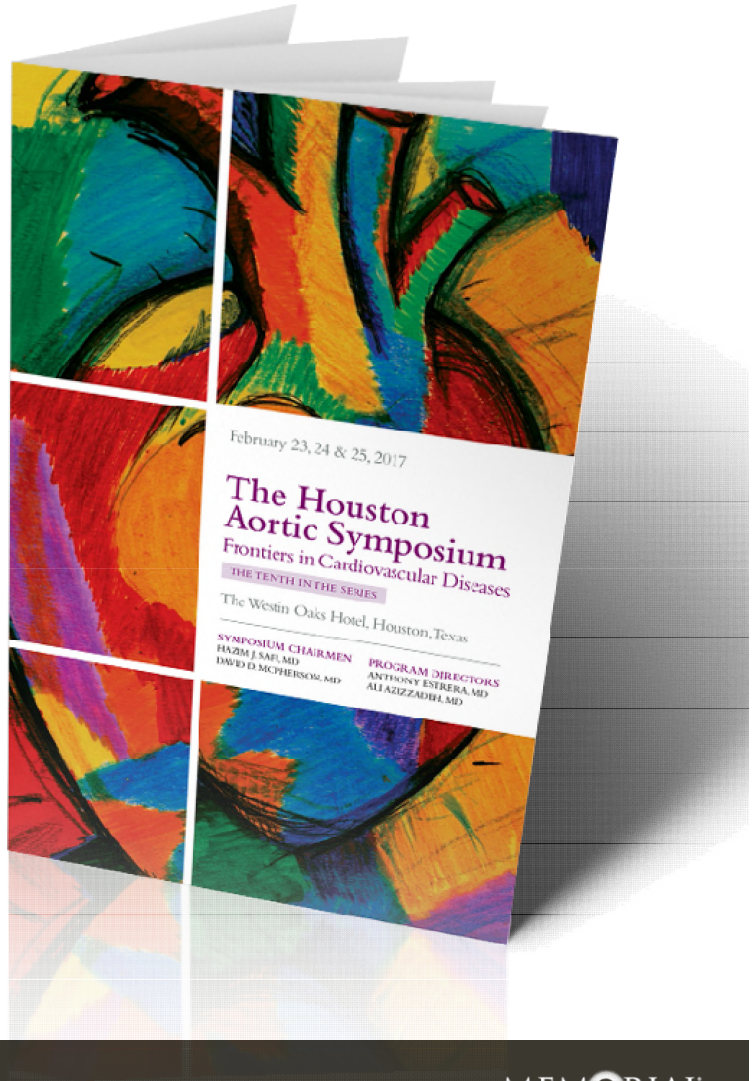
DEPARTMENT OF CARDIOTHORACIC & VASCULAR SURGERY

Department of Cardiothoracic & Vascular Surgery

McGovern Medical School / The University of Texas Health Science Center at Houston

A Quarter Century of Organ Protection in Open Thoracoabdominal Repair



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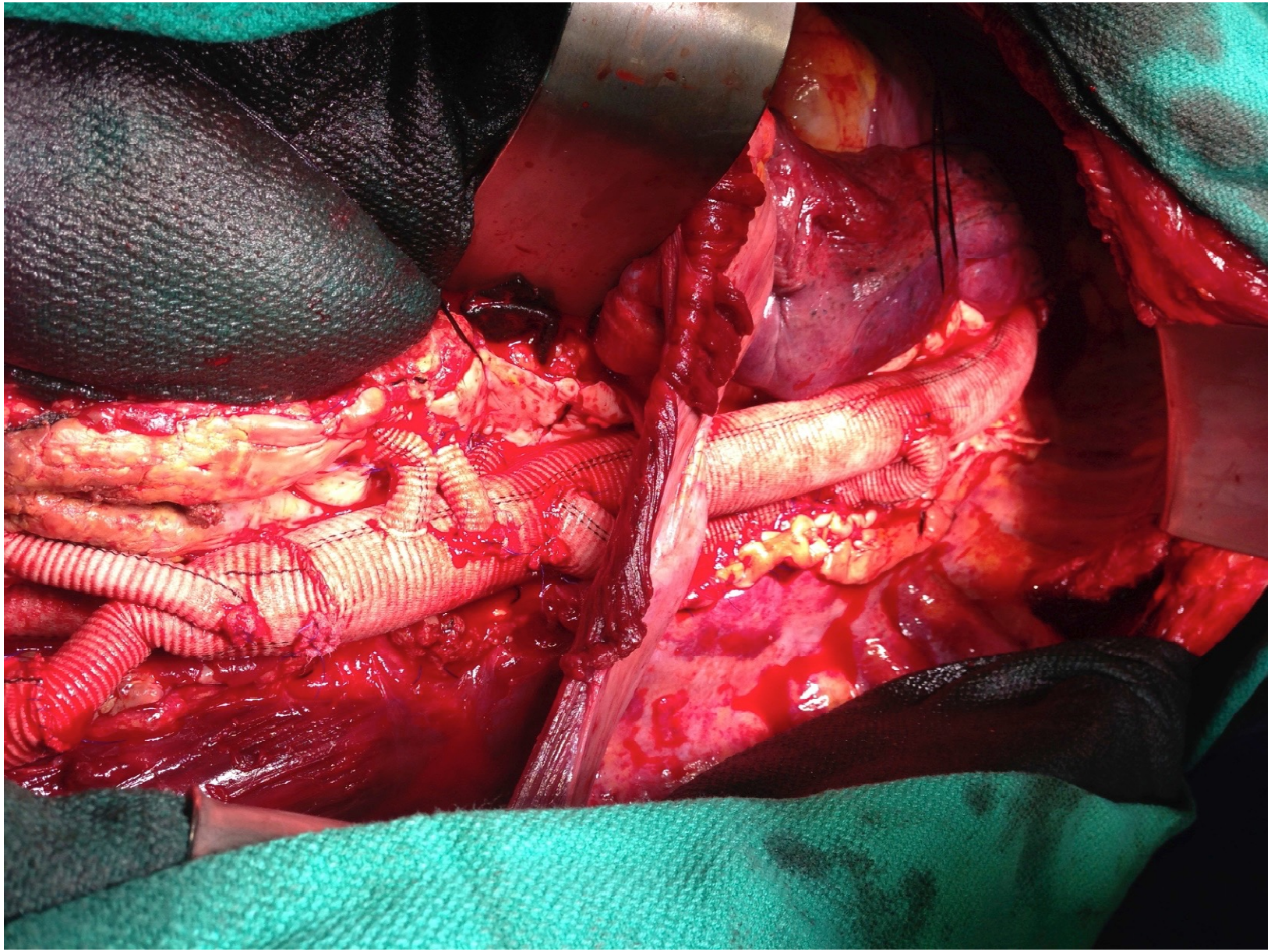

Experience with 1509 patients undergoing thoracoabdominal aortic operations

Lars G. Svensson, MD, PhD, E. Stanley Crawford, MD,† Kenneth R. Hess, MS, Joseph S. Coselli, MD, and Hazim J. Safi, MD, *Houston, Texas*

Purpose: The purpose of this study was to retrospectively identify variables associated with early death and postoperative complications in patients undergoing thoracoabdominal aortic operations.

Methods: The data on 1509 patients who underwent 1679 thoracoabdominal aortic repairs between 1960 and 1991 were retrospectively reviewed. The median age was 66 years (range 1.5 years to 86 years), and aortic dissection was present in 276 (18%) patients. The extent of the first repair performed included 378 (25%) type I (proximal descending to upper abdominal aorta), 442 (29%) type II (proximal descending and abdominal aorta), and 346 (23%) type III (distal descending and abdominal aorta). The median total aortic clamp time was 43 minutes. IV (most of the abdominal aorta). The 30-day survival rate was 92% (1386/1509) for the 30-year period. On multivariate analysis the preoperative and operative variables associated with death included ($p < 0.05$) increasing age, preoperative creatinine level, concurrent proximal aortic aneurysms, coronary artery disease, chronic lung disease, and total aortic clamp time. When the postoperative variables were also included in the stepwise logistic regression model, then in addition, cardiac complications, stroke, kidney failure, and gastrointestinal hemorrhage became significant ($p < 0.05$). The overall incidence of paraplegia or paraparesis was 16% (234/1509). By use of stepwise logistic regression analysis, the significant predictors ($p < 0.05$) of paraplegia or paraparesis developing were total aortic clamp time, extent of aorta repaired, aortic rupture, patient age, proximal aortic aneurysm, and history of renal dysfunction. Kidney failure (postoperative creatinine level > 3 mg/dl or dialysis) occurred in 18% (269/1509) of patients; dialysis was required in 9% (136/1509). Gastrointestinal complications manifested in 7% (101/1509) of patients.

