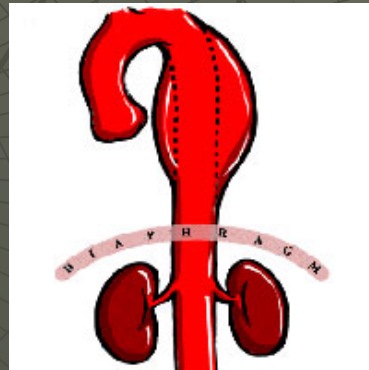
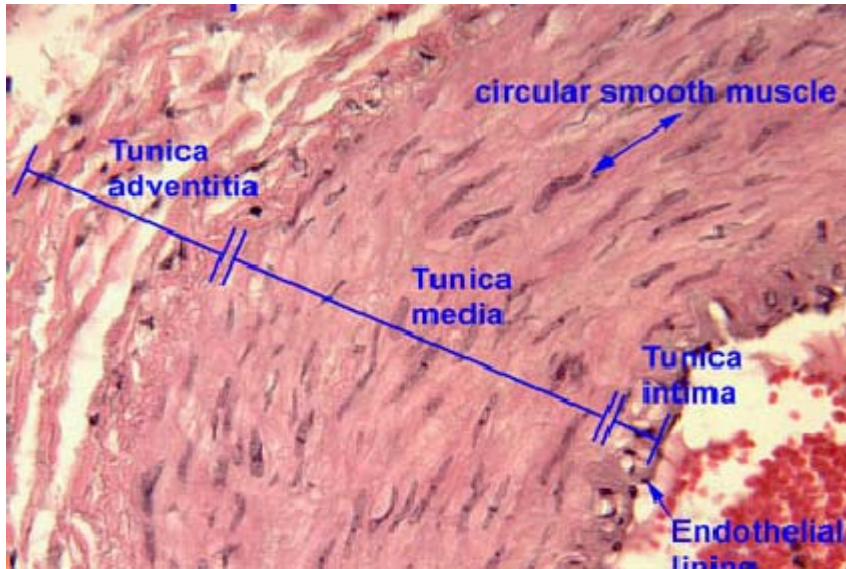


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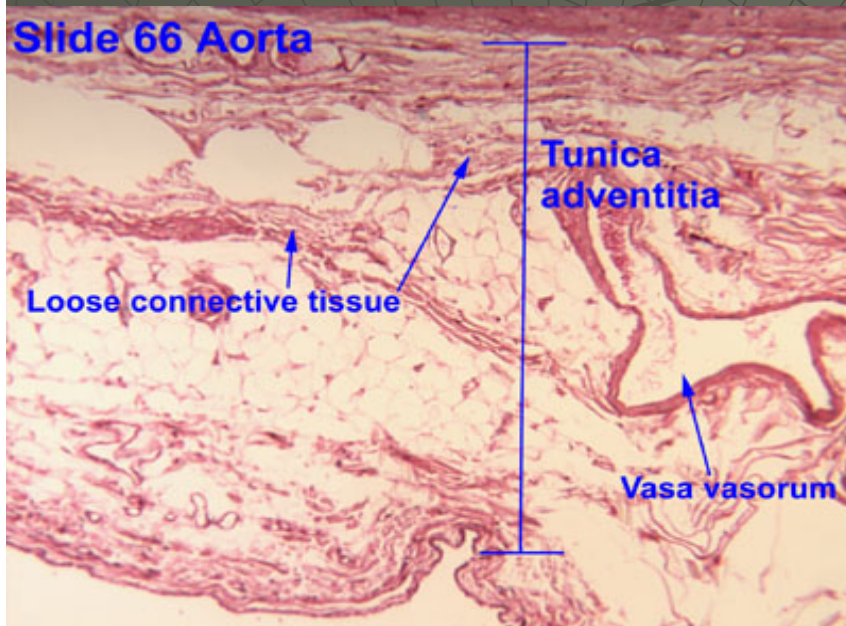
ANEURISMA CRONICO DELL'AORTA TORACICA



Blood Vessel Layers

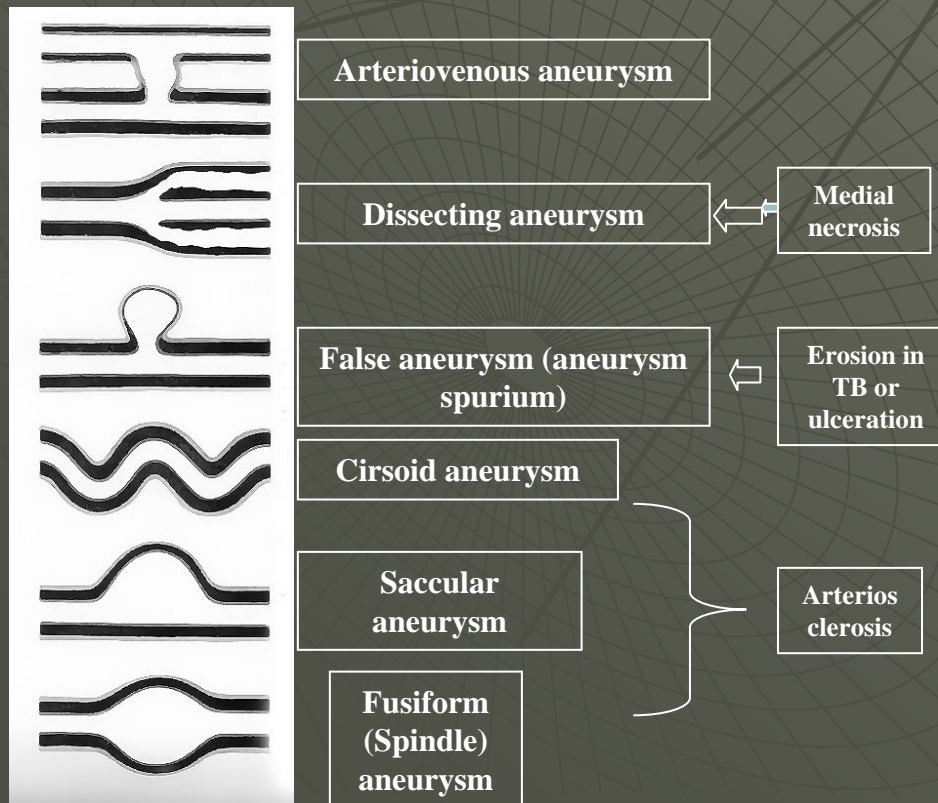
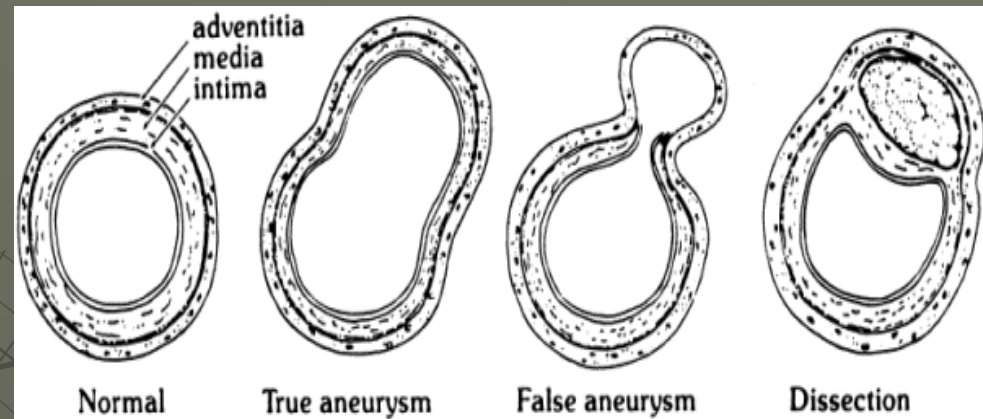
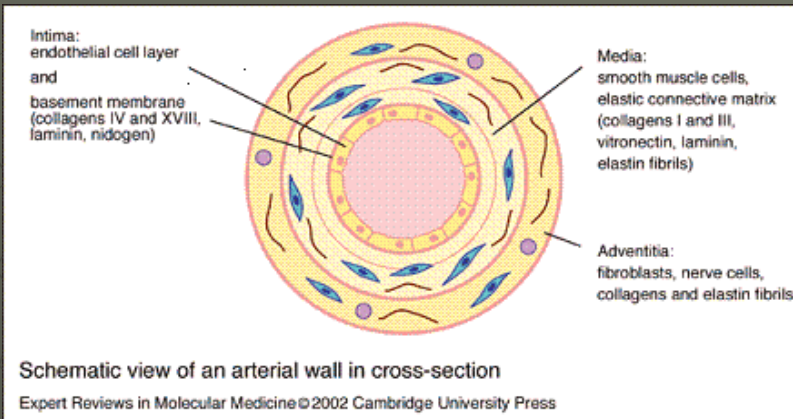


Slide 66 Aorta



- **Tunica intima**
 - Lines lumen
 - Endothelial cell layer
 - And subendothelial cell layer of loose connective tissue
- **Tunica media**
 - Circular layers of smooth muscle cells
 - Thick in arteries
 - Also lots of elastic fibers
- **Tunica Adventitia**
 - Loose connective tissue
 - Contains Fibroblasts and collagen fibers
 - Vaso vasorum
 - Blood supply to the blood supply

Aneurisma-Definizione



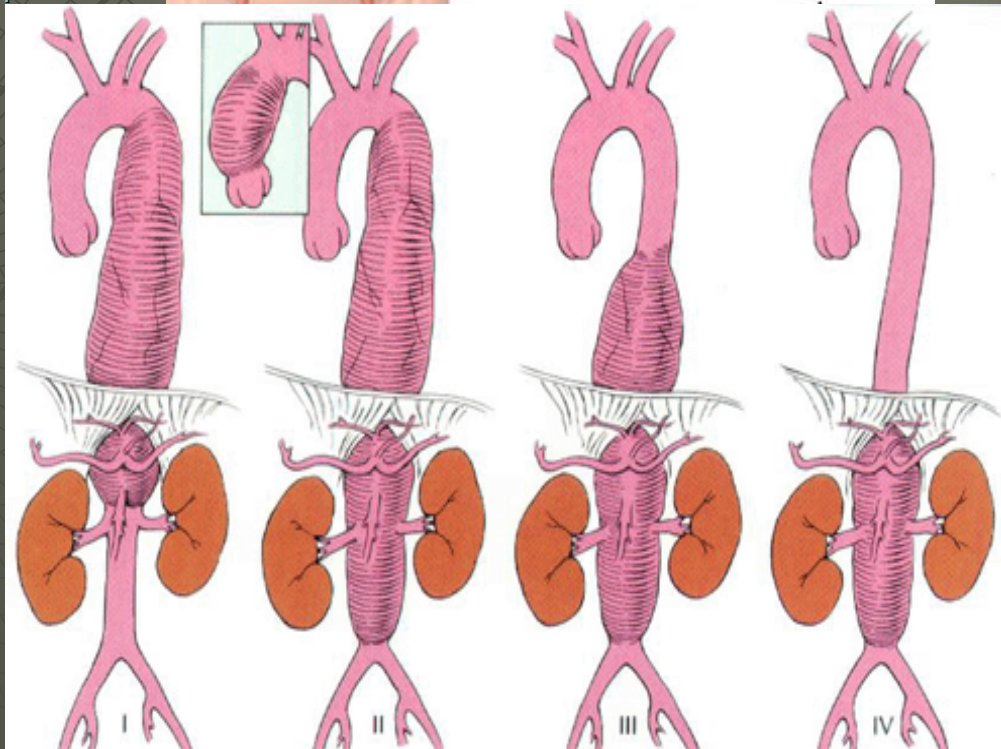
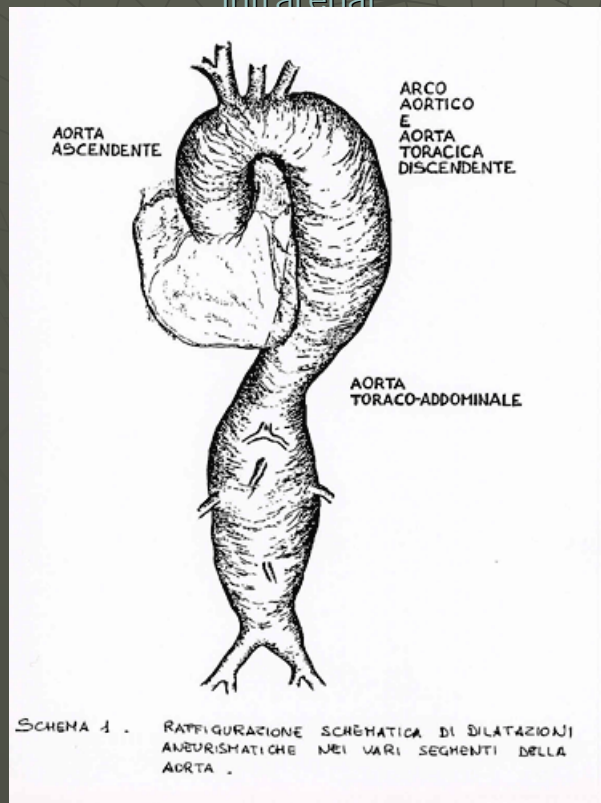
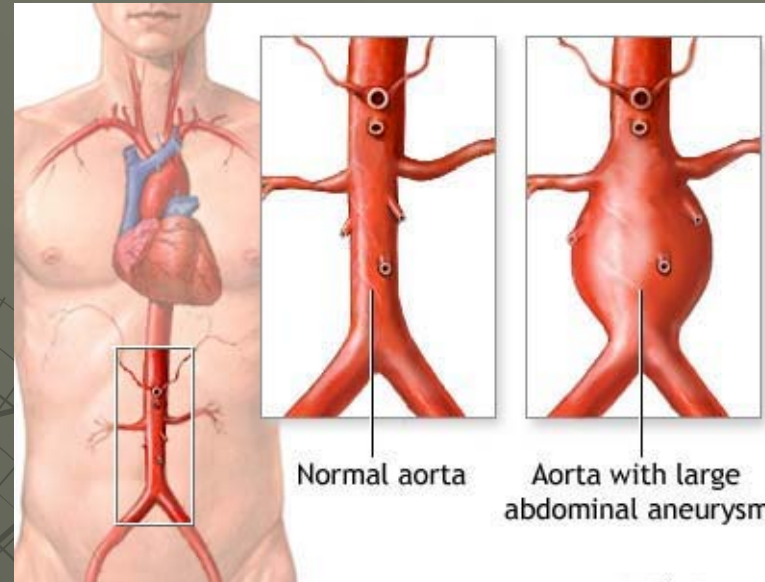
- **ANEURISMA**=dilatazione patologica localizzata di un segmento arterioso
- **VERO ANEURISMA**=dilatazione di un tratto di arteria che supera di oltre il 50% il calibro originale della stessa e la cui parete è formata da tutte le tre tuniche del vaso
- **FALSO ANEURISMA**=ematoma organizzato

Aneurisma dell'Aorta Toracica

- ◆ Aorta Ascendente
- ◆ Arco Aortico
- ◆ Aorta Discendente
- ◆ Aorta Toracoaddominale

