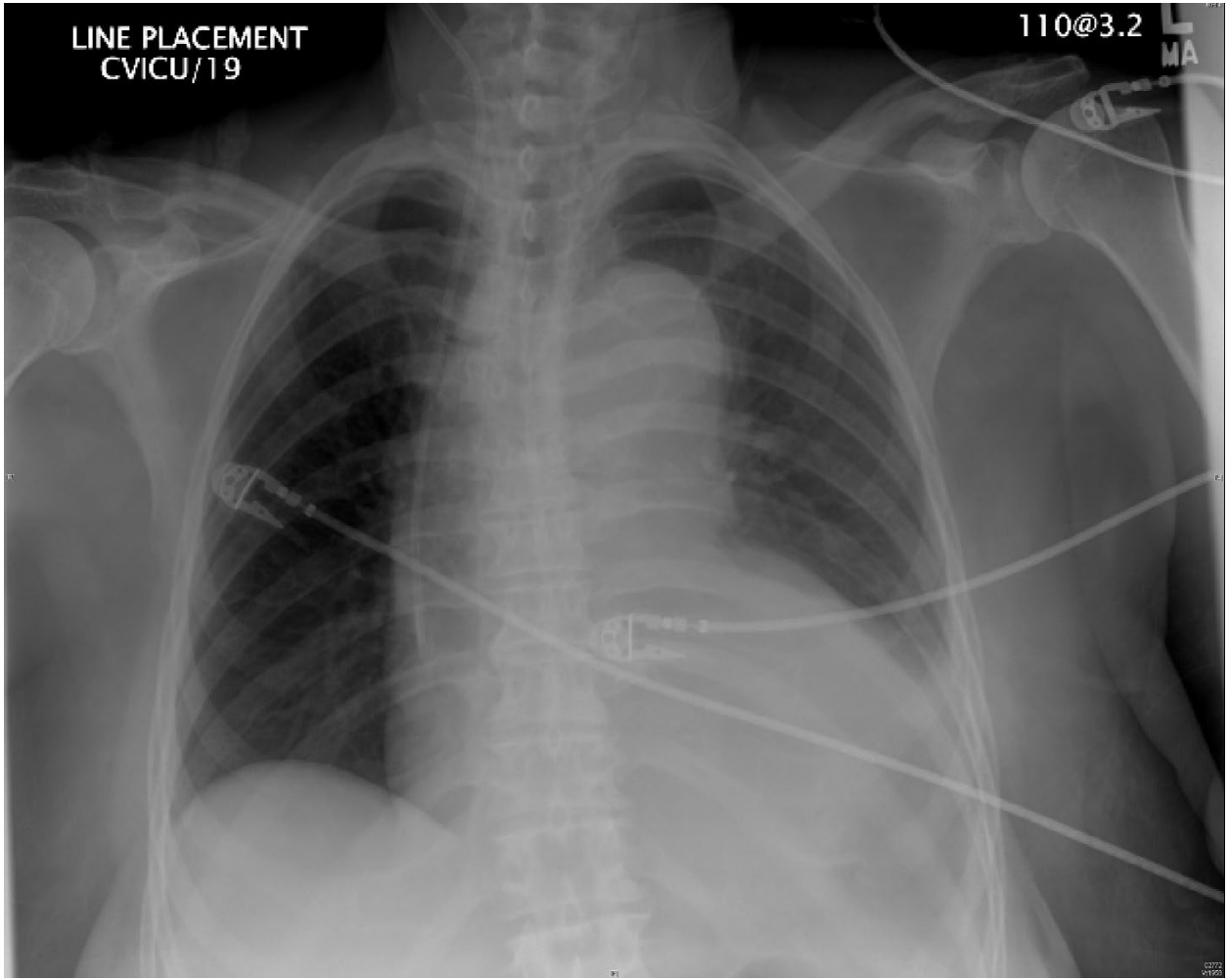
Spinal 13 (8%)
- Paraplegia/Paraparesis
  - Bilateral 11
  - Right 1
  - Left 1

8/13 (62%) resolved <24hrs

Visceral
- Nausea/Vomiting 44 (30%)
- Ileus 10 (6%)
- GI Bleeding 8 (5%)
- GI Ischemia 9 (6%)
- Hepatic Ischemia 5 (3%)

Renal
- ARF 32 (20%)
- Dialysis 21 (13%)


CVICU/19
110@4
L
MA


LINE PLACEMENT
CVICU/19
110@3.2
L
MA

Results

(N=159)

	Incidence		Mortality
Complicated	47%	→	18%
Uncomplicated	53%	→	1.2%

(OR = 17.9, p<0.0003)

Results

Univariate	Hospital Mortality
Rupture	($p<0.004$)
Laparotomy	($p<0.02$)
ARF	($p<0.0001$)
Dialysis	($p<0.0001$)
Leg ischemia	($p<0.0004$)

Results

Multivariate Mortality	Hospital
Rupture	($p<0.0009$)

Results

Multivariate Mortality	Mid -term
COPD	(p<0.002)
GFR (<57 ml/min)	(p<0.0001)

Results

Mortality	8.8%	
Complicated	**(47%)**	**18%**
Uncomplicated	**(53%)**	**1.2%**
Early Intervention	14%	
Mid-term Intervention	8%	

Conclusions

- Medical management for acute type B aortic dissection (uncomplicated) is associated acceptable outcomes.
- Outcomes of other management strategies for acute type B aortic dissection, e.g. endovascular stenting, need to compared to these results.

Thank You!