Conclusions: Although the survival rate has improved, paraplegia/paraparesis and kidney failure continue to be vexing problems that require further research. (J Vasc Surg 1993;17:357-70.)

After the initial reports in 1955 by Etheredge et al.[1] and in 1956 by DeBakey et al.[2] of the successful repair of thoracoabdominal aortic aneurysms, Crawford,[3] in 1965, commenced using the inclusion technique for repair of thoracoabdominal aortic aneurysms.[4-6] Results of thoracoabdominal aortic operations have improved considerably over the ensuing years to the extent that in recent prospective studies, we have reported a 97% 30-day survival rate in 210 consecutive patients who underwent operation over a 13-month period.[7,8] Similarly the results of thoracoabdominal aneurysm operations combined with repairs of occlusive disease of the visceral arteries have been good.[9] Nevertheless the postoperative complications of lower extremity neuromuscular deficits,[4,10] kidney failure,[11] and lung failure[4] have continued to be significant problems.

In this study we retrospectively reviewed 1509 patients who underwent operation by the senior author (E.S.C.) to establish a baseline of results and thus identify the predictors of early death, lower extremity deficits, and kidney failure.

PATIENTS AND METHODS

Between June 20, 1960, and January 31, 1991, the senior author operated on 1509 patients with

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†Deceased.

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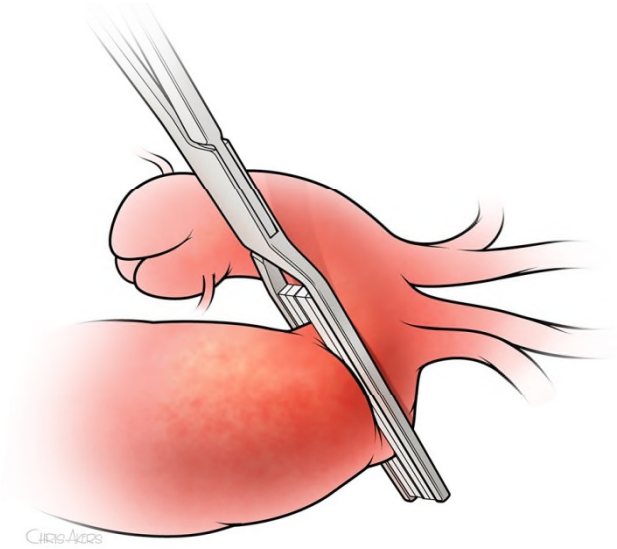
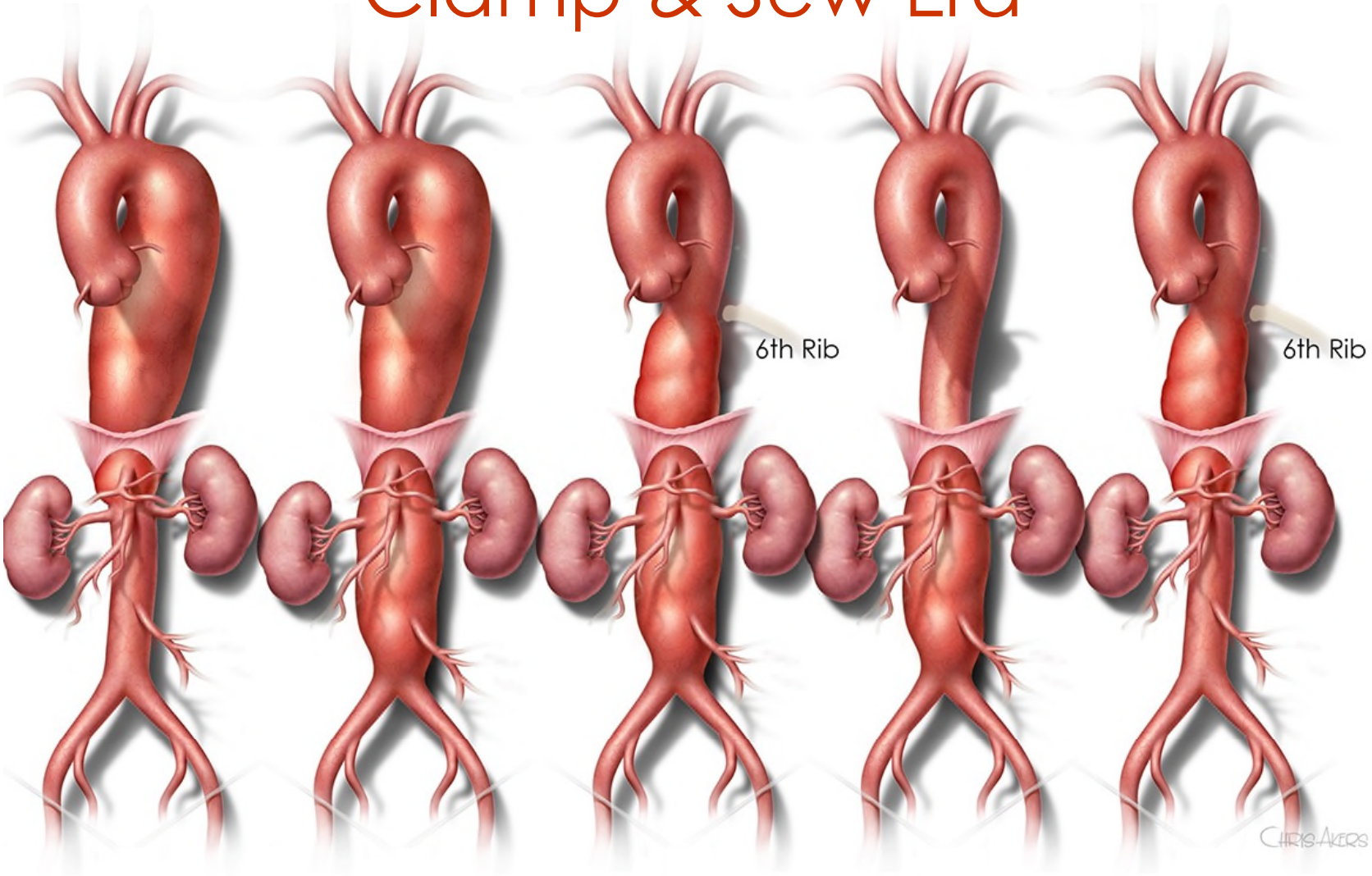
1993



SCI - Clamp and Go

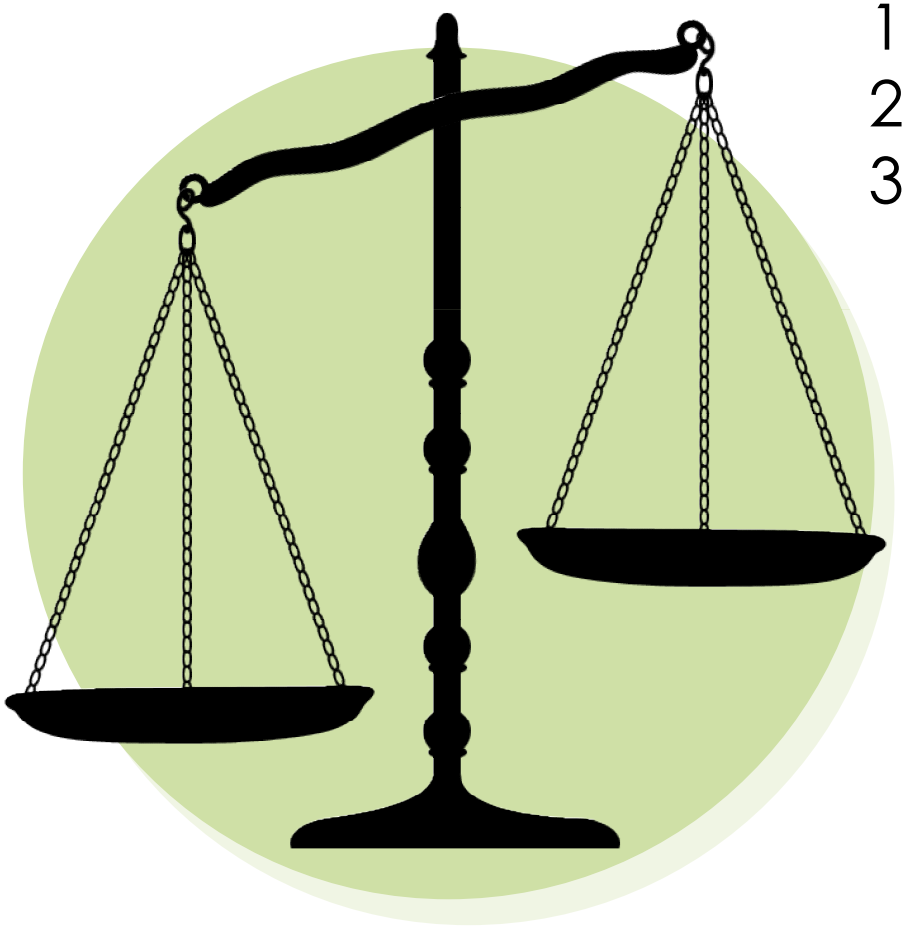
Extent	<0.0001
Aortic Clamp Time	<0.0001
Rupture	0.0073
Age	0.025
Proximal Aneurysm	0.034
Renal Dysfunction	0.040