Type I: Proximal descending to proximal abdominal

Type II: Proximal descending to infrarenal

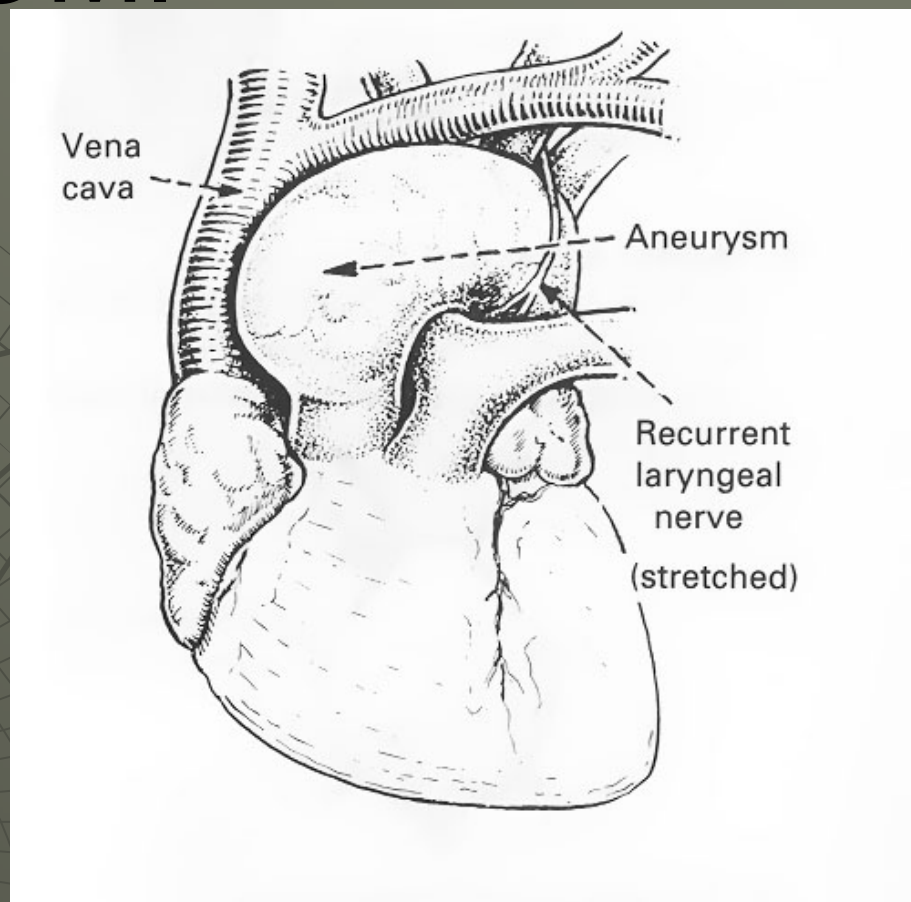


EZIOLOGIA

- ◆ Aterosclerosi
- ◆ Disordini del tess.connettivo o necrosi cistica della media (S. di Marfan,S. di Ehlers-Danlos)
- ◆ Malattie infiammatorie (granulomatosi,arterite a cellule giganti,arterite di Takayasu)
- ◆ Sifilide
- ◆ Dissezione aortica
- ◆ Trauma aortico
- ◆ Infezioni
- ◆ Gravidanza

SINTOMI

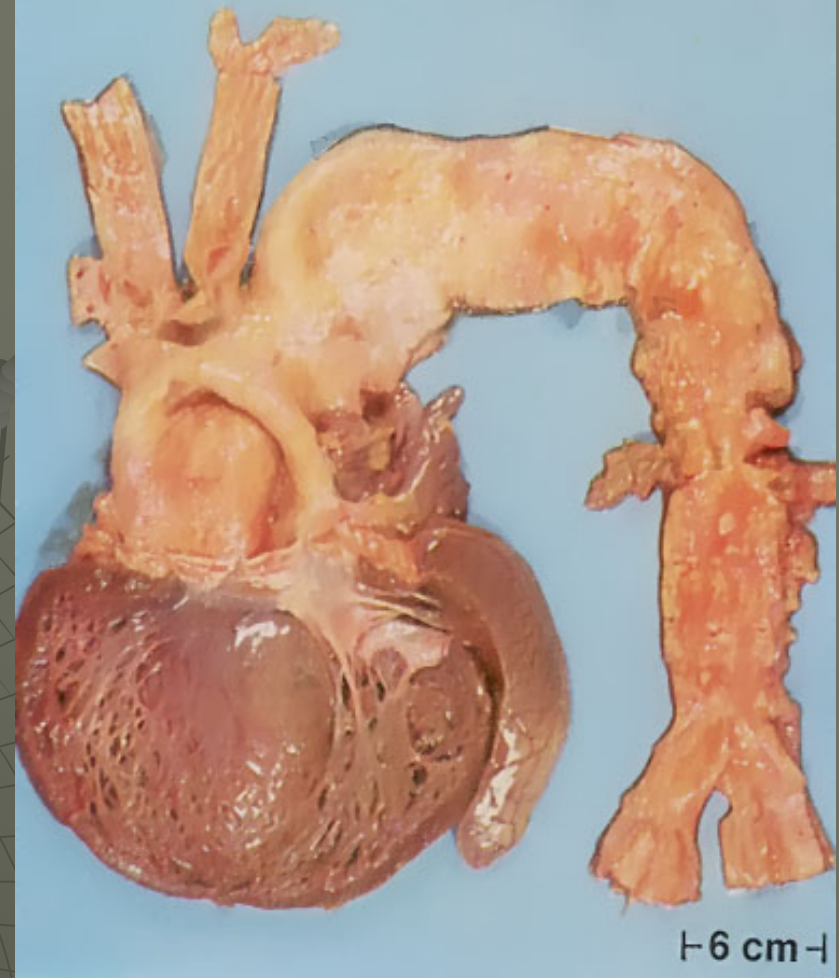
- ◆ 40%
ASINTOMATICI
- ◆ SINTOMI più comuni:
 - dolore toracico/dorsale
 - disfonia**
 - disfagia
 - tosse, dispnea
 - angina
 - pletora e edema
 - ictus, ischemie delle estremità, infarti renali, ischemia mesenterica



Aneurysm with ascending aorta location. This diagram clearly shows how an aneurysm here would cause a hoarse voice as it **stretches the recurrent laryngeal nerve.**

SEGNI

- ◆ **Soffio da rigurgito aortico** con o senza manifestazioni periferiche
- ◆ **Ampia pressione differenziale**
- ◆ **Deviazione tracheale**
- ◆ **Soffio paravertebrale**



Aorta with aortic dilatation limited to the ascending aorta. The damage to the vessel wall often extends to the aortic valve ring, causing **severe aortic valve insufficiency**

DIAGNOSTICA PER IMMAGINI

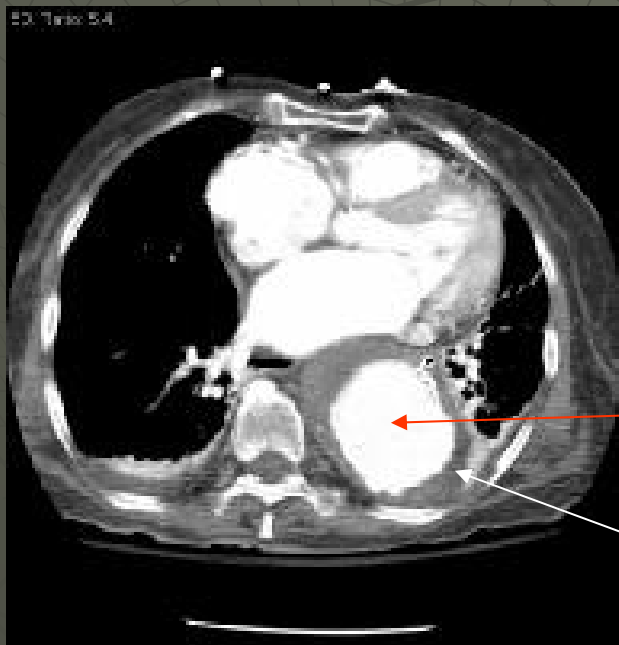
- ◆ RX Torace
- ◆ Tomografia computerizzata
- ◆ Aortografia
- ◆ Angio-Risonanza Magnetica
- ◆ Ecocardiografia transtoracica
- ◆ Ecocardiografia transesofagea

RX TORACE



TOMOGRAFIA COMPUTERIZZATA

Aortic aneurysm

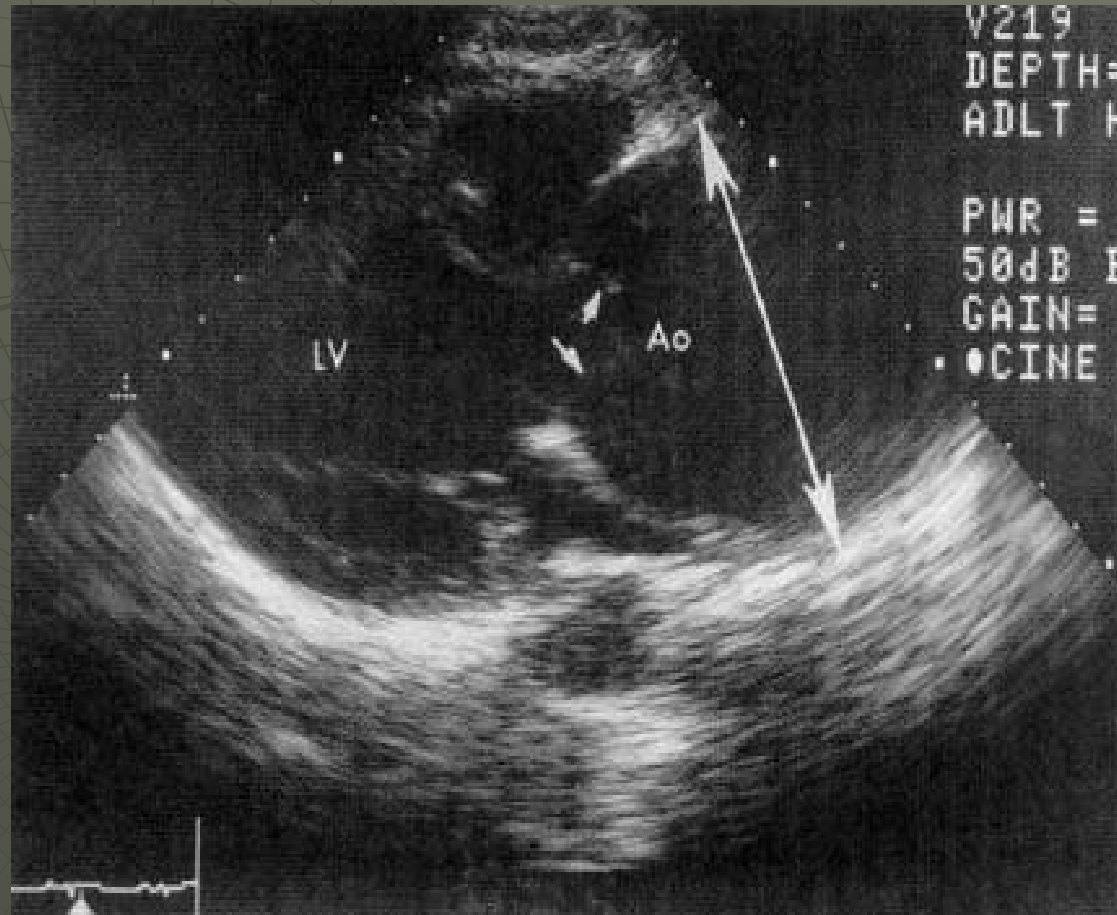


Descending thoracic aortic aneurysm with mural thrombus at the level of the left atrium, showed on CT scan with contrast

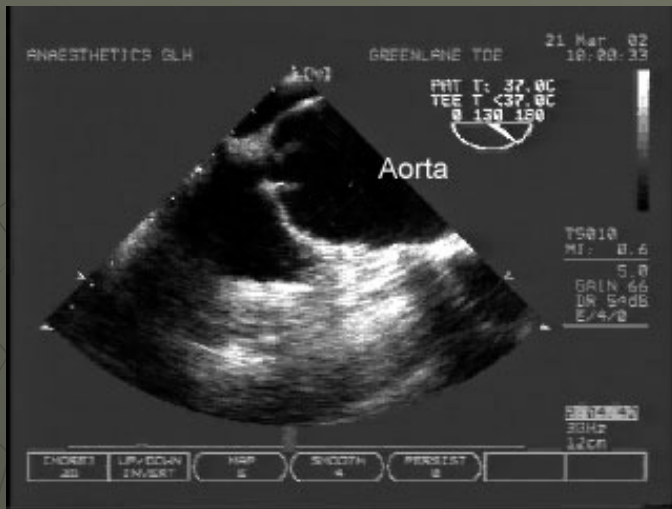
aortic aneurysm

mural thrombus

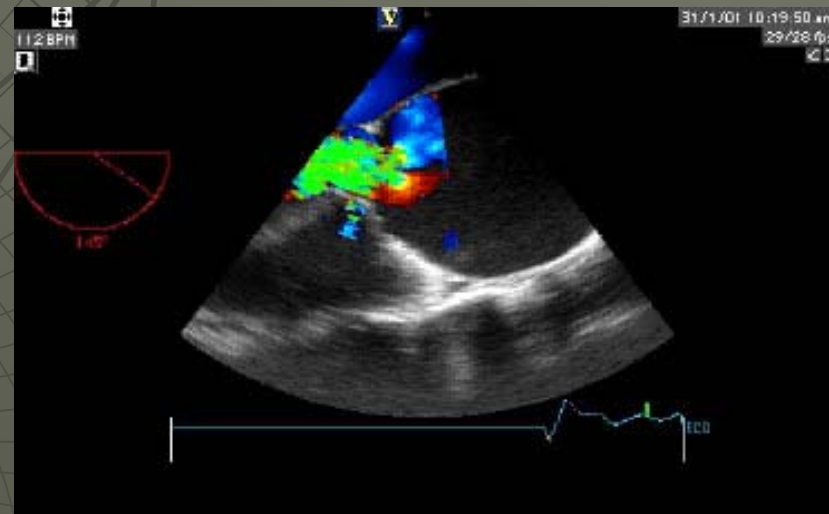
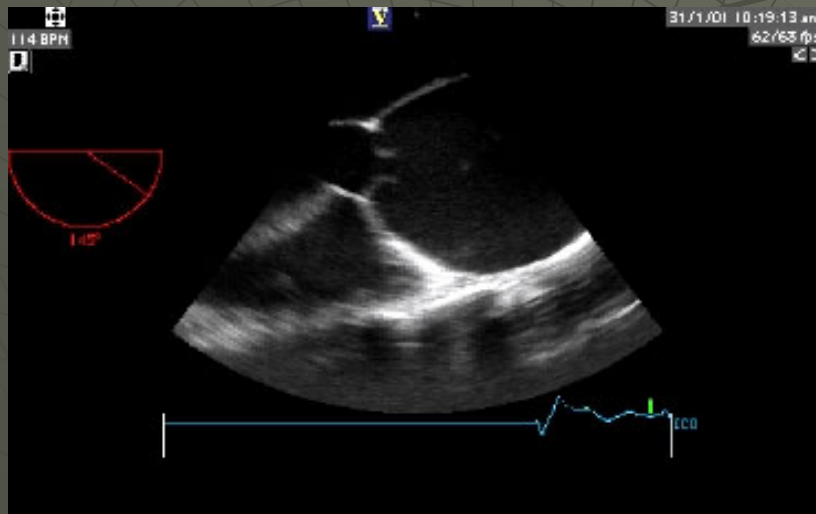
ECOCARDIOGRAFIA TRANSTORACICA



Ecocardiografia TranSESofagea



There is gross dilatation of the ascending aorta, with loss of the sinotubular junction (note the 1 cm markers on the left side of the sector).



Marked dilatation of the ascending aorta has resulted in functional aortic regurgitation. There is limited opening and closing of the AV because the leaflets are suspended from the markedly dilated sinotubular junction. A large diastolic coaptation defect of the AV is apparent. Colour flow Doppler imaging confirms the presence of severe aortic regurgitation (jet width > 40% of outflow tract width).