Clamp & Sew Era

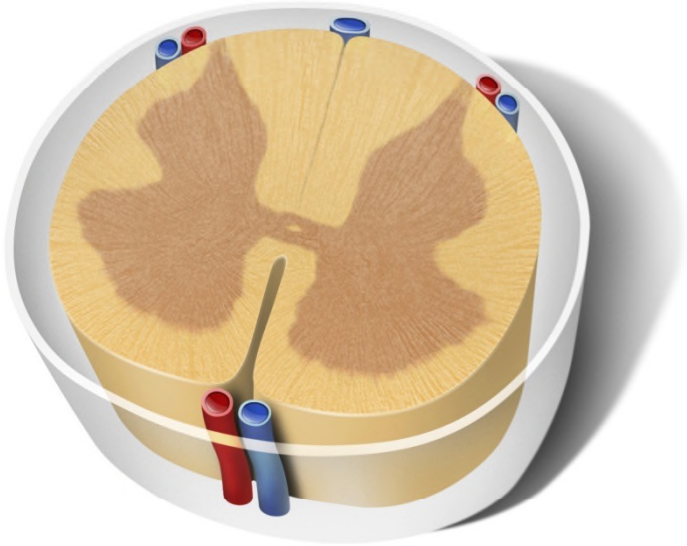


I 15% II 31% III 7% IV 4% V

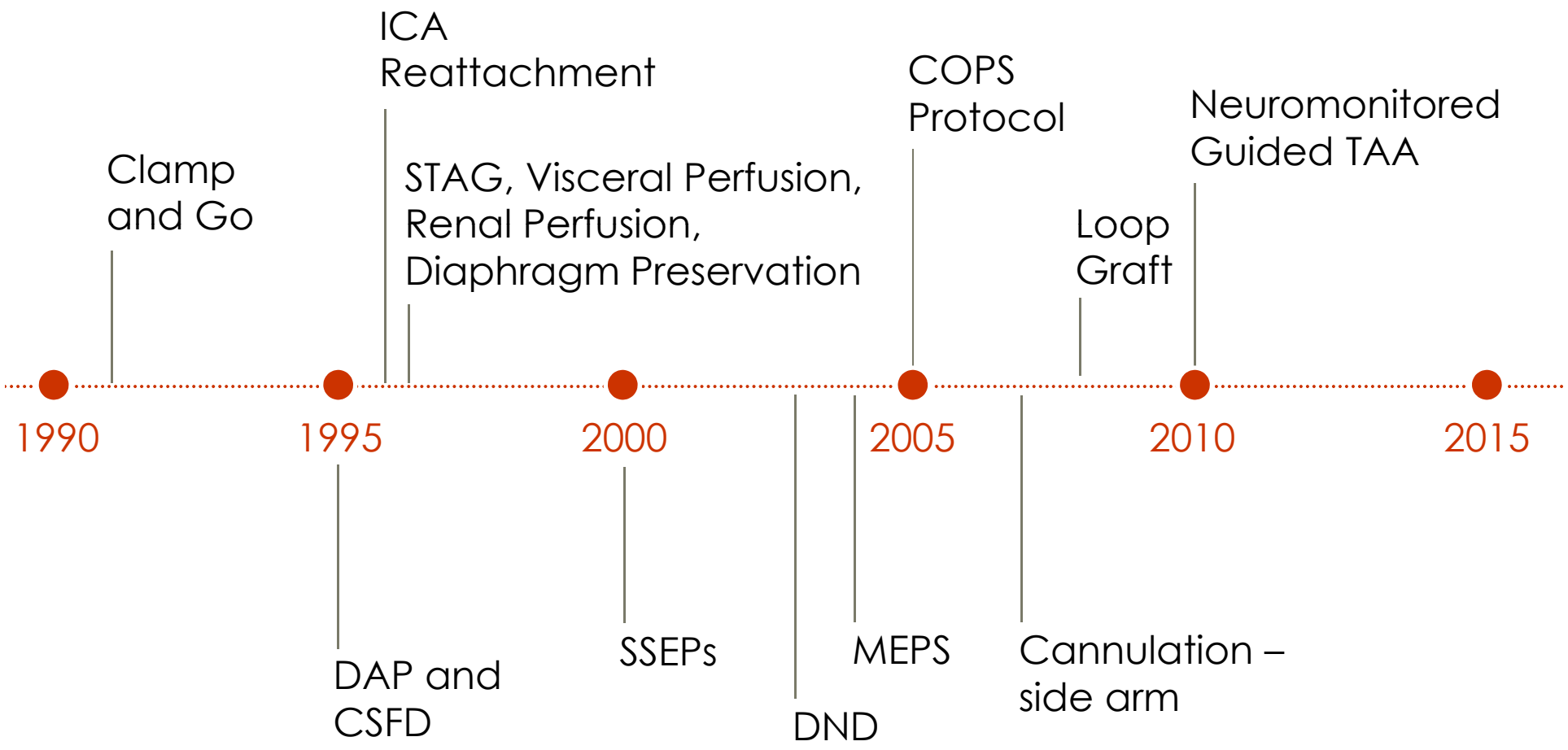
Spinal Cord Protection



1. Distal aortic pressure
2. Moderate hypothermia
3. CSF pressure



TAAA Modifications



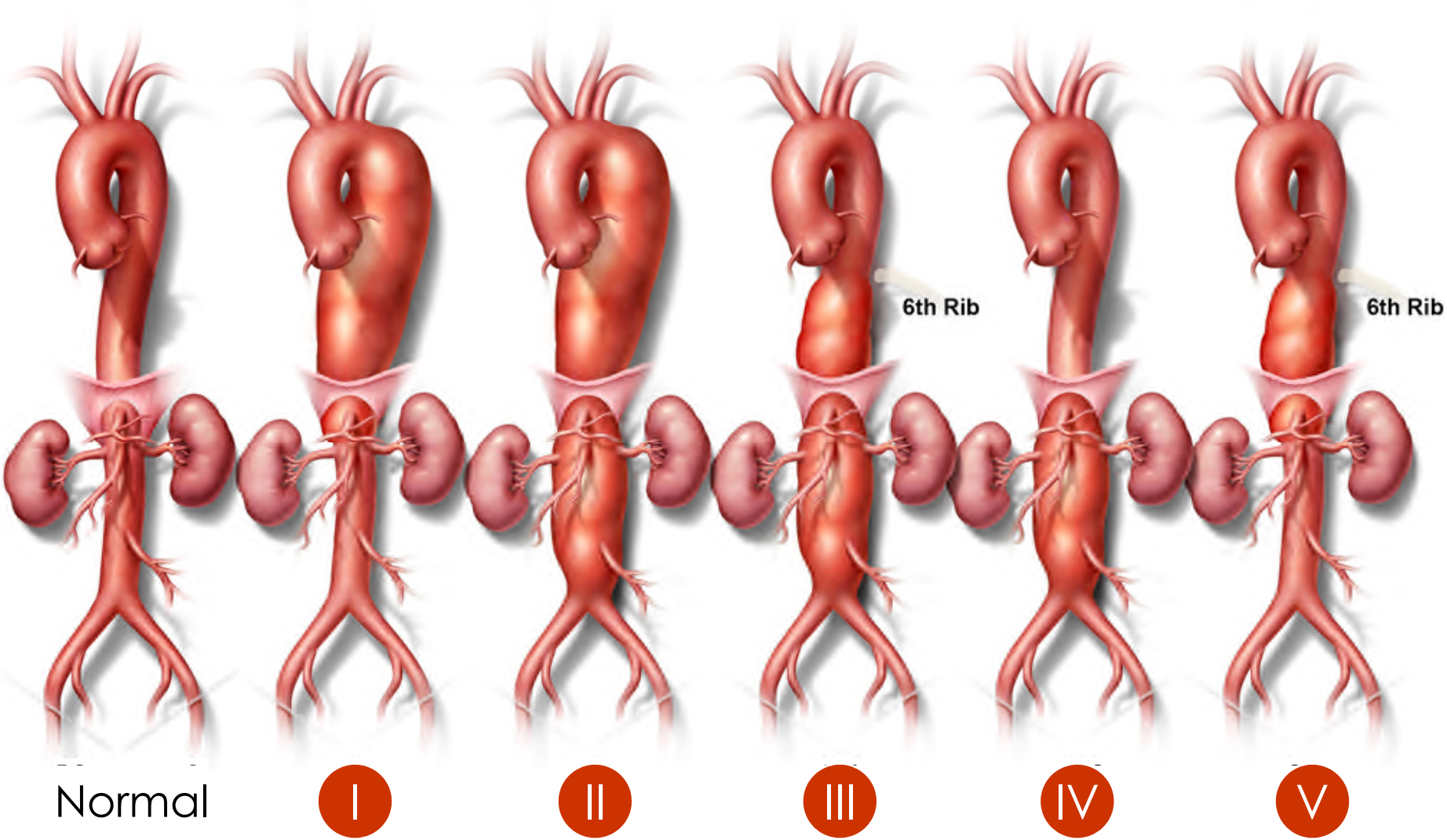
1896 Patients

Feb 1991 – Dec 2014

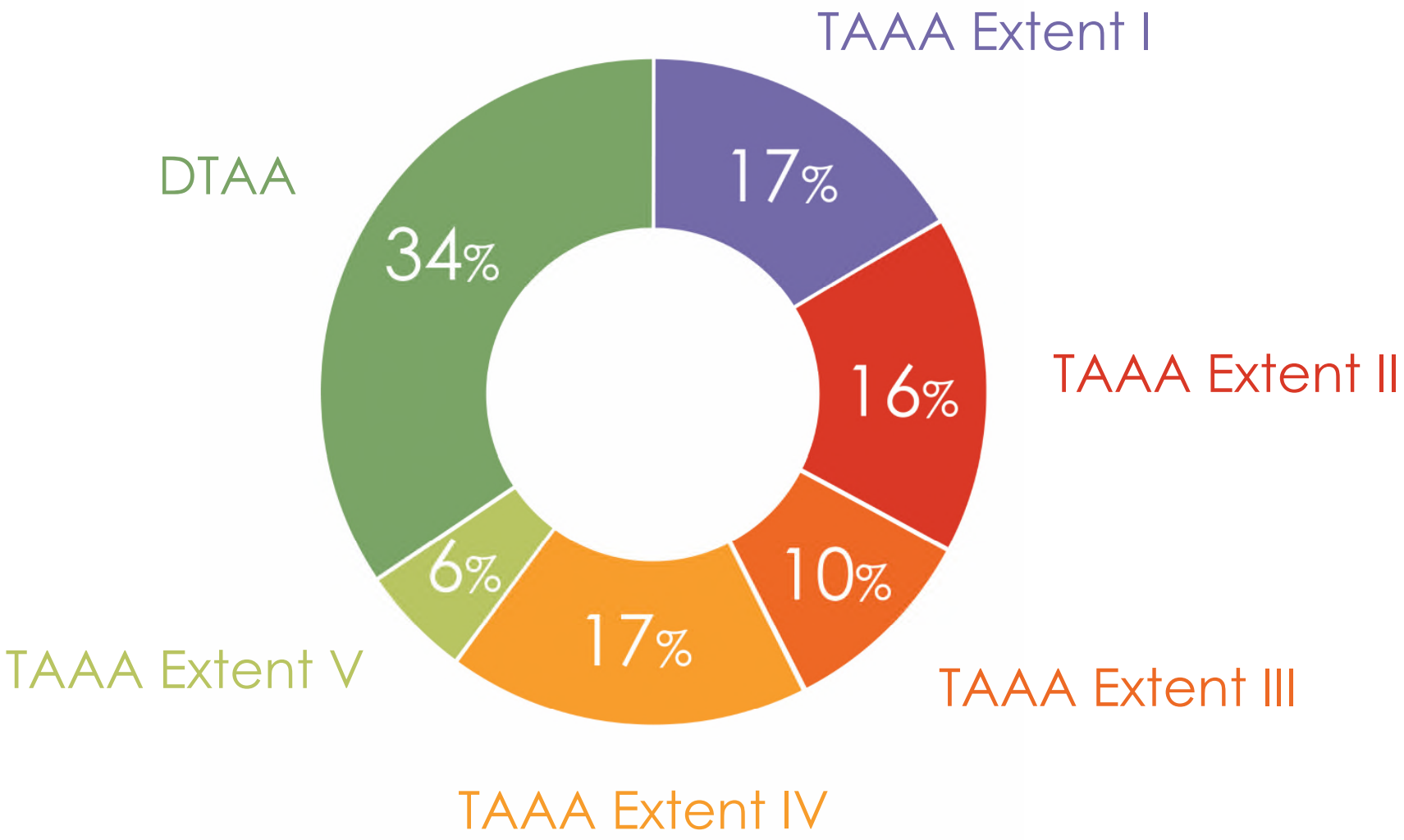
Mean age 64 ±13.8

♂ 63% ♀ 37%

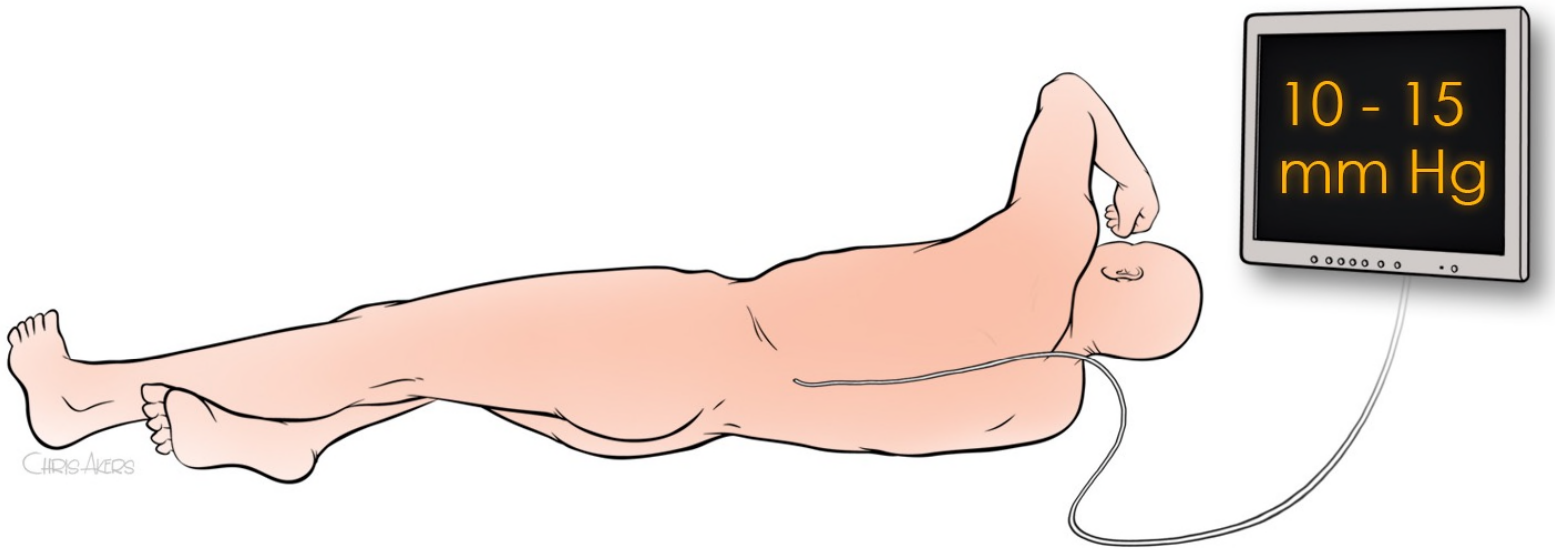