Aortografia

- Sensitive and specific
- Invasive
- Can be done Time consuming
- intraoperatively if needed



Storia Naturale

- L'evoluzione naturale degli aneurismi vascolari è la progressiva dilatazione sino alla **rottura del vaso**.

- Secondo la **legge di Laplace**, al progressivo aumento del diametro corrisponde un incremento della tensione di parete con conseguente **tendenza alla fissurazione**

- The only independent predictor of rapid expansion ($>0.5\text{cm/yr}$) is an initial **aortic diameter larger than 5cm**

- Aneurysms that are 5cm or smaller show mean growth rates of 0.17cm/yr

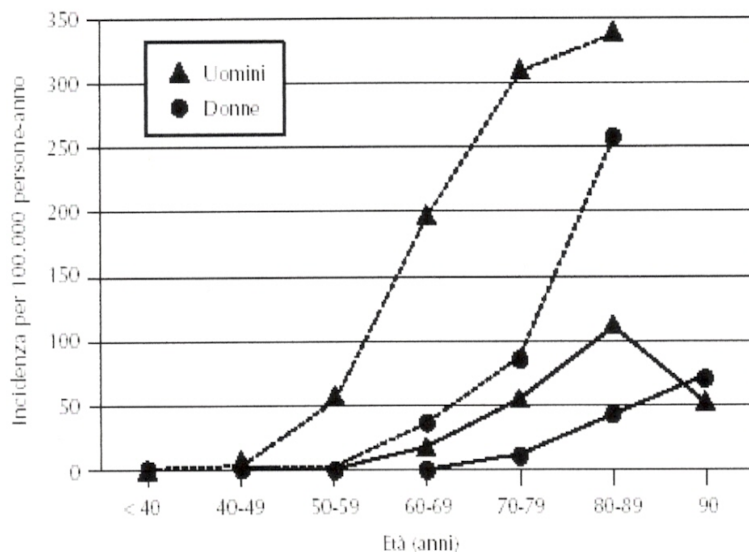
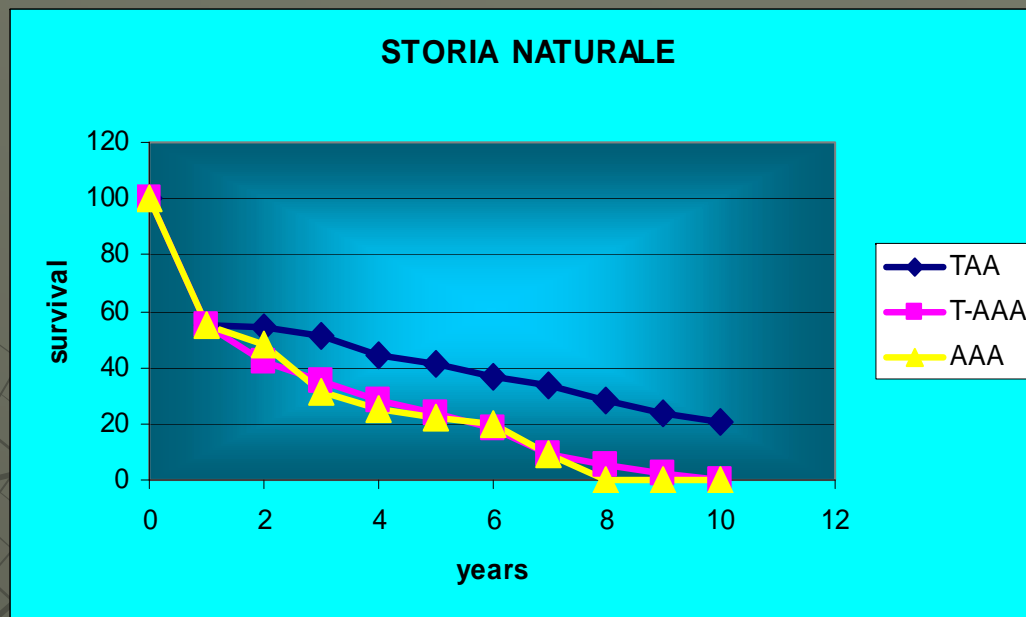
- Aneurysms larger than 5cm grow by 0.79cm/yr

Incidenza:

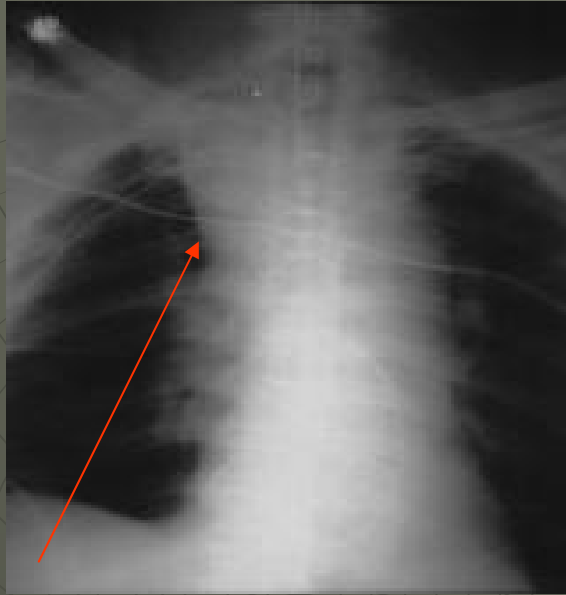
- ◆ 400/100000 (>65anni)
- ◆ 670/100000 (>80 anni)

Incidenza rottura:

20/100000/15



Epidemiologia degli ANEURISMI(- - -) e degli ANEURISMI ROTTI(—)



increased attenuation of the mediastinum which is consistent with mediastinal hematoma

widening of the mediastinal contour and deformity and blurred margins of the superior mediastinum



irregularity continuity of the aortic outline

ROTTURA:Esami radiologici

TRATTAMENTO

- ◆ FARMACOLOGICO

↓
BETA-BLOCCANTI

- ◆ CHIRURGICO

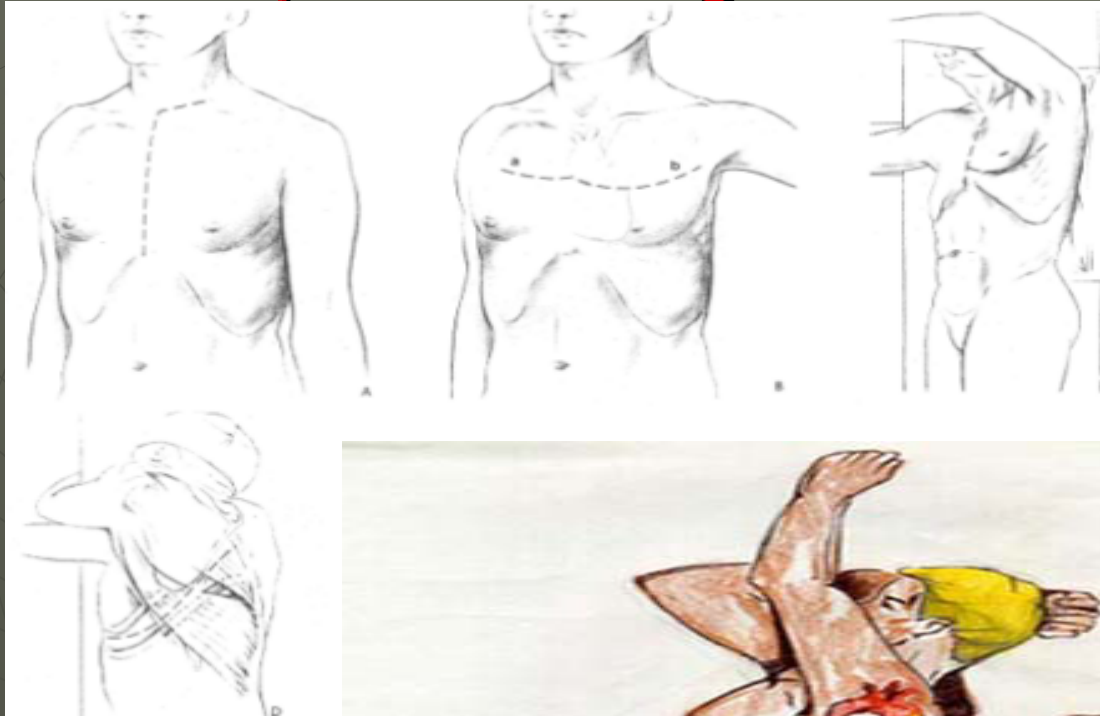
↓
sostituzione con *PROTESI SINTETICHE*

- ◆ Uso di **ENDOPROTESI**

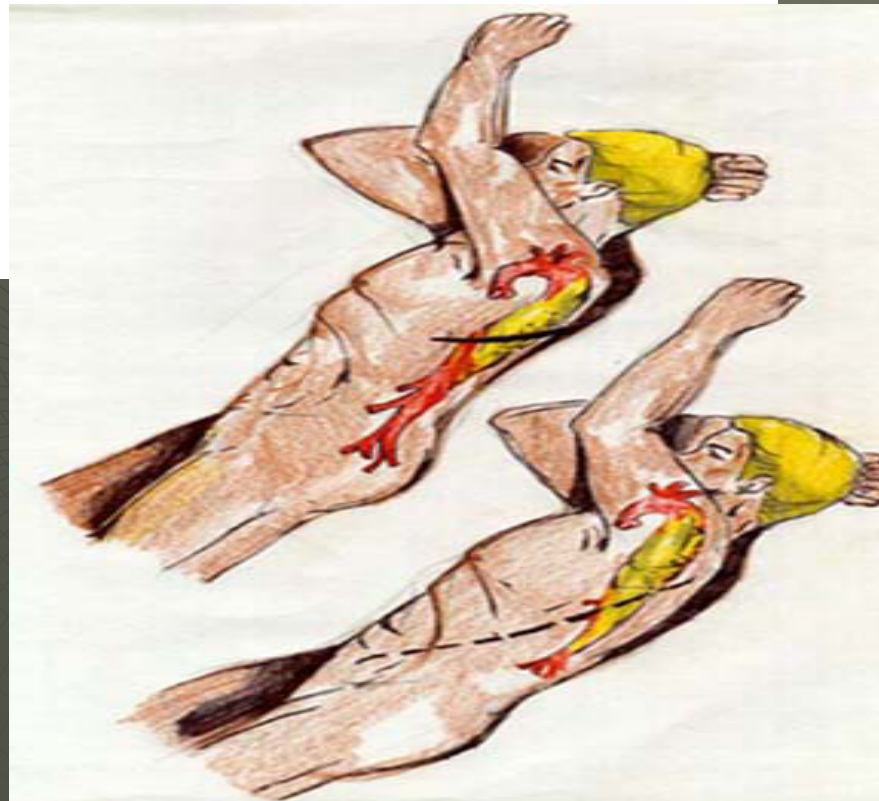
Indication for operation

- Symptoms
- 5.0-6.0 cm size in Ascending Aorta
- 5.5-6.0 size cm in Aortic Arch
- 5.0-6.0 cm size in Descending Aorta
- Marfans $>5.0-5.5\text{cm}$
- Growth > 1 cm per year

Terapia Chirurgica- VIE D'ACCESSO



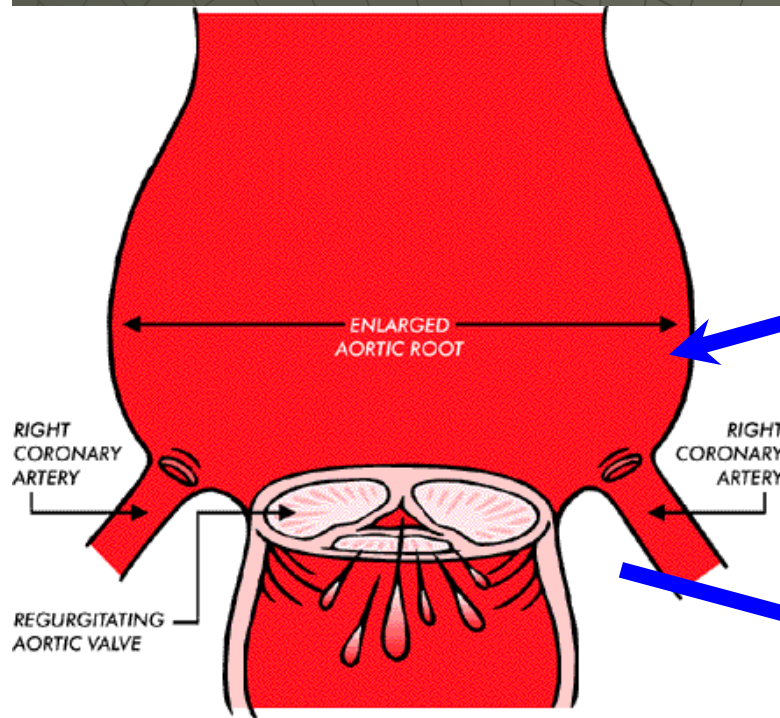
- ◆ INCISIONE TORACICA POSTERIORE SINISTRA
- ◆ INCISIONE TORACOLAPAROFRENICA



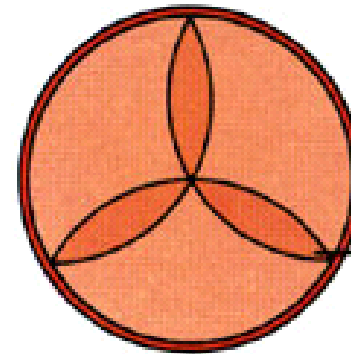
TRATTAMENTO CHIRURGICO

L'aorta ascendente e la valvola aortica

- Sostituzione Ao Ascendente
- Sostituzione Ao Ascendente + sostituzione valvolare

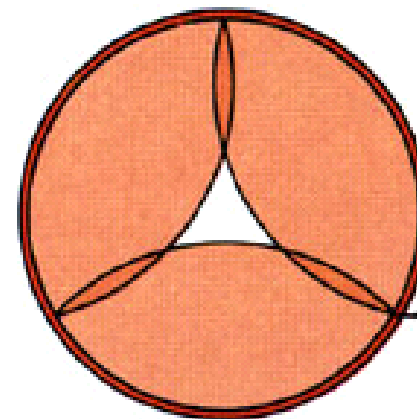


Normal aortic valve



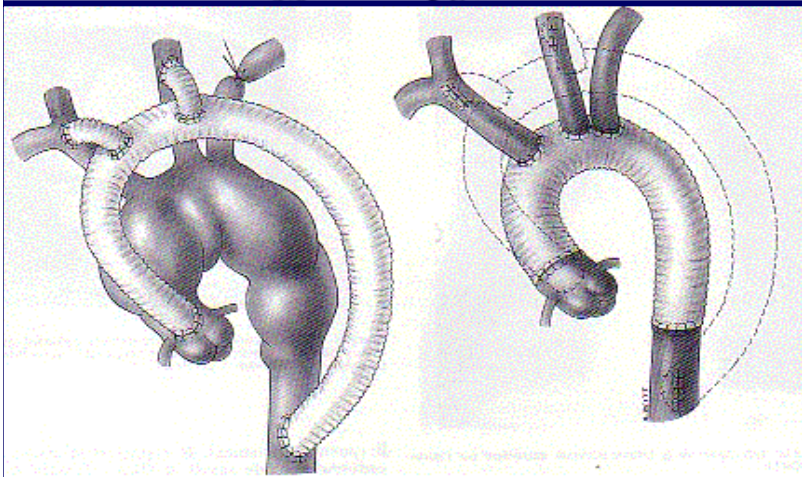
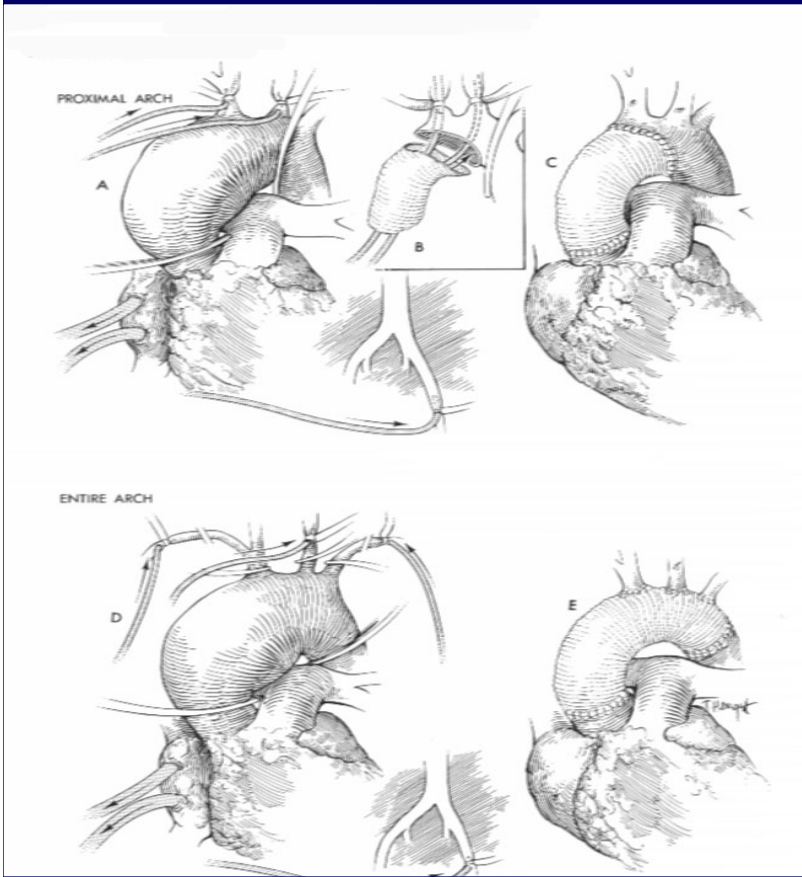
Area of cusp overlap