Modified Crawford Classification



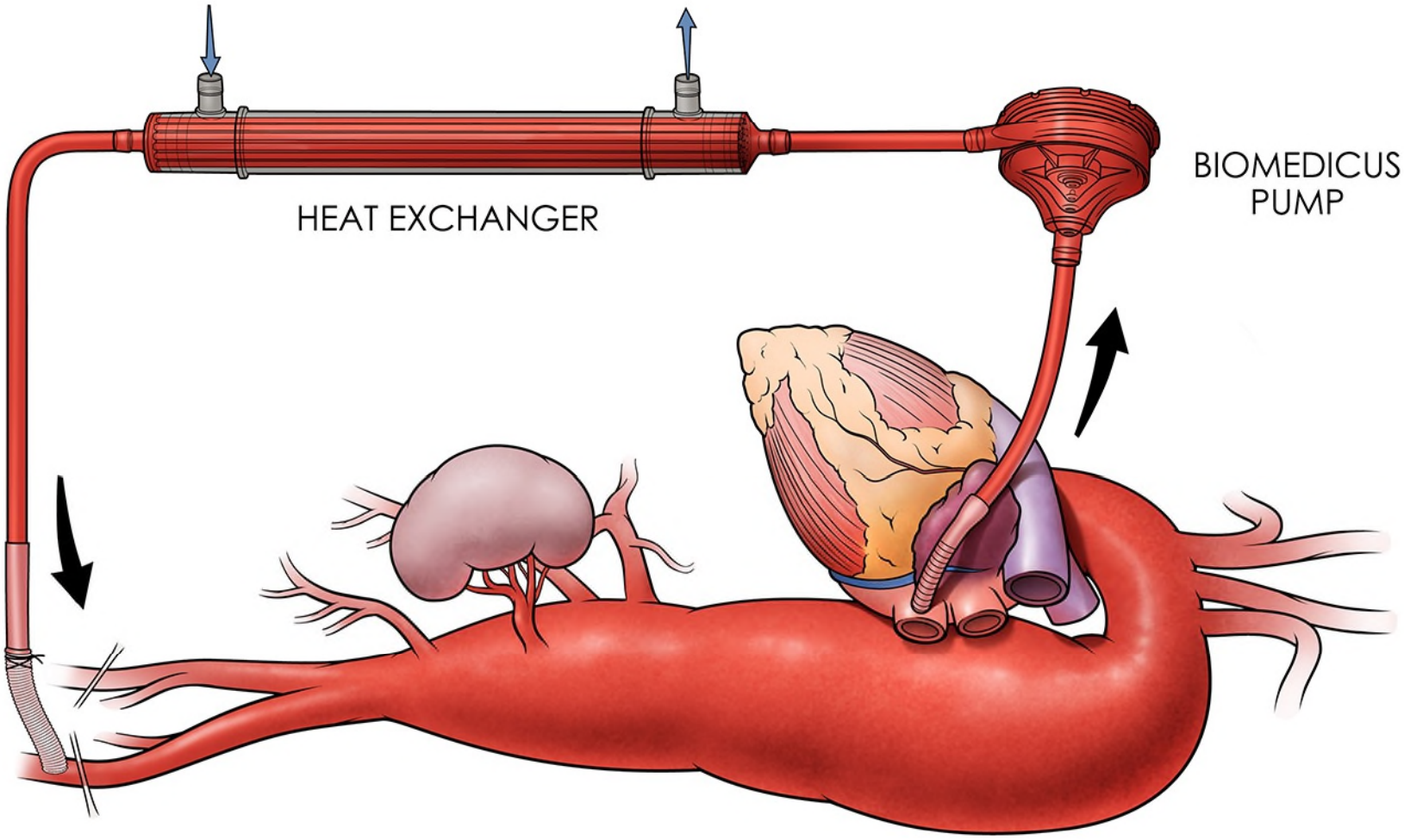
Extent

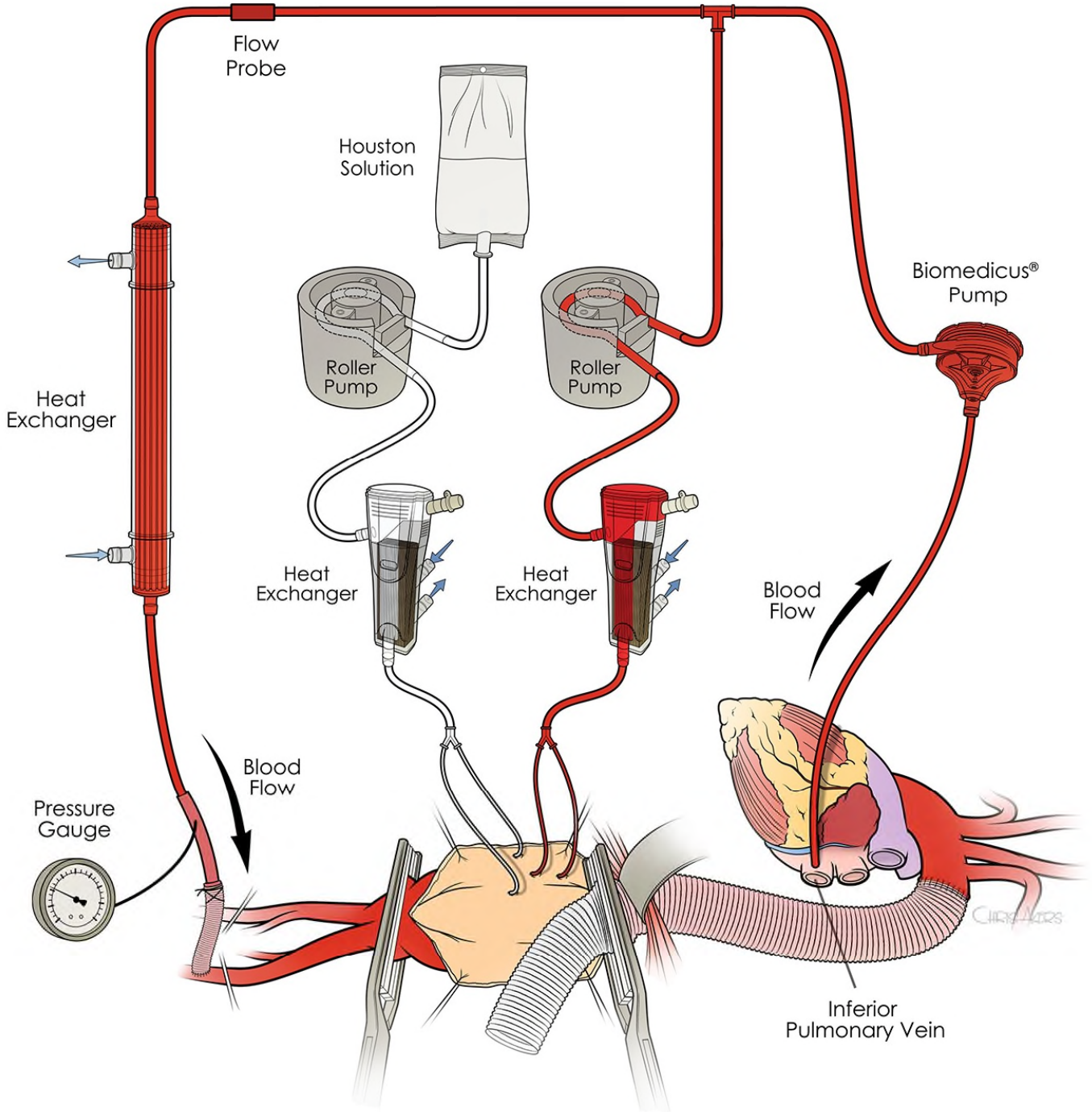

TAAA Extent I
17%
TAAA Extent II
16%
TAAA Extent III
10%
TAAA Extent IV
17%
TAAA Extent V
6%
DTAA
34%

CSF Drainage



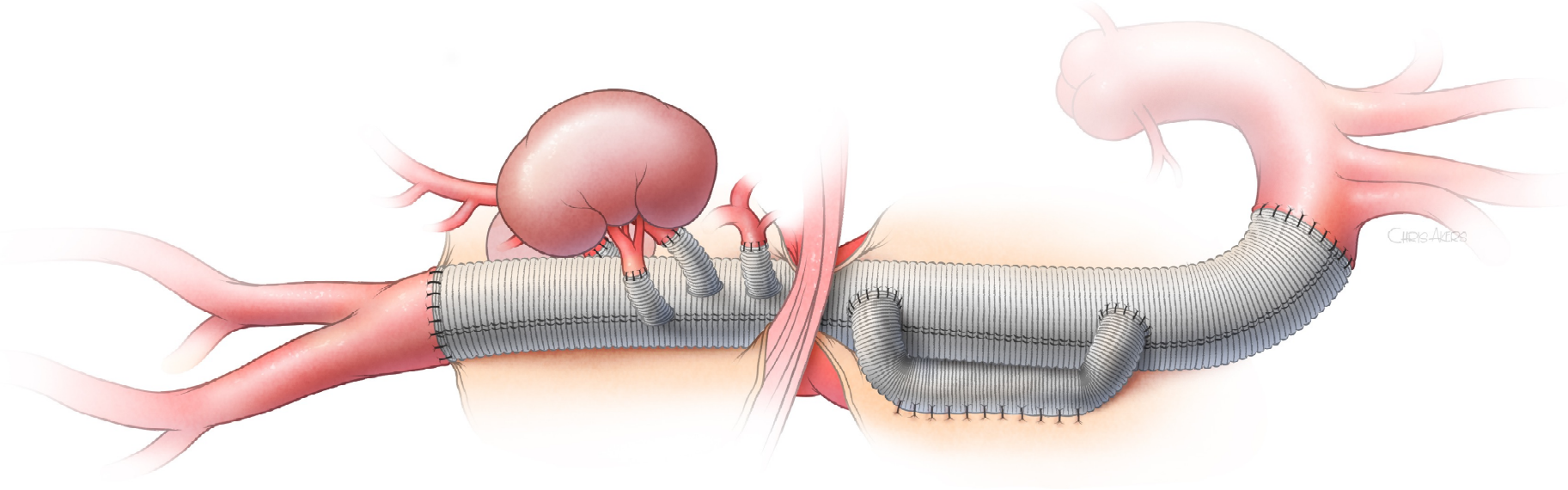
Distal Aortic Perfusion




Flow
Probe
Houston
Solution
Biomedicus®
Pump
Roller
Pump
Roller
Pump
Heat
Exchanger
Heat
Exchanger
Heat
Exchanger
Blood
Flow
Blood
Flow
Pressure
Gauge
Inferior
Pulmonary Vein

Conduct

- ✦ Proximal Anastomosis
- ✦ Visceral/Renal
- ✦ Distal Anastomosis
- ✦ ICA reimplant selectively



Results: Preoperative

Variable	No (%)
COPD	714 (37)
CAD	519 (27)
HTN	1573(83)
Connective Tissue (Marfan, LDS,etc.)	105 (6)
Prior Proximal Aneurysm	112 (6)
Chronic Dissection	587 (31)
Acute Dissection	81 (4)
Rupture	173 (9)
Redo TAA	255 (14)
Renal Dysfunction (median GRF)	68 ml/min

Results: Operative

Variable	No (%)
Distal Aortic Perfusion	1628 (86)
CSF Drain	1579 (83)
Elephant trunk (std, reverse)	255 (13)
ICA reattachment	596 (31)
DAP time (min.)	55 ± 32
Aortic Clamp Time	47 ± 26
Transfusion: PRBC (units, IQR)	5 (3-8)
FFP (units, IQR)	4 (2-12)
Platelets (units, IQR)	6 (0-18)

Results: Early Outcomes

Variable	No (%)
Stroke	95 (5)
Trachesotomy	288 (15)
Renal Dysfunction (Dialysis)	461 (24)
Immediate Neurologic Deficit	79 (4)
Delayed Neurologic Deficit (DND)	104 (5.5)
Recovered DND	47 (45)
Paraplegia at Discharge	136 (7)
LOS (Days, IQR)	17 (12-27)
Early Mortality	302 (15.9)

Risk Factors for IND

Variable	Regression Coeffient	p-value
GFR	-0.009	0.009
Extent 2 or 3	2.434	<0.0001
Clamp time	0.009	0.036
Adjunct	0.485	0.326
Adjunct w Extent 2 or 3	-1.497	0.014

Risk Factors for IND

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GFR	-0.009	0.009
Extent 2 or 3	2.434	<0.0001
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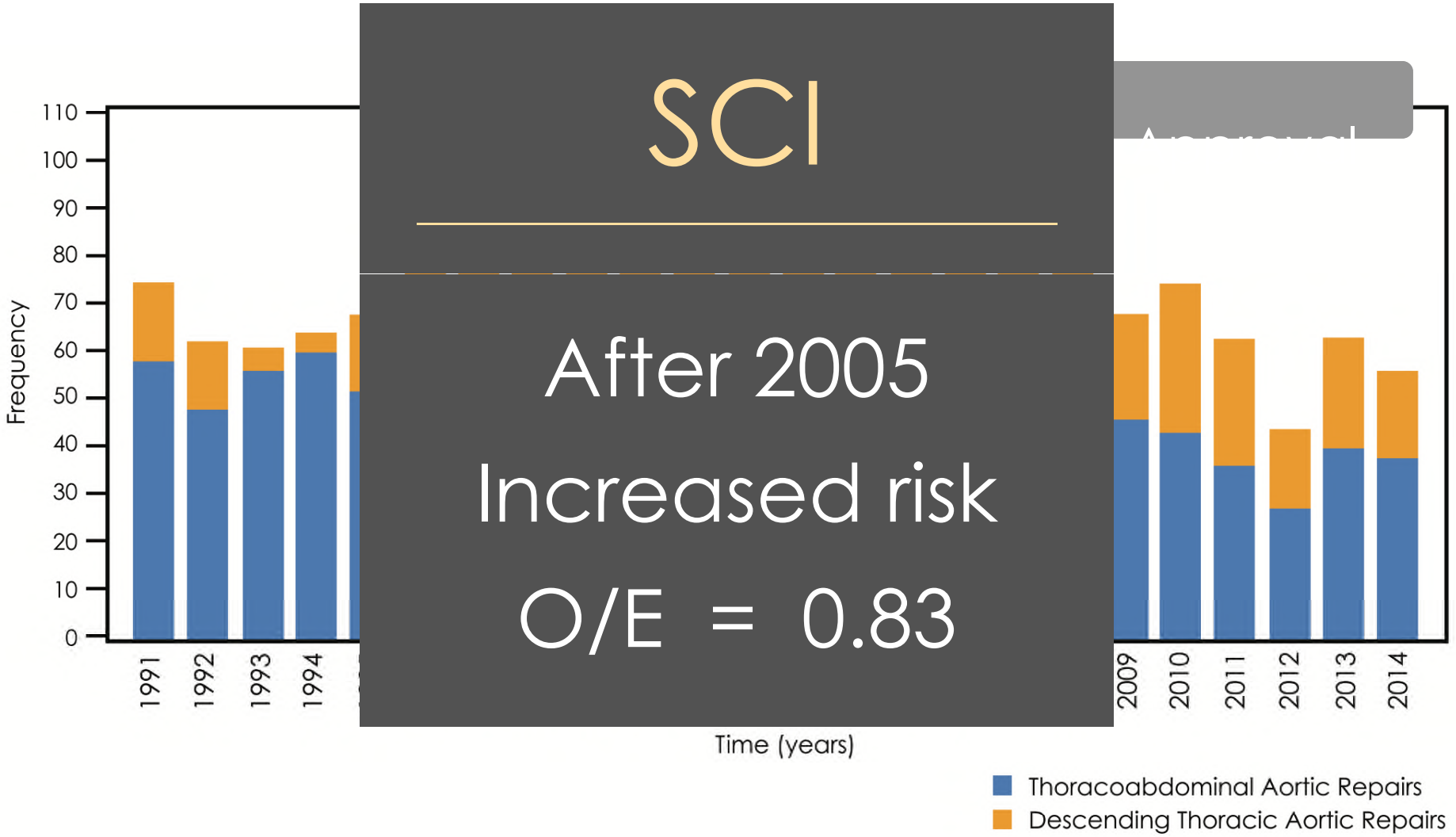
Adjunct w Extent 2 or 3	-1.497	0.014