Dilated aortic valve



Area of cusp overlap

CHIRURGIA DELL'AORTA ASCENDENTE E DELL'ARCO AORTICO



ATTACHMENT OF DACRON TUBE GRAFT WITH AORTIC VALVE

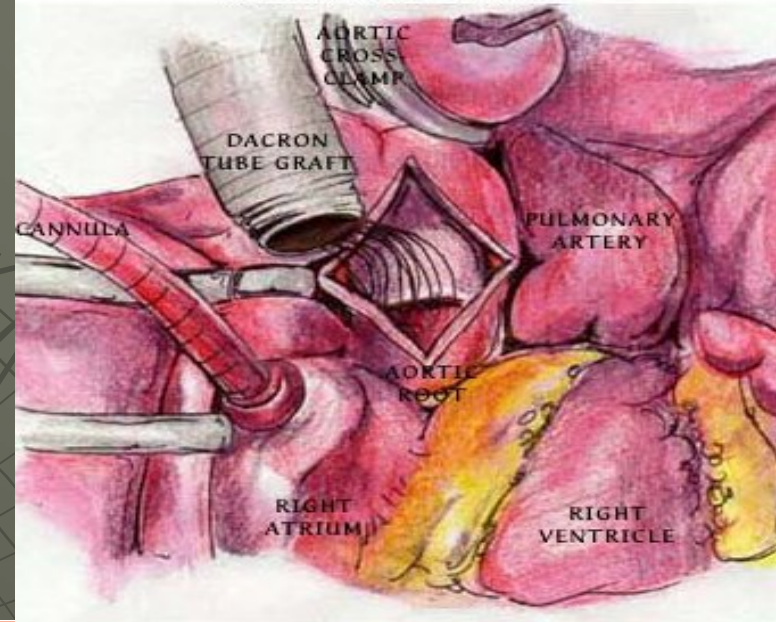
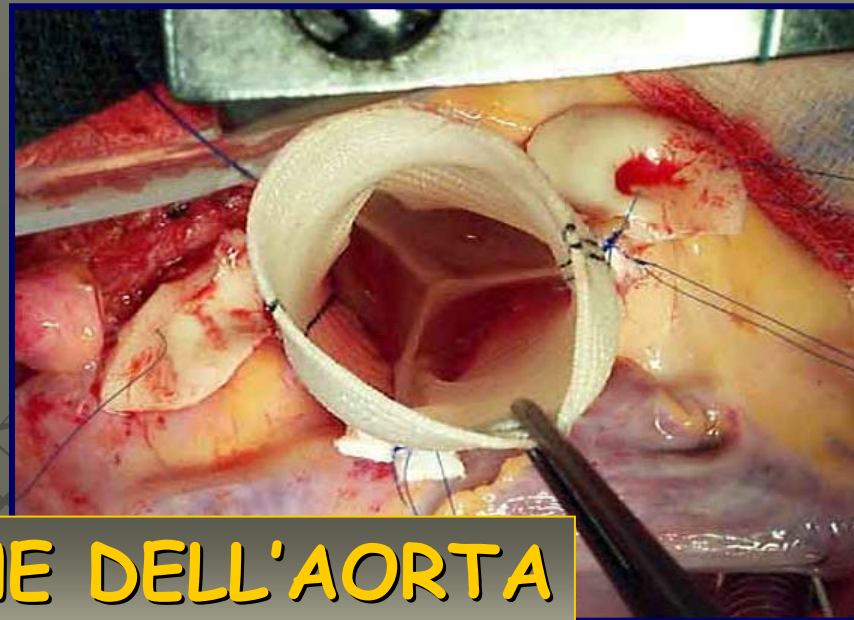
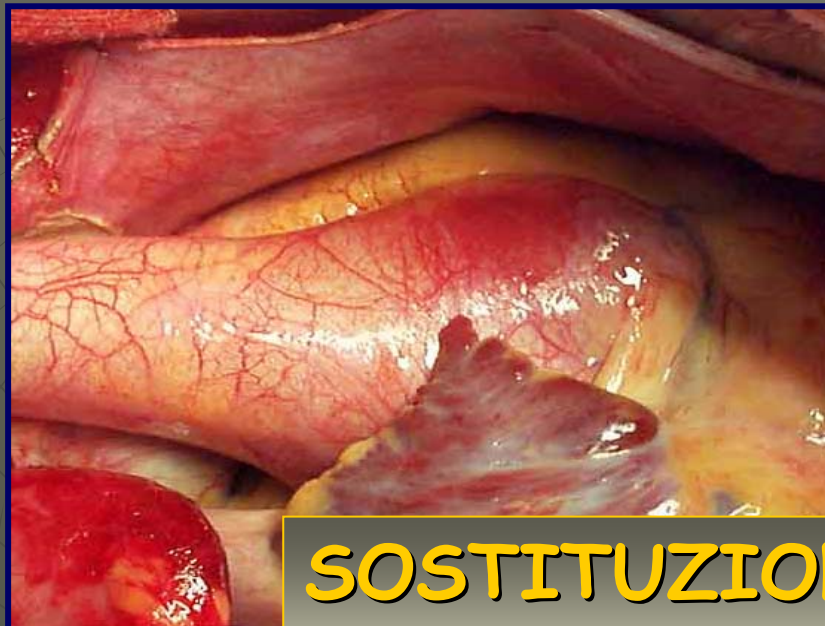
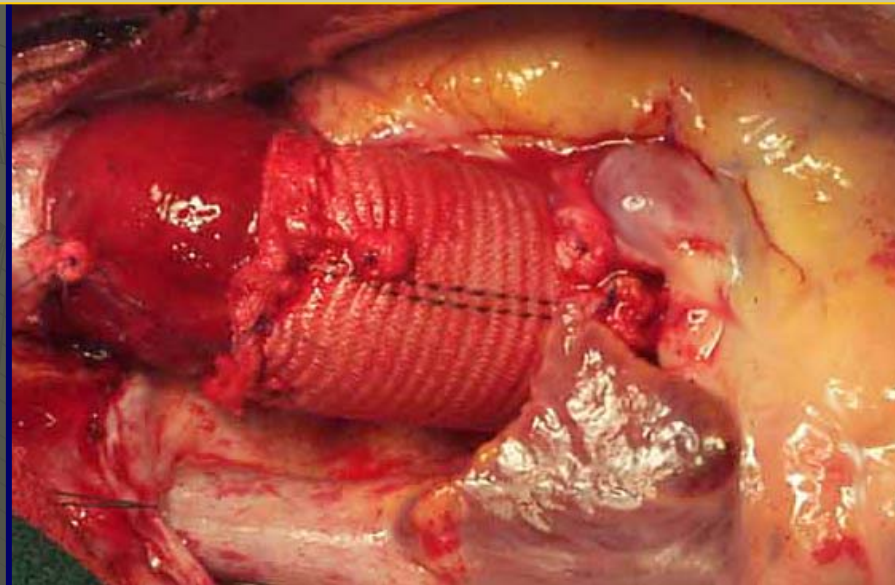


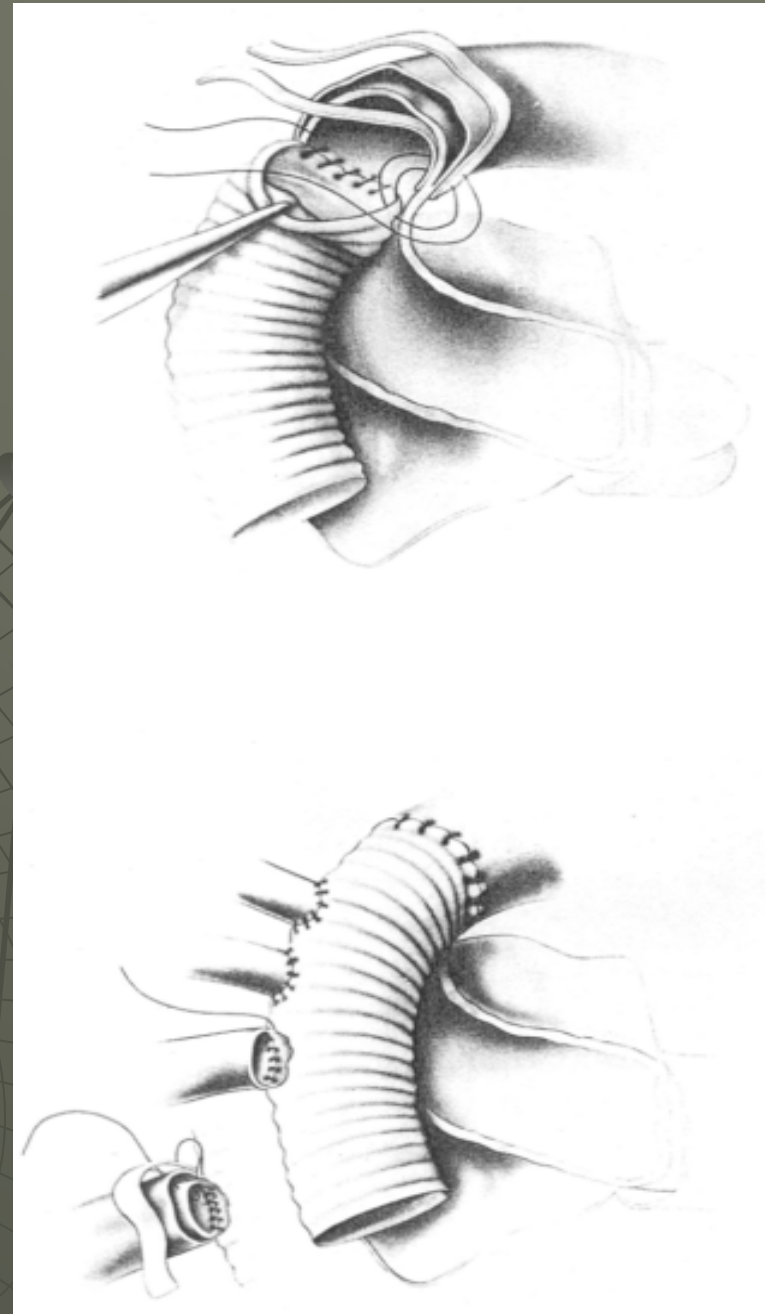
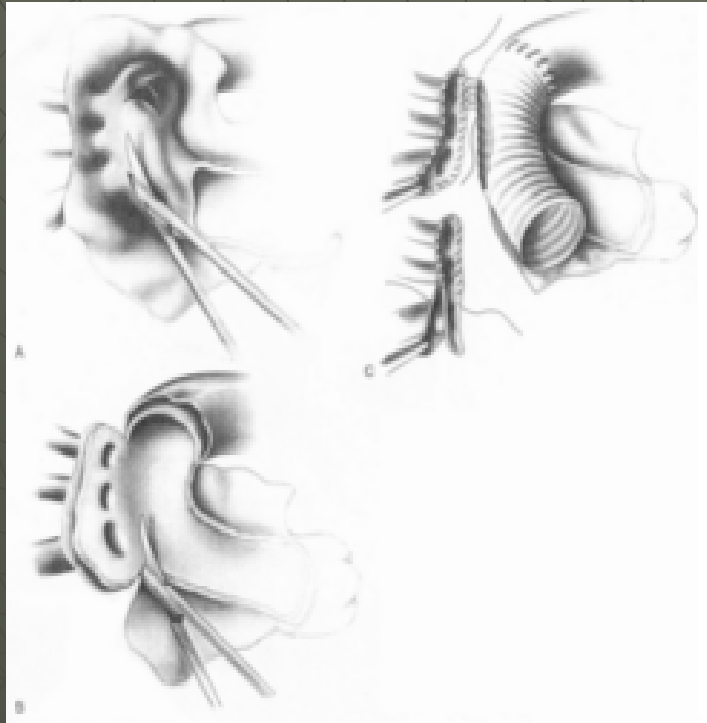
Fig. 7.1. Intervento secondo Bentall-De Bono modificato di sostituzione dell'aorta ascendente per un aneurisma. L'aorta ascendente è sostituita da un condotto valvolato, le coronarie sono reimpiantate sul condotto.