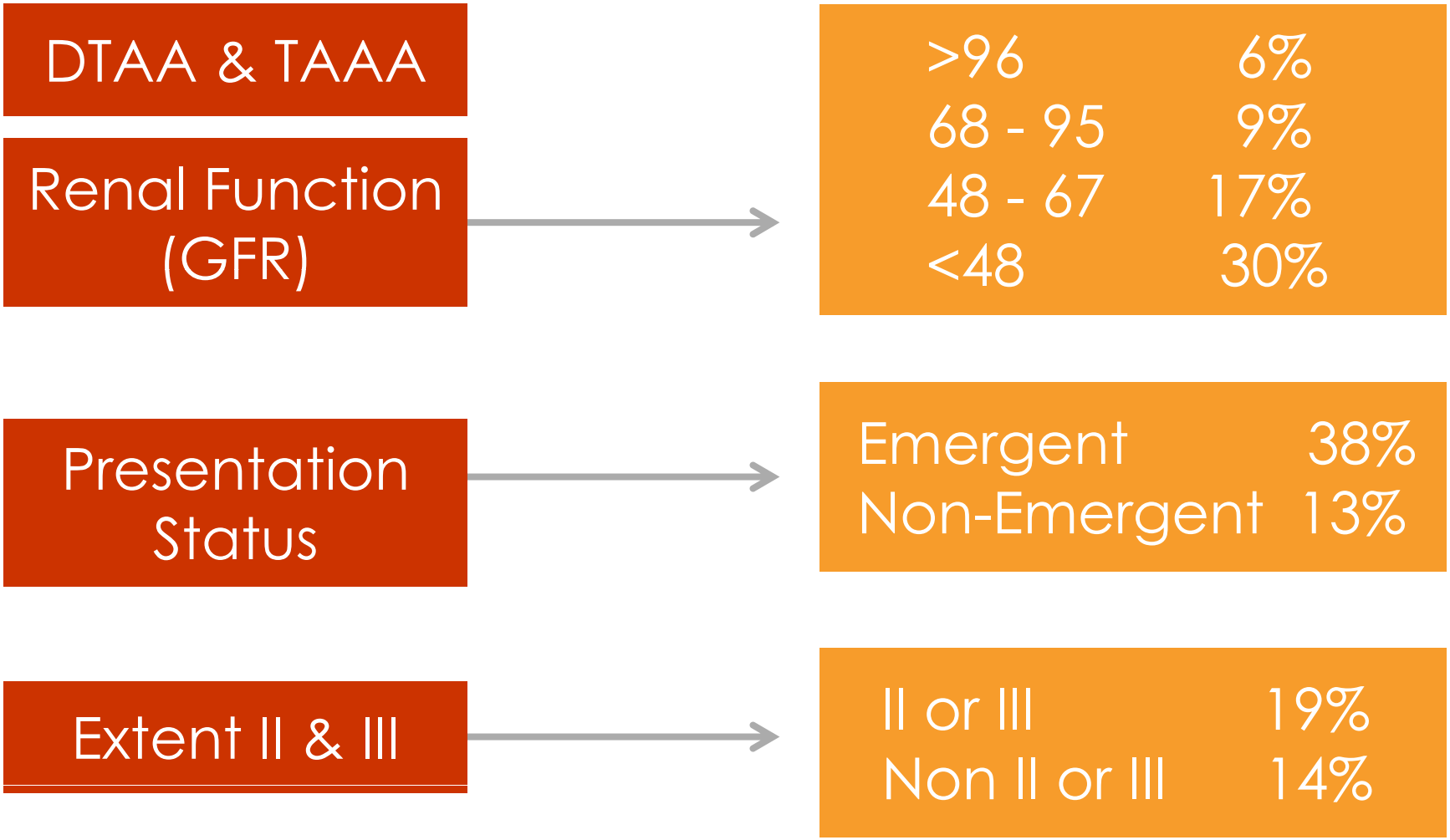
Open DTAA & TAAA



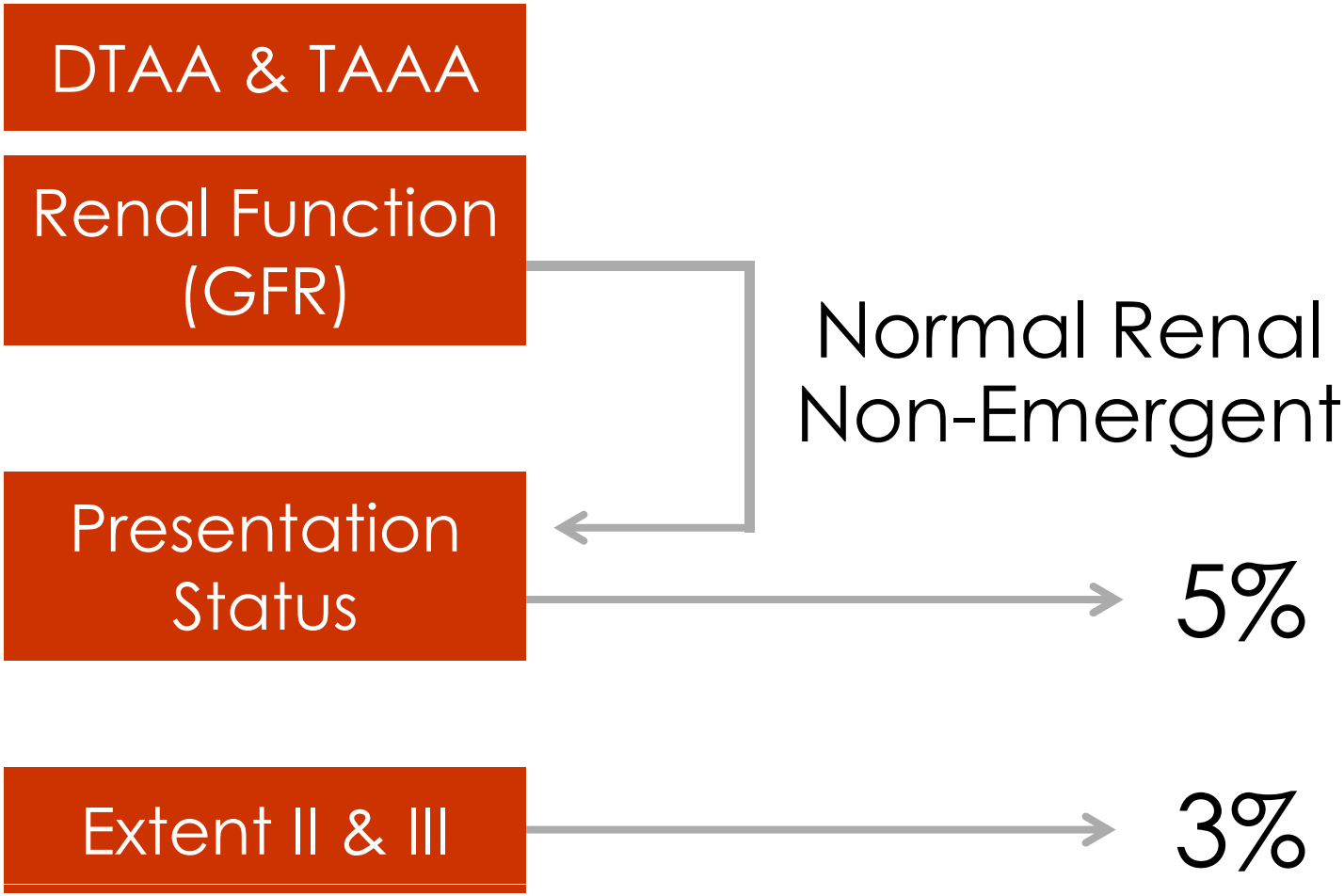
Risk Factors for Early Mortality

Variable	OR	CI	p-value
Age	1.02	1.00-1.03	0.004
GFR	0.98	0.97-0.99	<0.0001
Extent 2 or 3	1.62	1.21-2.16	0.001
Emergent	2.69	1.81-4.01	<0.0001
Clamp time	1.01	1.00-1.01	0.054
Redo	1.61	1.11-2.34	0.012
pRBC	1.07	1.05-1.09	<0.0001