**SOSTITUZIONE DELL'AORTA
ASCENDENTE**



REIMPIANTO DEI TRONCHI EPIAORTICI

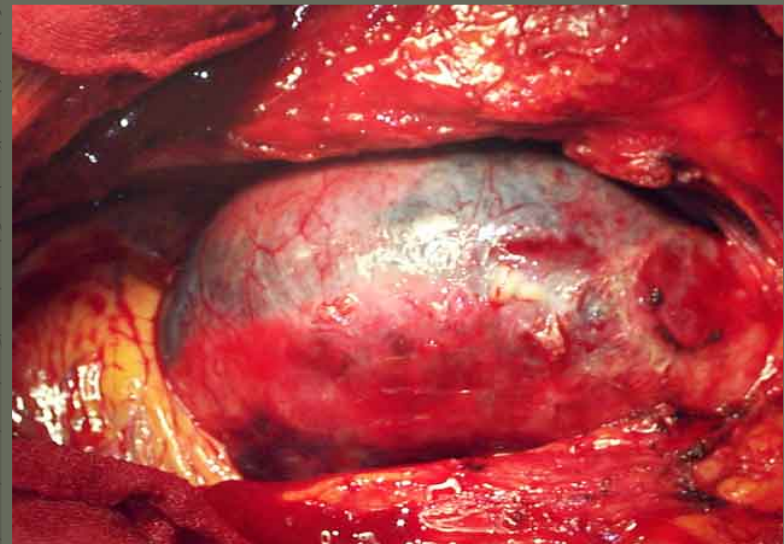


COMPLICANZE

- ◆ **Danno cerebrale**
- ◆ Paresi e Paraplegia
- ◆ Disfunzione e Insufficienza renale
- ◆ Disfunzione polmonare
- ◆ Reintervento

PROTEZIONE CEREBRALE DURANTE CHIRURGIA DELL'AORTA E DELL'ARCO

- IPOTERMIA PROFONDA CON
ARRESTO DI CIRCOLO (DHCA)
- PERFUSIONE CEREBRALE
RETROGRADA (CRP)
- PERFUSIONE CEREBRALE
SELETTIVA
(SCP) ANTEROGRADA
SECONDO KAZUI



MONITORAGGIO DELLA TEMPERATURA



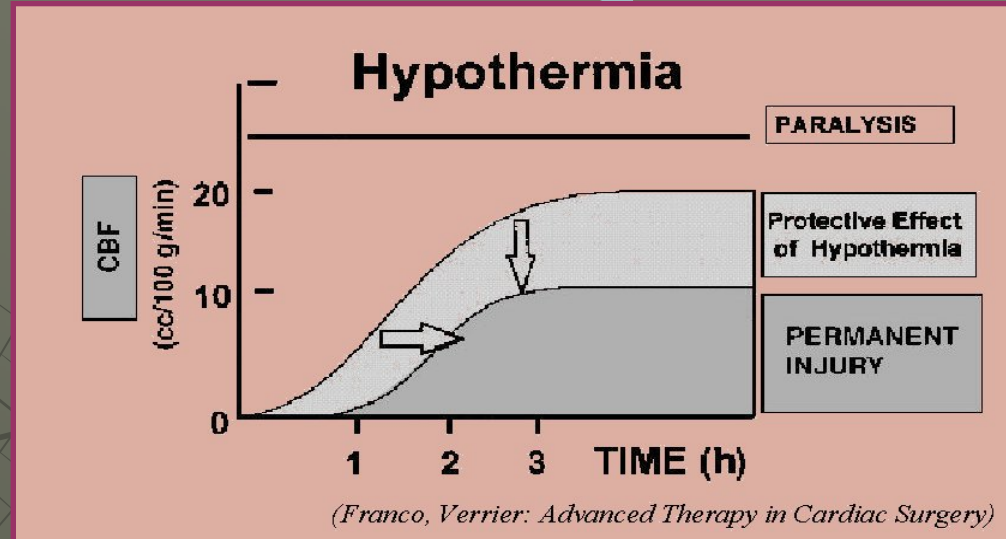
**IN CASO DI IPOTERMIA PROFONDA ED
EVENTUALE ARRESTO DI CIRCOLO, IL
RAFFREDDAMENTO DELLE RADICI
DEGLI ARTI O DELLA TESTA CON
BORSE DI GHIACCIO RIMANE
TUTTORA UNO DEI PRESIDI PIU'
VALIDI**

1) IPOTERMIA PROFONDA E ARRESTO DI CIRCOLO (DHCA)

- TECNICA SEMPLICE
- CAMPO ESANGUE E LIBERO DA CANNULE
- FACILE ISPEZIONE DELL'ANEURISMA
- OPEN AORTIC ANASTOMOSIS

Protective mechanism of brain during HCA

- Exact mechanism
 - unknown
 - Major effect
 - hypothermic metabolic suppression



Safe Duration of HCA

•Temp • (°C)	Cerebral Metabolic Rate (% of baseline)	Safe Duration of HCA (min)
•37	100	5
•30	56 (52-60)	9 (8-10)
•25	37 (33-42)	14 (12-15)
•20	24 (21-29)	21 (17-24)
•15	16 (13-20)	31 (25-38)
•10	11 (8-14)	45 (36-62)

•Q10 : 2.3 (to 15 °C; 2.05, 15-11.4 °C; 3.5)

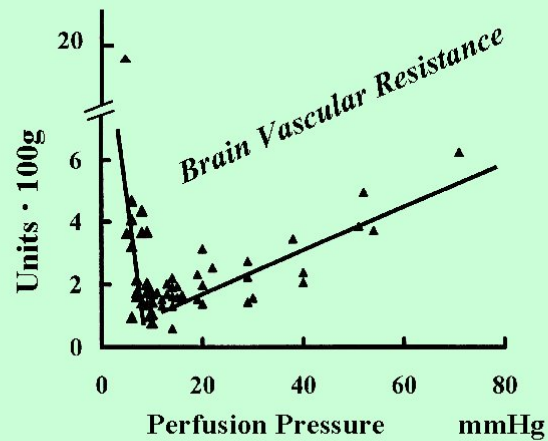
(Ann Thorac Surg 1999;67:1895-9)

Hypothermic protection

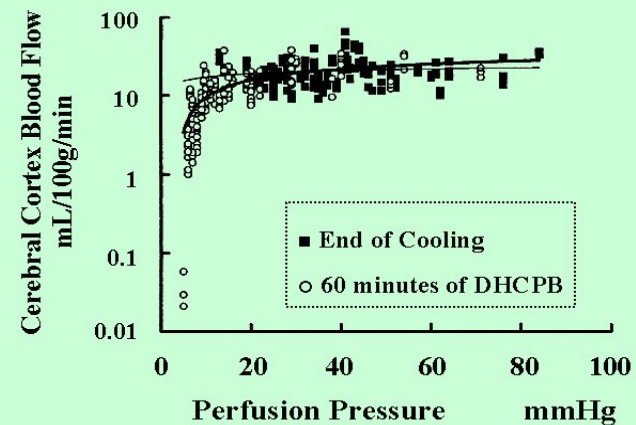
- ↓ in O_2 demand, ↑ in ischemic tolerance
- Degree of protection is not proportional to metabolic rate reduction
- inhibition of biosynthesis, release, and uptake of these excitatory neurotransmitters
- Glutamate remained depressed even after rewarming to normothermia

Cerebral Vascular Resistance and Flow During Hypothermic CPB

CVR vs Perfusion Pressure



Cerebral cortex blood flow at 20°C



(Ann Thorac Surg 1999;68:867)

DHCA

TEMPO LIMITE DI SICUREZZA (TEORICO)

30 MINUTI A 15°C

MC CULLOUGH: Annals Thoracic Surgery 1999; 54:609-16

2) PERFUSIONE CEREBRALE RETROGRADA

- WASH OUT EMBOLICO
- SUPPORTO NUTRITIVO

UEDA Y. (Osaka Prefectural General Hospital-JAPAN)
Journal Cardiovascular Surgery 1990; 31: 553-8

CASISTICA

COSELLI J. (590 Pazienti di cui **290** con DHCA E CRP)

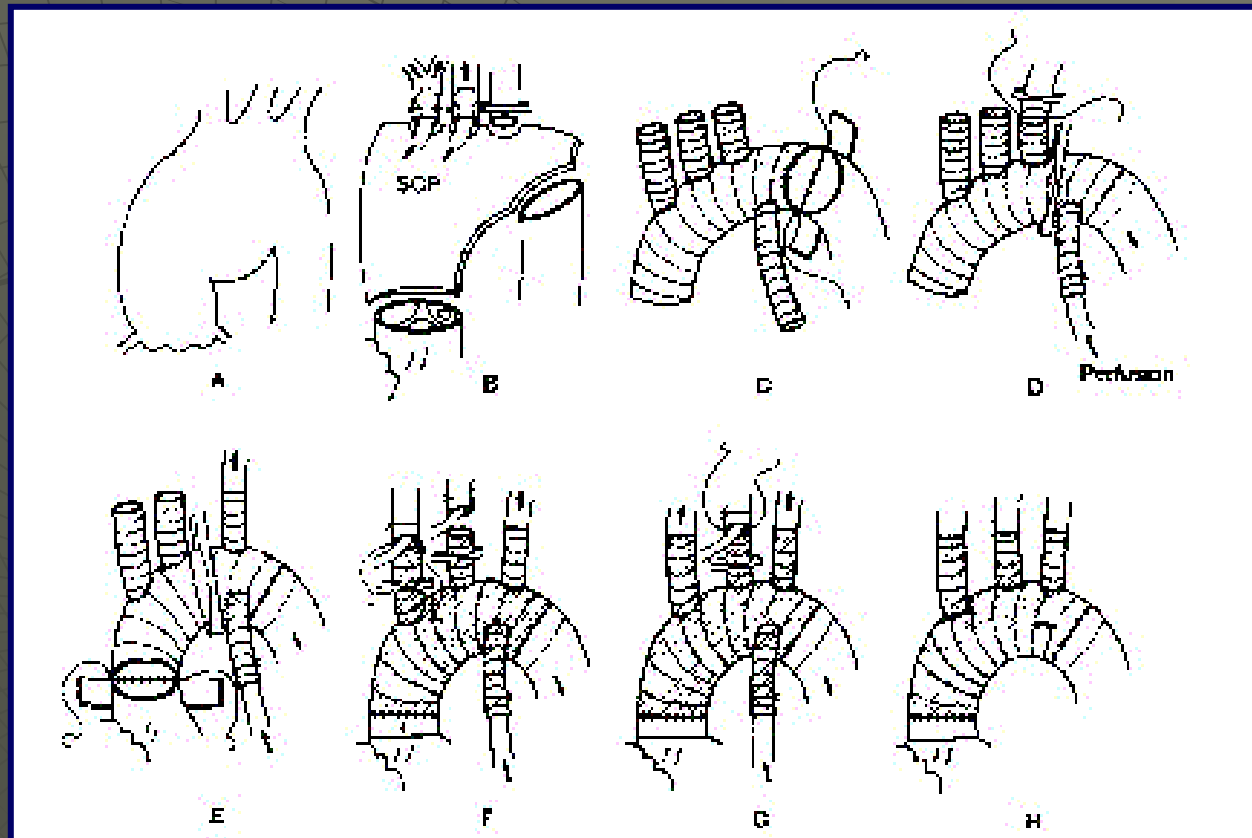
DHCA + CRP

MORTALITA'
3.4 %

DHCA

MORTALITA'
14.8 %

3) PERFUSIONE CEREBRALE SELETTIVA SECONDO KAZUI



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TECNICA DI CANNULAZIONE SELETTIVA



- TRONCO ANONIMO
- ARTERIA CAROTIDE COMUNE SINISTRA

VANTAGGI

ALLO STATO ATTUALE DELLE CONOSCENZE NON E' POSSIBILE INDICARE UNA METODICA DI PROTEZIONE CEREBRALE VALIDA IN ASSOLUTO PER LA CHIRURGIA DELL'AORTA, TUTTAVIA SULLA BASE DELLA LETTERATURA E DELL'AMPIA CASISTICA RIPORTATA, SI PUO' RITENERE LA SCP COME LA MIGLIORE TECNICA DI PROTEZIONE CEREBRALE PER:

- SICUREZZA DEI TEMPI DI ARRESTO CIRCOLATORIO
- RIDUZIONE DELLE COMPLICANZE COAGULATIVE, POLMONARI E MICROEMBOLICHE LEGATE ALL'IPOTERMIA PROFONDA

MONITORAGGIO NEUROLOGICO INTRAOPERATORIO

- DOPPLER TRANSCRANICO
- ELETTROENCEFALOGRAMMA
- PESs
- NIRS
- SbjVO₂
- CMRO₂(TEORICO)



MONITORAGGIO NEUROLOGICO



➤ DOPPLER TRANSCRANICO

VALUTAZIONE DEL FLUSSO EMATICO CEREBRALE

➤ EEG, PES_s

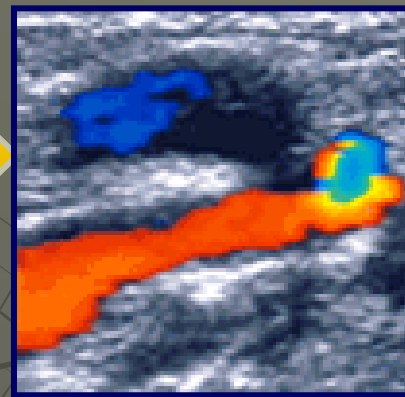
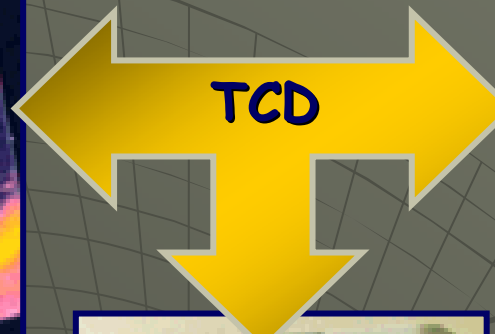
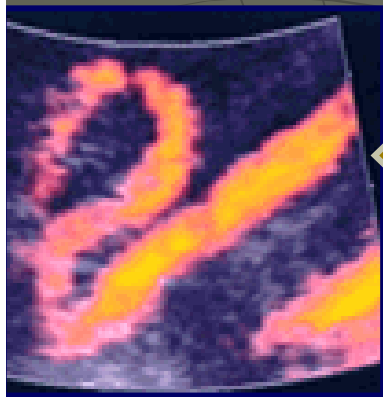
VALUTAZIONE DEL DANNO NEURONALE

➤ SbjVO₂, NIRS, CMRO₂

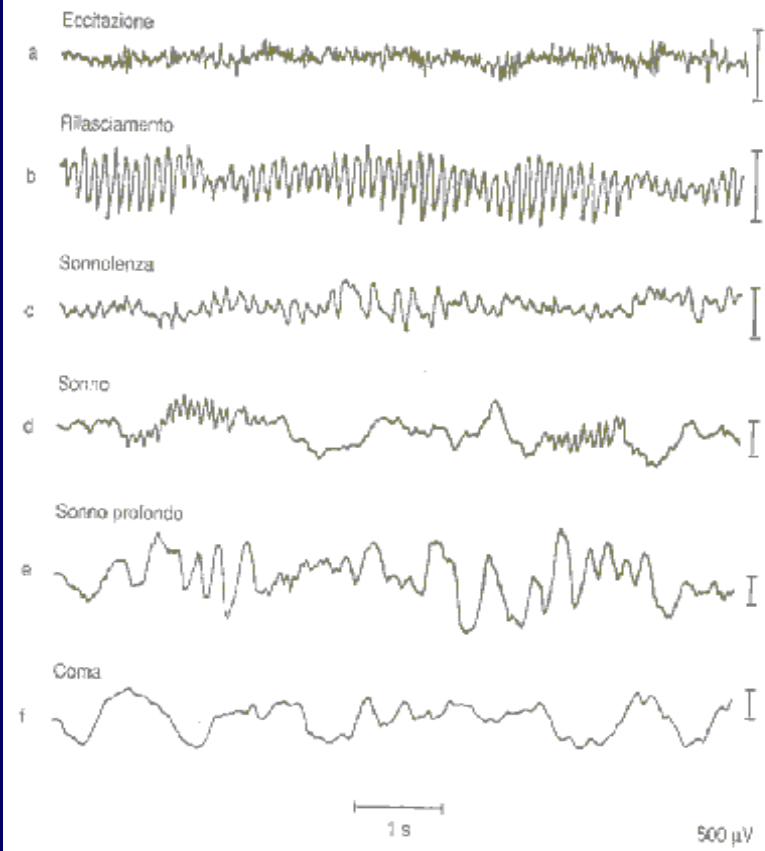
VALUTAZIONE DELLO STATO METABOLICO E DELLA OSSIGENAZIONE DEL CERVELLO

L'AUMENTO DEL CONSUMO DI OSSIGENO
E' INDICE DI SOFFERENZA CEREBRALE

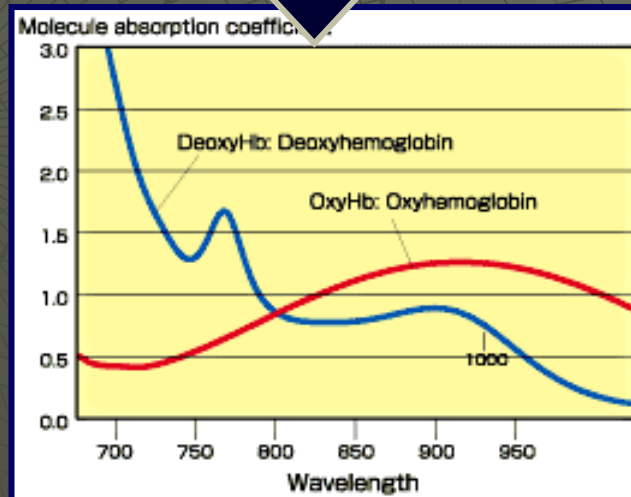
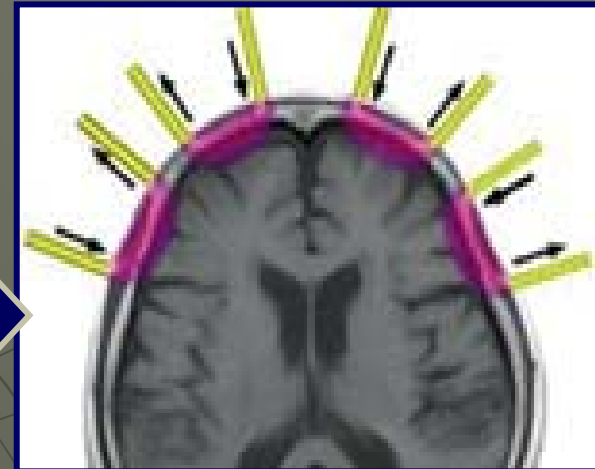
DOPPLER TRANSCRANICO



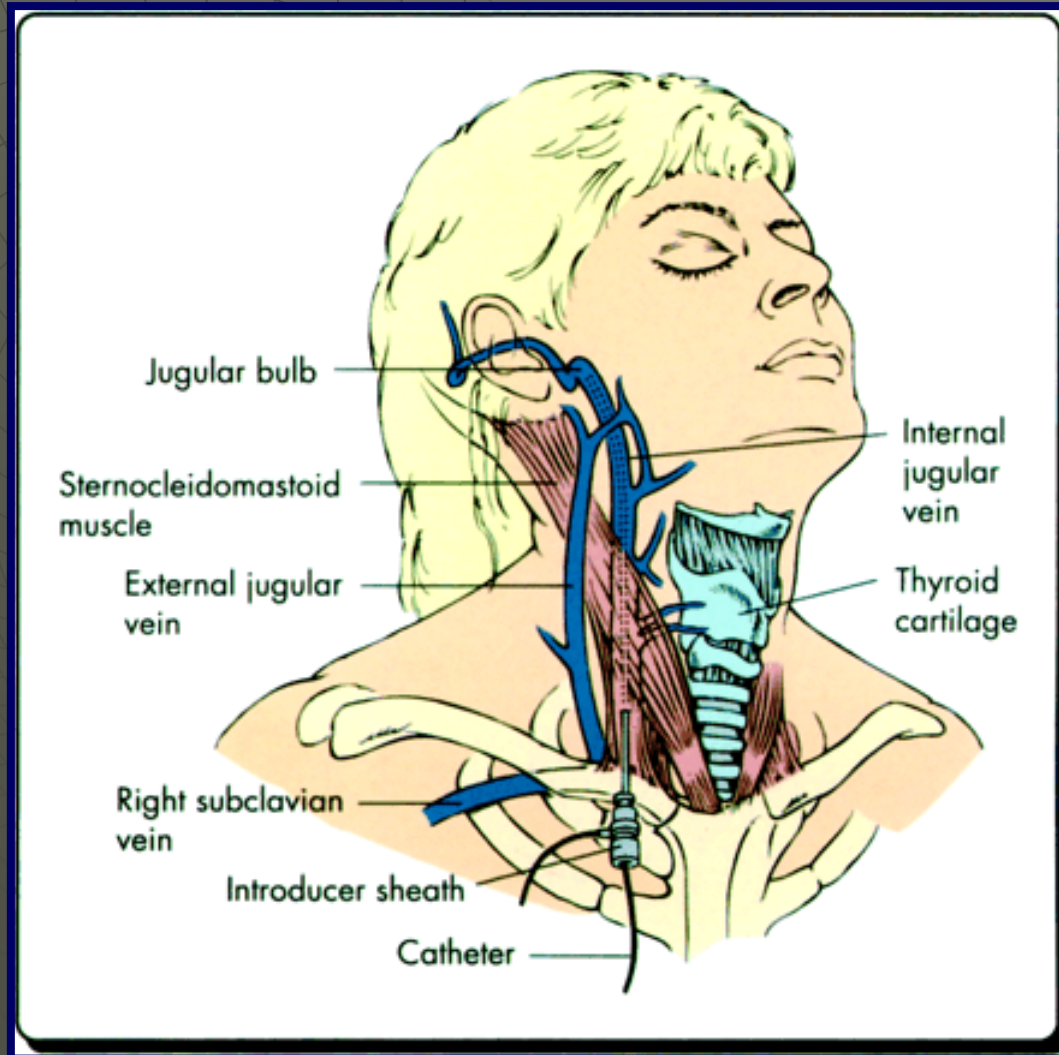
ELETTROENCEFALOGRAFIA



NEAR INFRARED SPECTROSCOPY



JUGULAR VENOUS OXIMETRY



$S_{BJ}VO_2$

CMRO₂

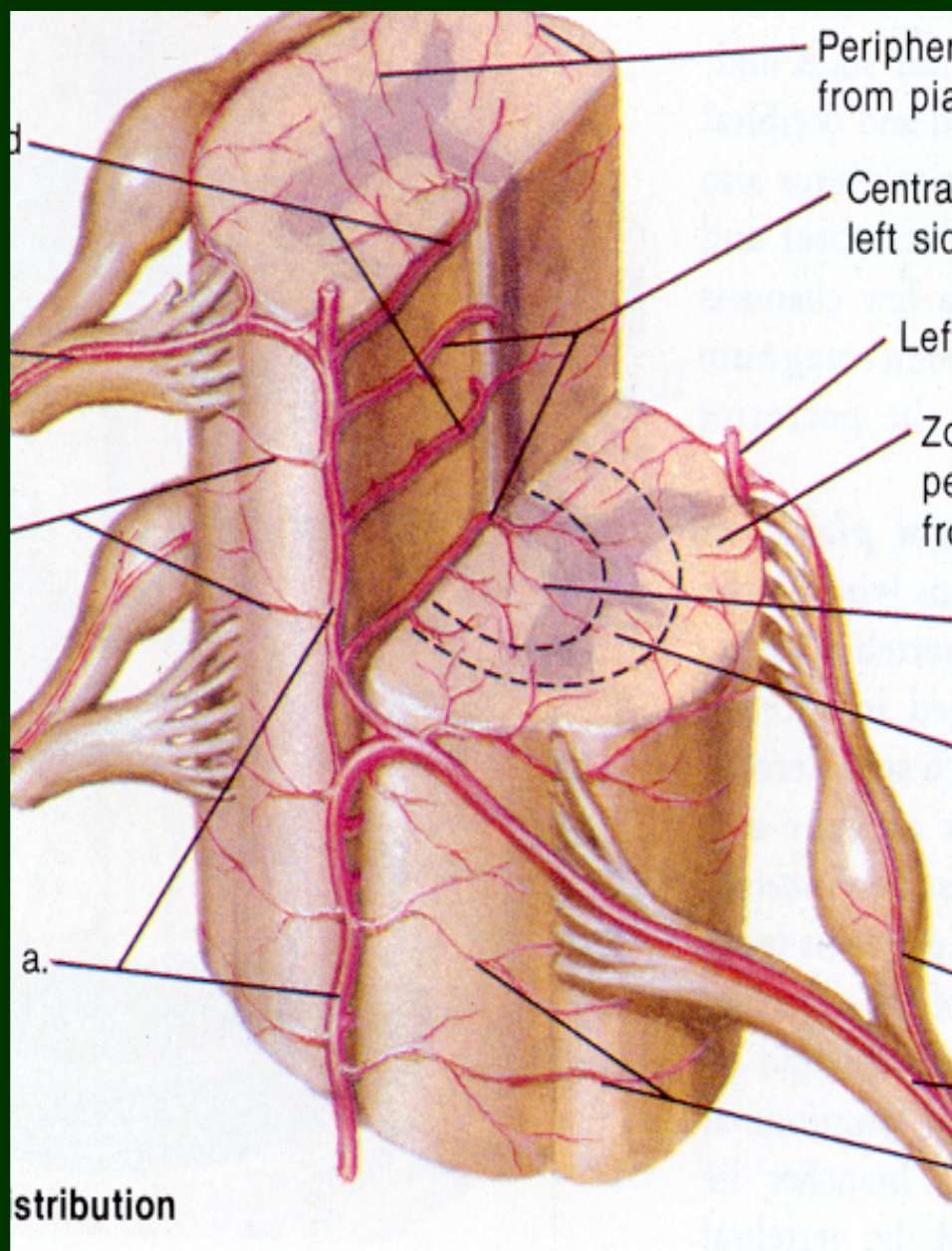
CMRO₂ = (CONSUMO CEREBRALE DI O₂)

CBF x a-vjDO₂

TRATTAMENTO POSTOPERATORIO

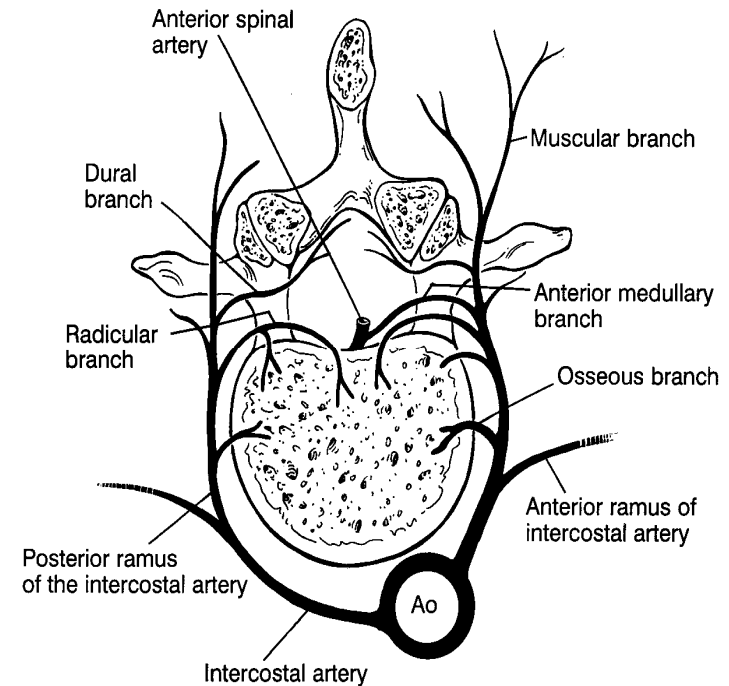
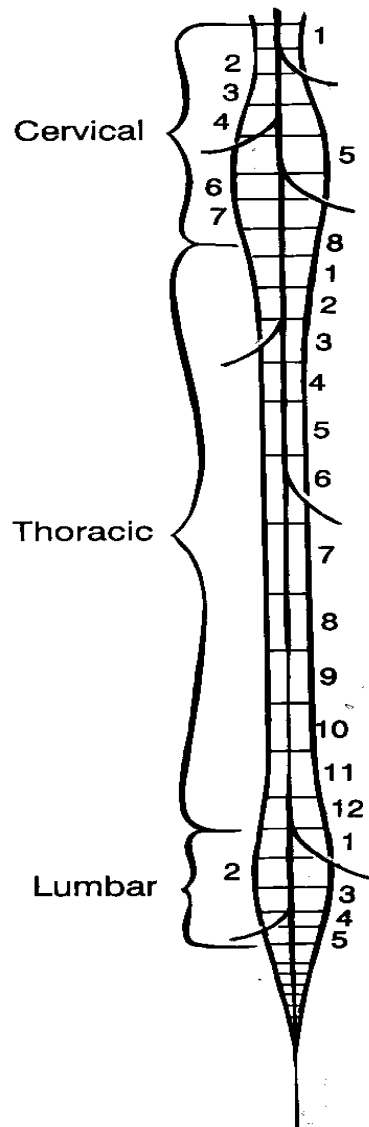
- RISCALDAMENTO ATTIVO PER OTTENERE LA STABILIZZAZIONE TERMICA
- EVITARE E/O CONTROLLARE L'IPERGLICEMIA
- INSTAURARE TRATTAMENTO PRECOCE IRA CON CRRT
- SEDAZIONE CON PROPOFOL 1-2 mg/Kg/h
- SOGLIA LIMITE DI RISVEGLIO: II^a GIORNATA (VALUTAZIONE EEG E/O TAC CEREBRALE)

Blood supply of spinal cord



- 75% : ASA
- 25% : PSA from PICA
- ASA from :
 - Radicular a from intercostal
 - and lumbar aa.
 - Basilar, vertebral, cervical
 - Iliac a.