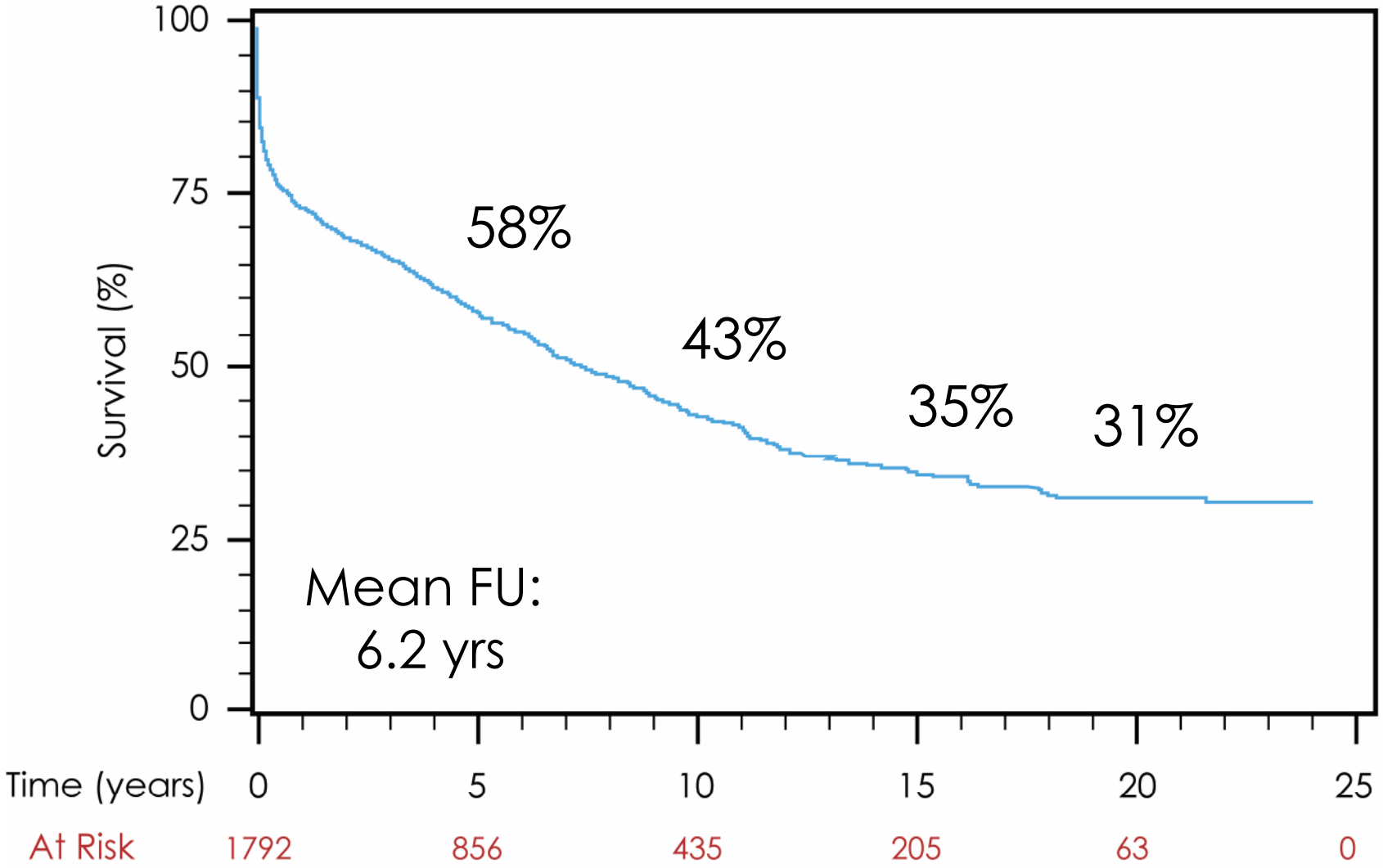
Risk Stratification: Mortality



Risk Stratification: Mortality



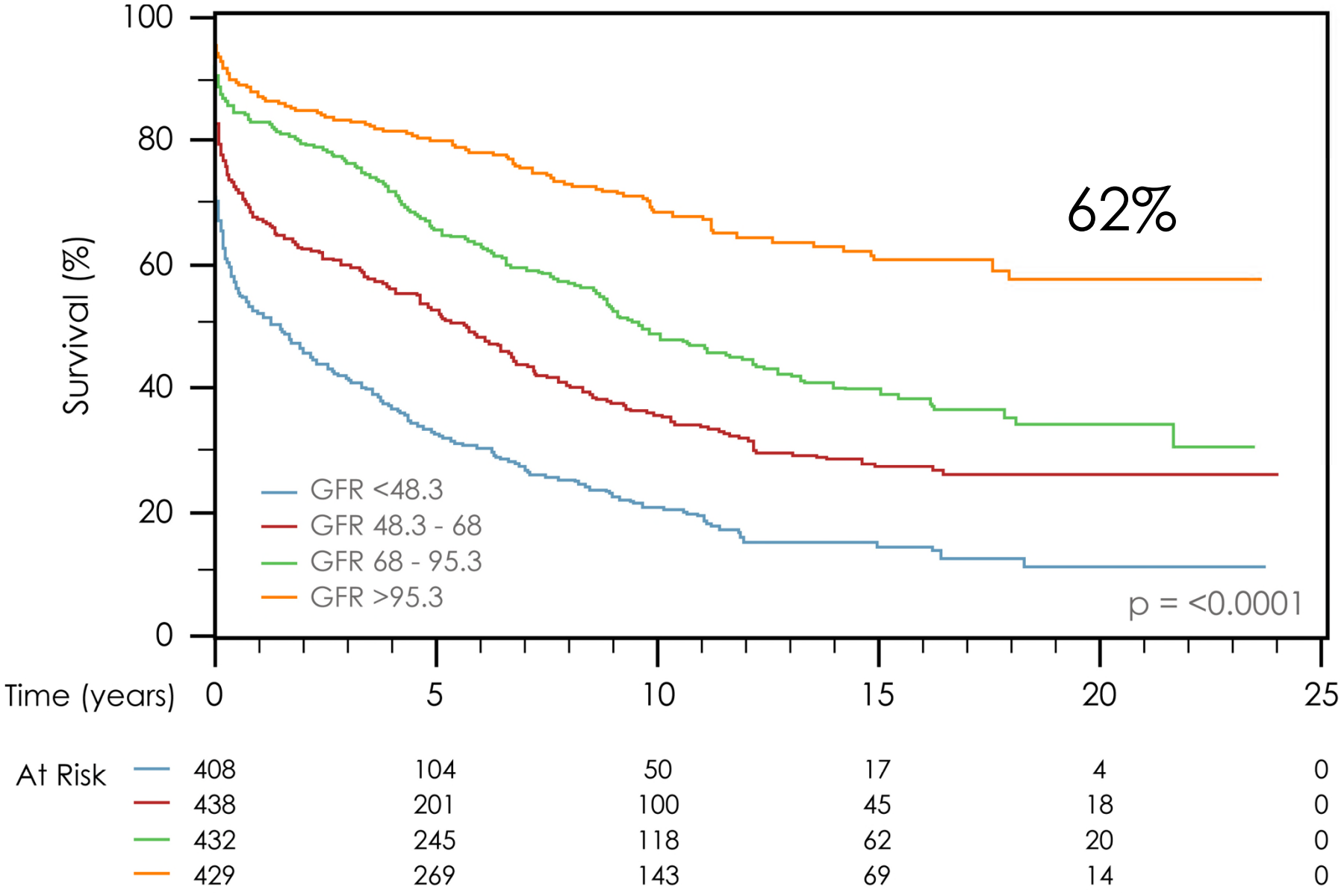
Long-term Survival over Two Decades



Risk Factors for Late Mortality

Variable	OR	CI	p-value
Age	1.02	1.02-1.04	<0.0001
GFR	0.99	0.98-0.99	<0.0001
Extent 2 or 3	1.29	1.11-1.50	0.0008
Rupture	1.75	1.40-2.18	<0.0001
CTD (Marfan)	1.48	1.02-1.01	<0.042
Redo	1.51	1.23-2.35	0.0001
pRBC	1.07	1.05-1.09	<0.0001
Prior Stroke	1.29	1.10-1.53	0.0025

Late Survival: GFR



Conclusions

- Open DTAA and TAAA repair remains a challenge.
- Adjuncts (CSFD & DAP) are important in reducing the paraplegia.
- Open repair can be performed in select patients with good results.
- Patients deemed high risk may be considered for endovascular therapy.

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