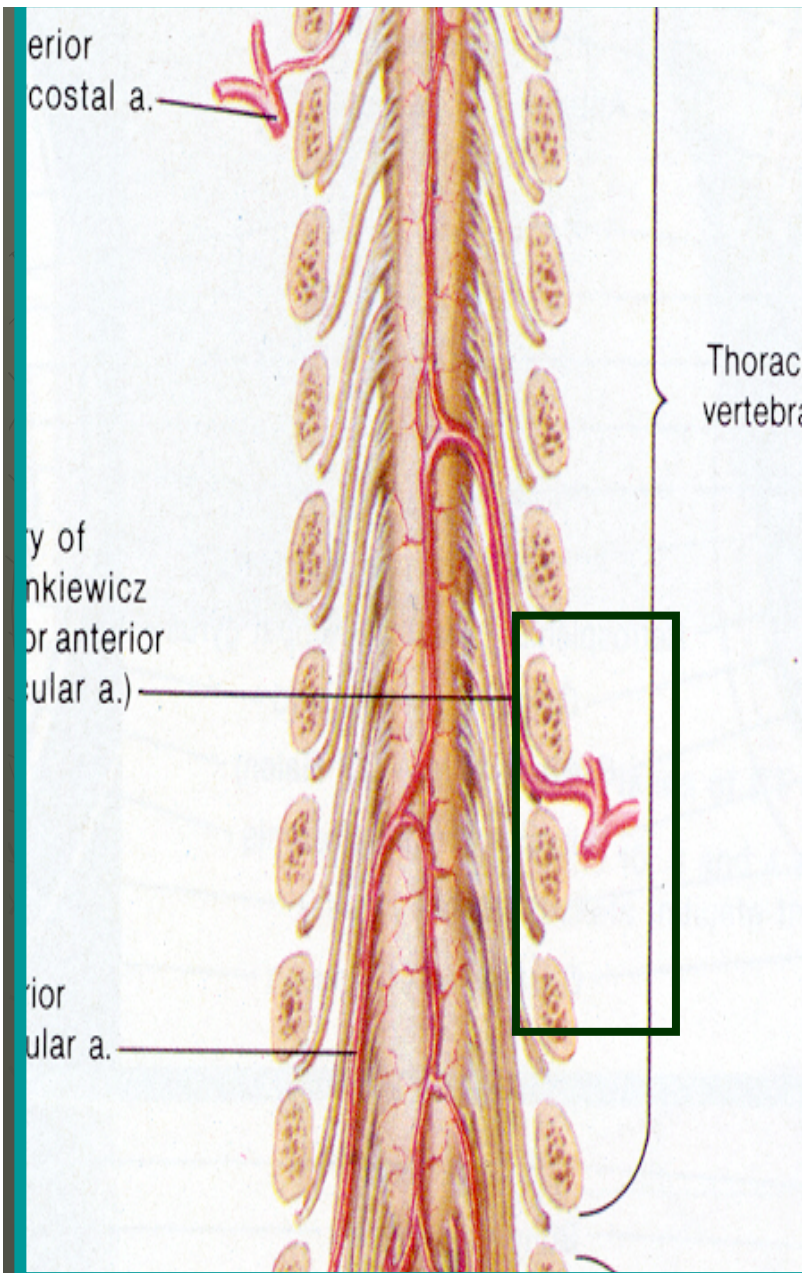
Radicular arteries



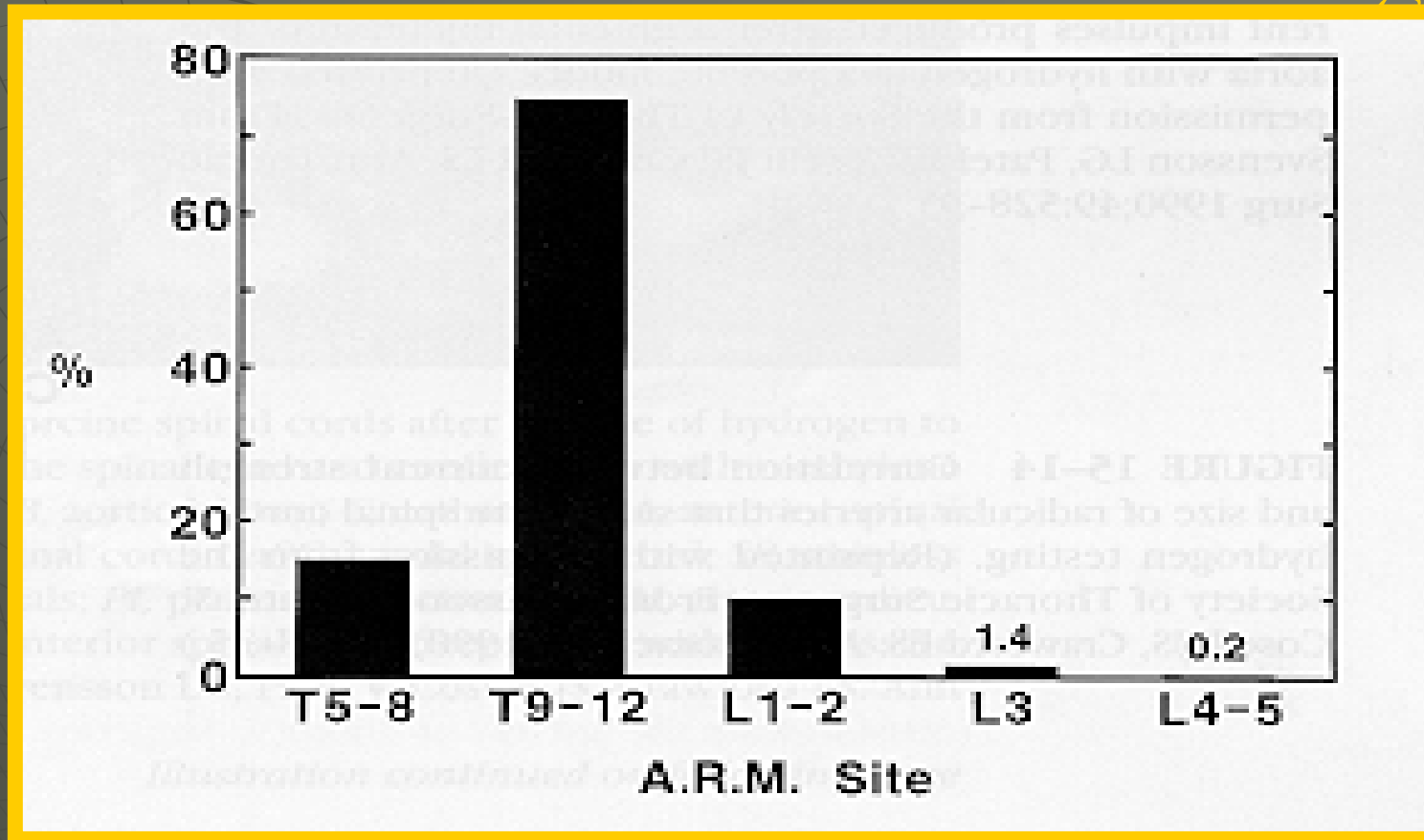
- 6 ~ 10 ant radicular a
- T3 ~ T7
 - usually one radicular a
 - poor afferent supply
 - may be discontinuous

Artery of Adamkiewicz

- ◆ Major ant. radicular artery
- ◆ From T₇ ~ L₁
- ◆ Larger than the other
- ◆ Hairpin bend
- ◆ Perfuses the spinal cord distal to junction with ASA
- ◆ ASA above ARM is smaller in diameter than below the ARM

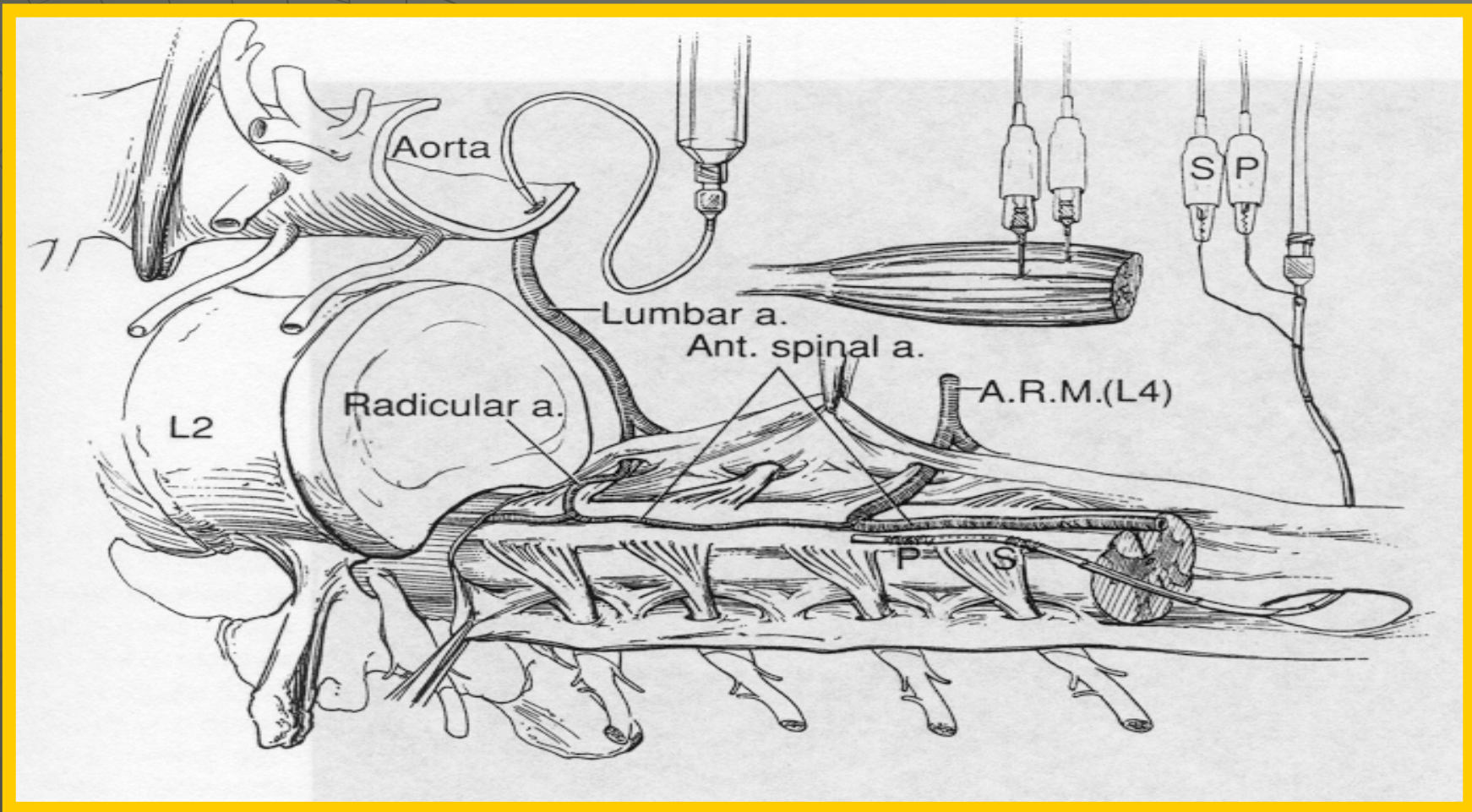


Sites of Arteria Radicularis Magna

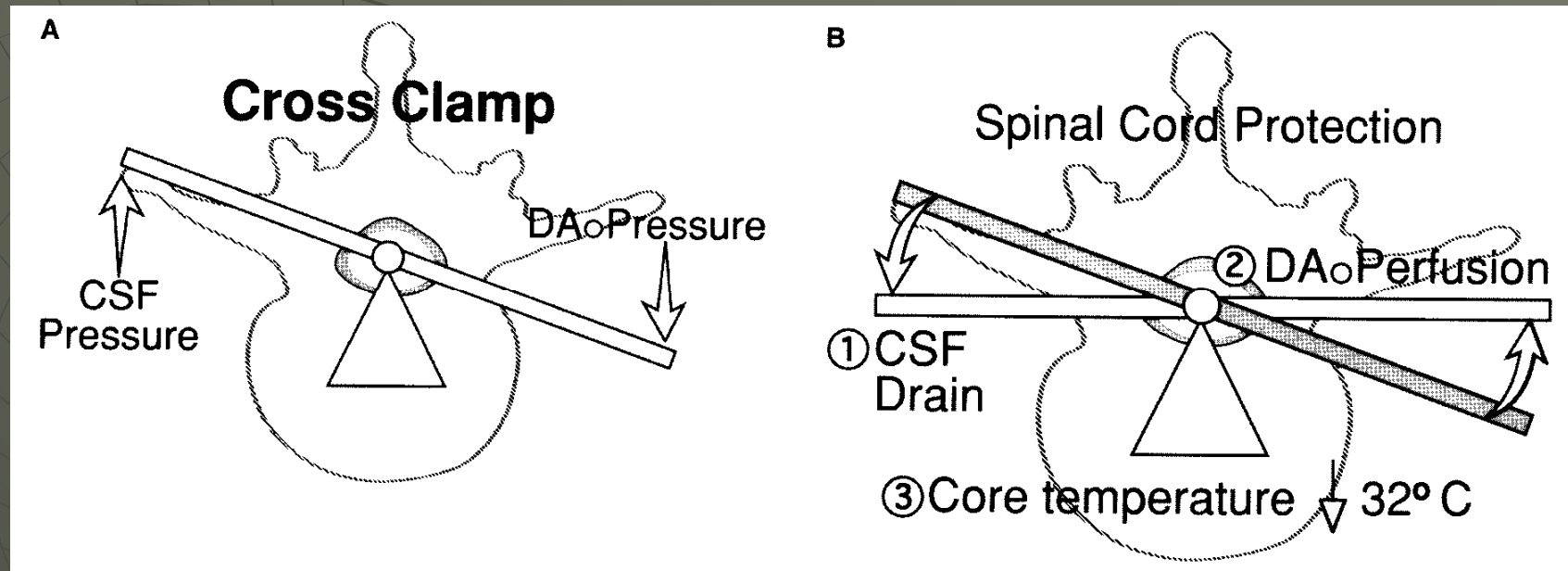


- Based on this finding, recommend, whenever possible, all intercostal and lumbar arteries from T₆ down to and including L₁ should be reattached

(Lars G. Svensson, 1998)



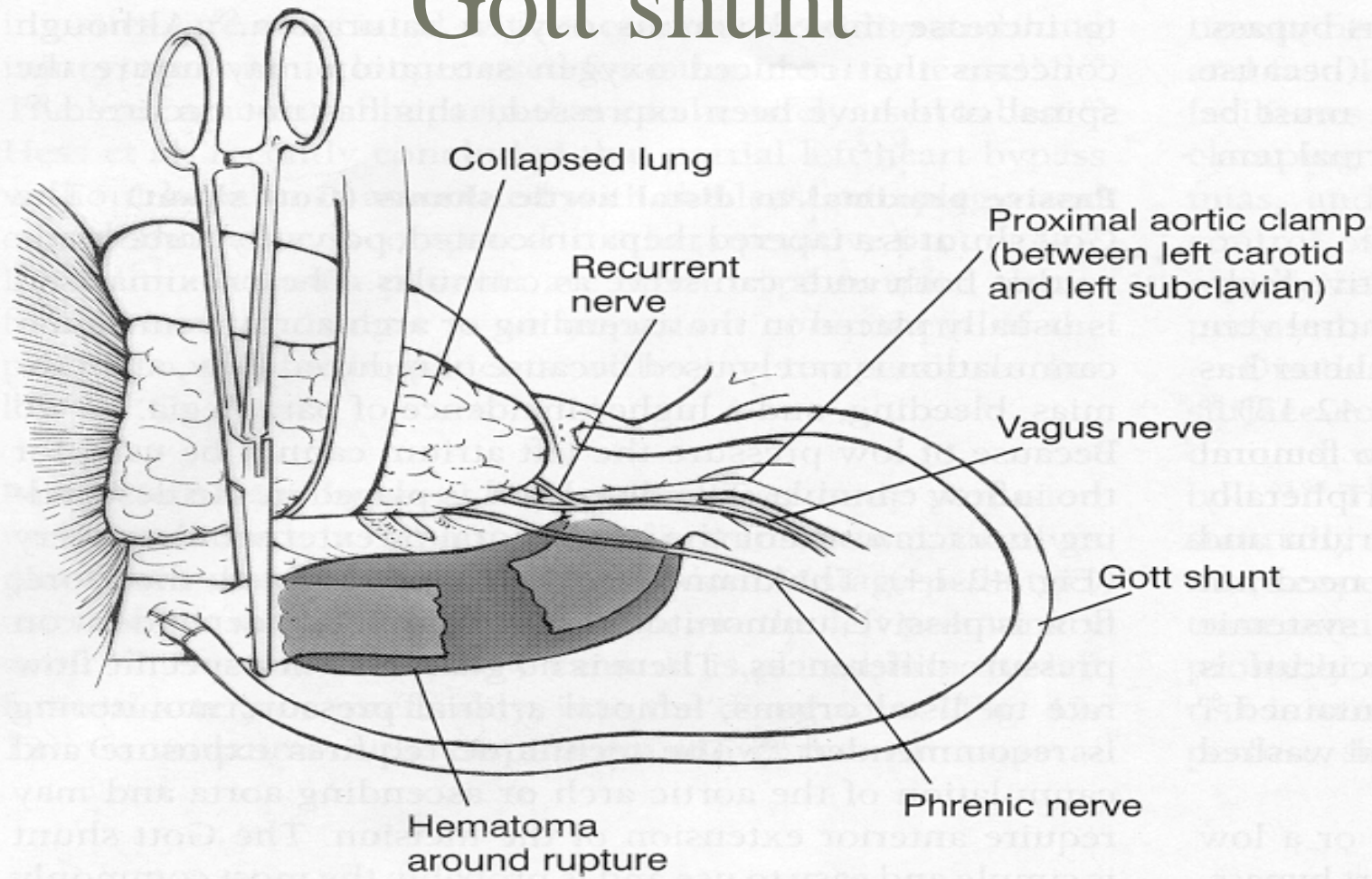
CSF drainage



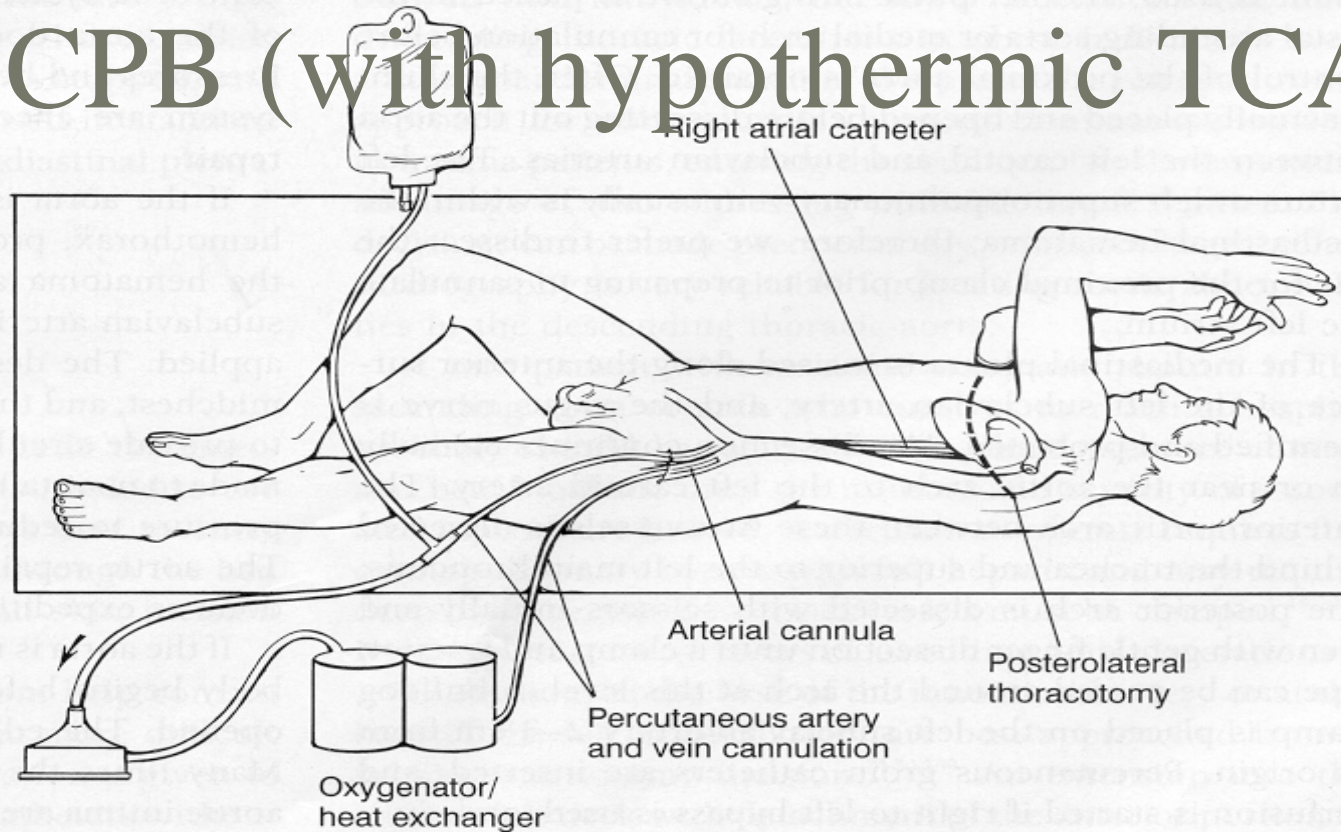
A) During ACC, distal Ao. Pr. decreases markedly, causing a reduction in spinal a. perfusion Pr. and a subsequent increase in CSF Pr. B) LA to LtFA bypass, or distal aortic perfusion, increases distal Ao. Pr. leading to an increase in the spinal a. perfusion Pr., thus increasing blood flow to the spinal cord. The addition of CSFD further decreases CSF Pr. and augments the perfusion of the spinal cord. Moderate hypothermia (32°C) provides additional spinal cord protection.

(Safi, et al.)

Gott shunt



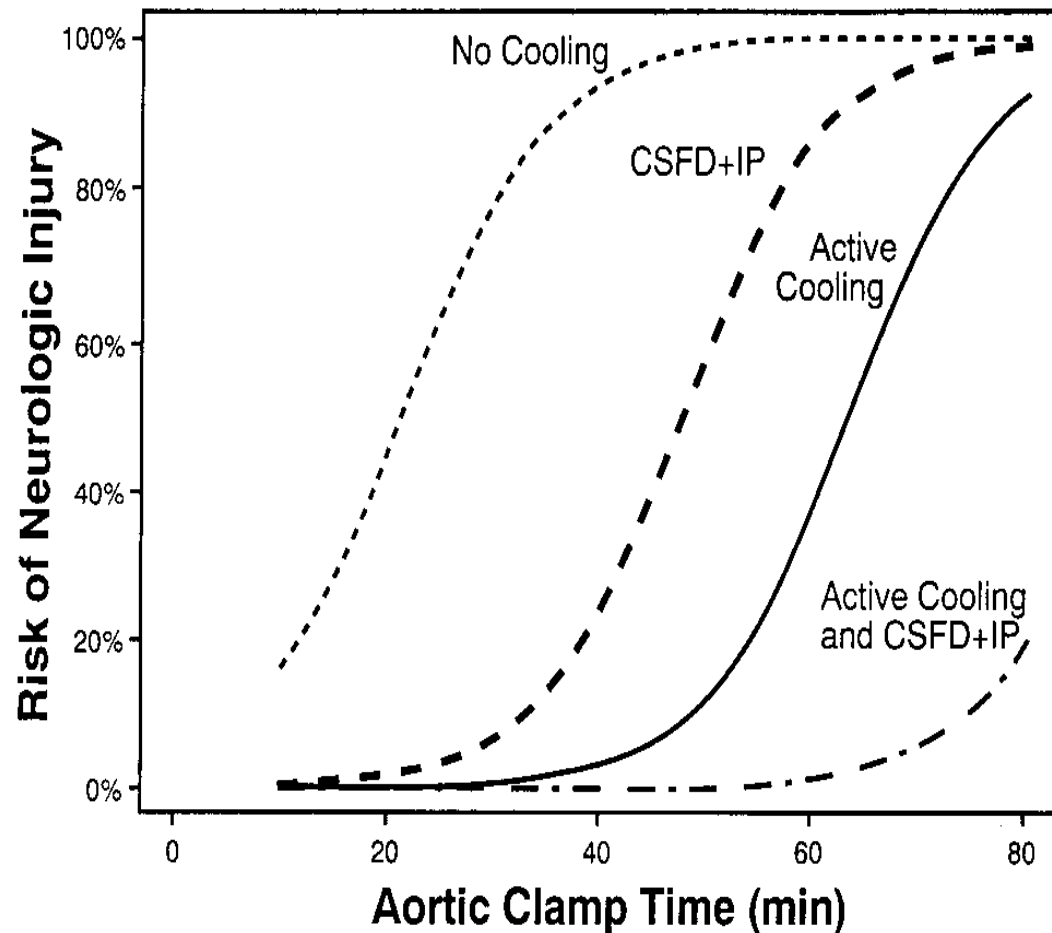
CPB (with hypothermic TCA)



- Kouchoukos et al : 9.8% early mortality, 6.5% cord injury
- Crawford et al : paraplegia in 2/25 due to unable to anastomose critical intercostal aa
- Distal perfusion pr > 60 mmHg

An approach to spinal cord protection during descending or thoracoabdominal aortic repairs

Lars G Svensson (*ATS 1999;67:1935-6*)



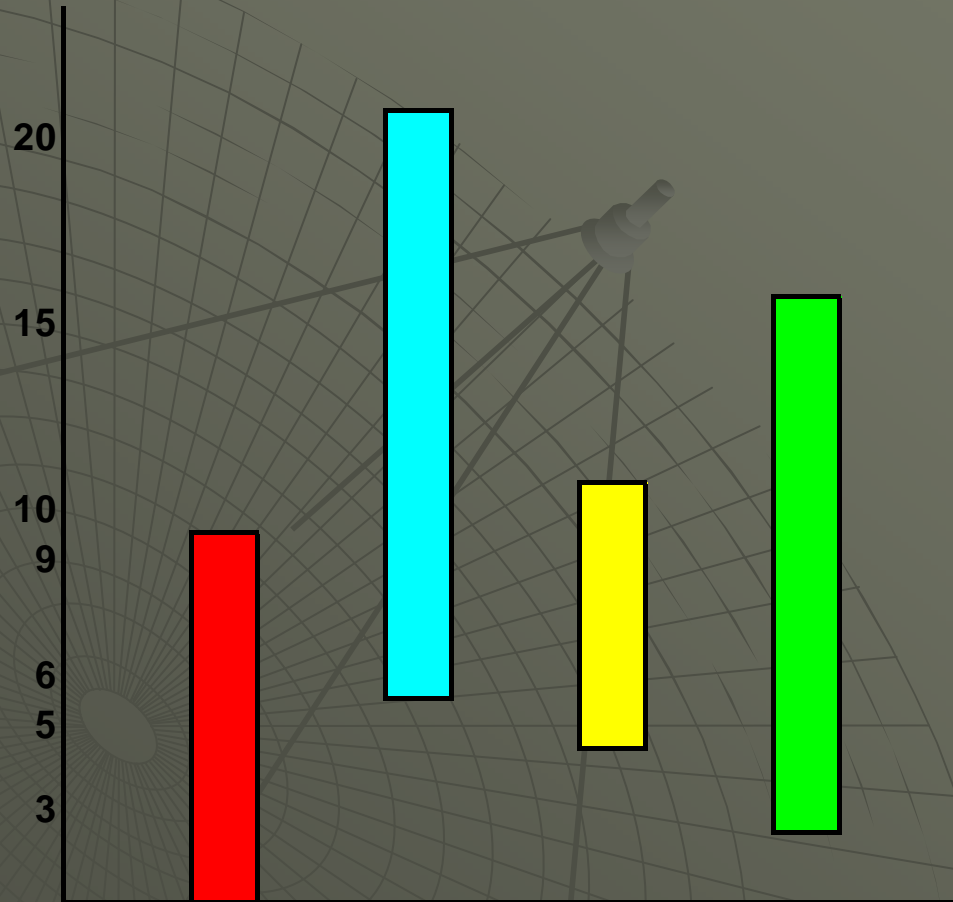
- LA fem bypass
- systemic hypothermia (29 - 30 ° C)
- CSF drainage
- IT papaverine
- Various topical and local cooling techniques
- Reattachment of intercostals btw T6 - L2

Unfortunately, there are *no prospective randomized studies showing that any one method is significantly effective*, but it is likely that *a combination of various techniques and agents* reduces the risk of this dreaded complication

By Lars G. Svensson

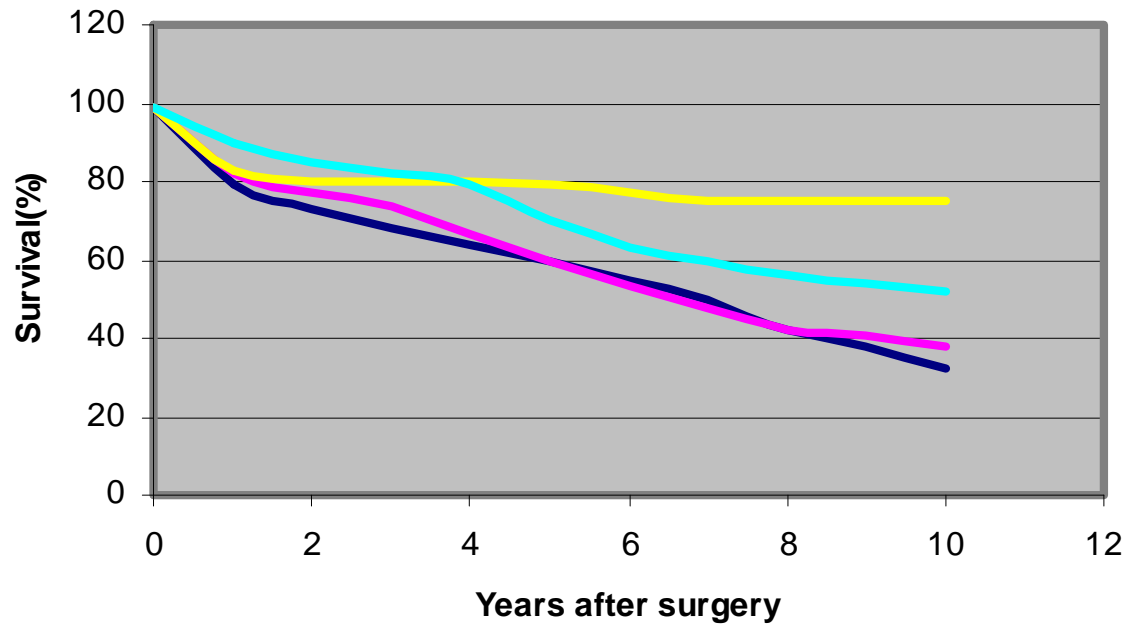
Mortalità PostOperatoria

MORTALITA' %



A.Ascendente Arco Aortico A.Discendente A.Toracoaddominale

Prognosi



- — A. toracoaddominale — Arco Aortico
- — A. Discendente — A. Ascendente

CAUSE DI MORTE

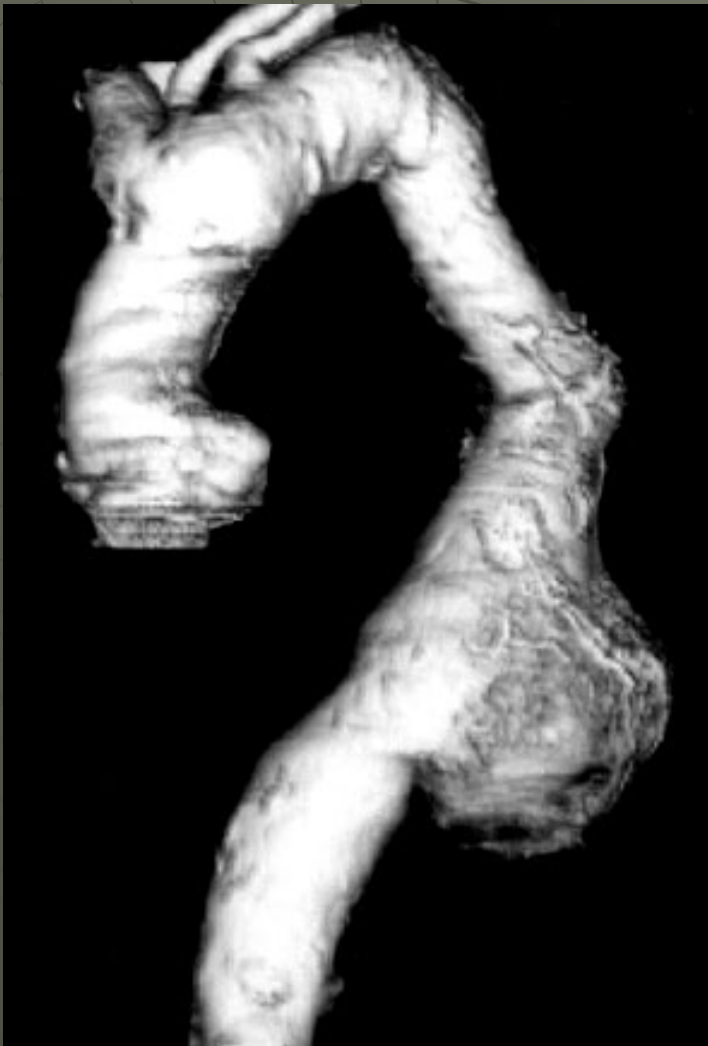
◆ PRECOCI

- Infarto miocardico
- Scompenso cardiaco
- Emorragia
- Disfunzione neurologica

◆ TARDIVE

- Scompenso cardiaco
- Rottura di un nuovo aneurisma
- Insufficienza renale
- insufficienza respiratoria

ENDOPROTESI



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