

A 5 year - old boy
Extracardiac Fontan (At 3 yr)
Fenestration (+)
Good hemodynamics

Warfarin vs. Aspirin

Thrombo - Embolism Incidence after Fontan op

■ Incidence

Venous TE	3 - 33%
Stroke	3 - 19%

From many literatures,
(1971 - 2002, more than 50 studies)

Variability of TE Incidence

- Dx method

TEE 33 %

- Longer FU duration

Upto 20%, 33% Recently

- Modification Fontan op.

AP Fontan (20%), LT (13%), EC (24%)

Recently EC (7%, 0% Recently)

- Anticoagulation type

No medication (22%), Aspirin (7%), Warfarin (4%)

- Fenestration

Stroke (+/-) 4.3/0.95%

Morbidity & Mortality of TE

- Despite aggressive Tx

Total resolution	48%
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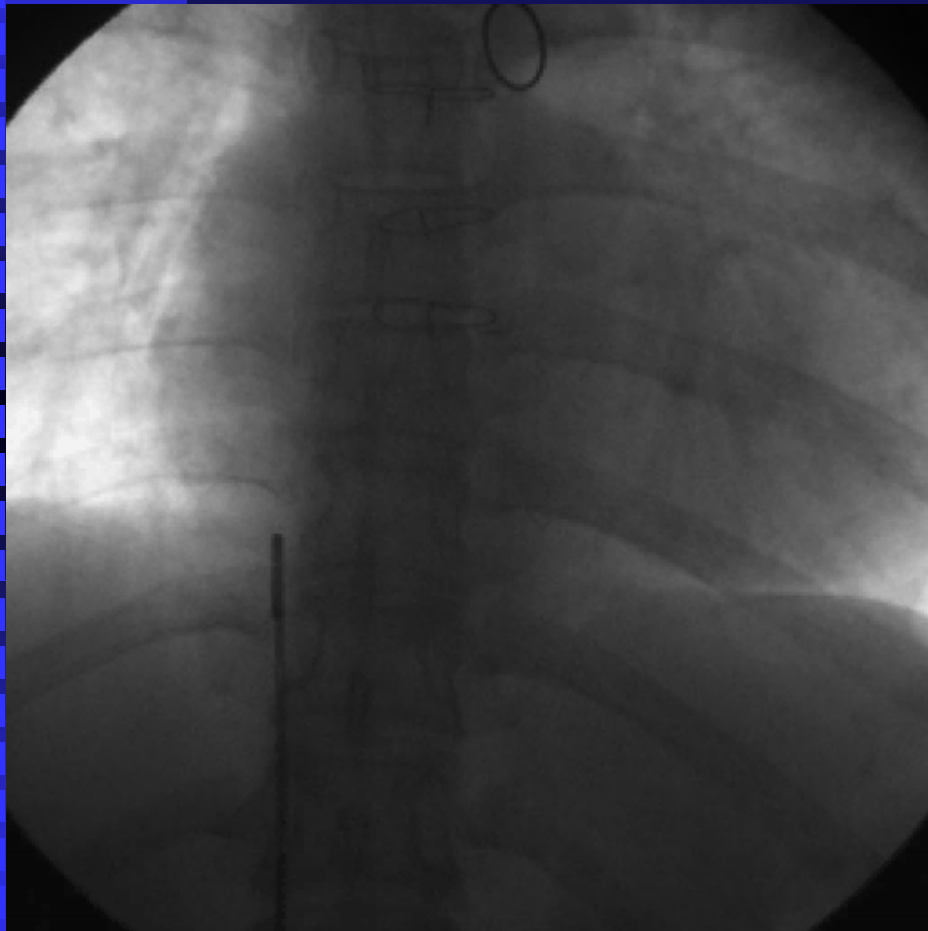
Death	25%
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- True Incidence ?

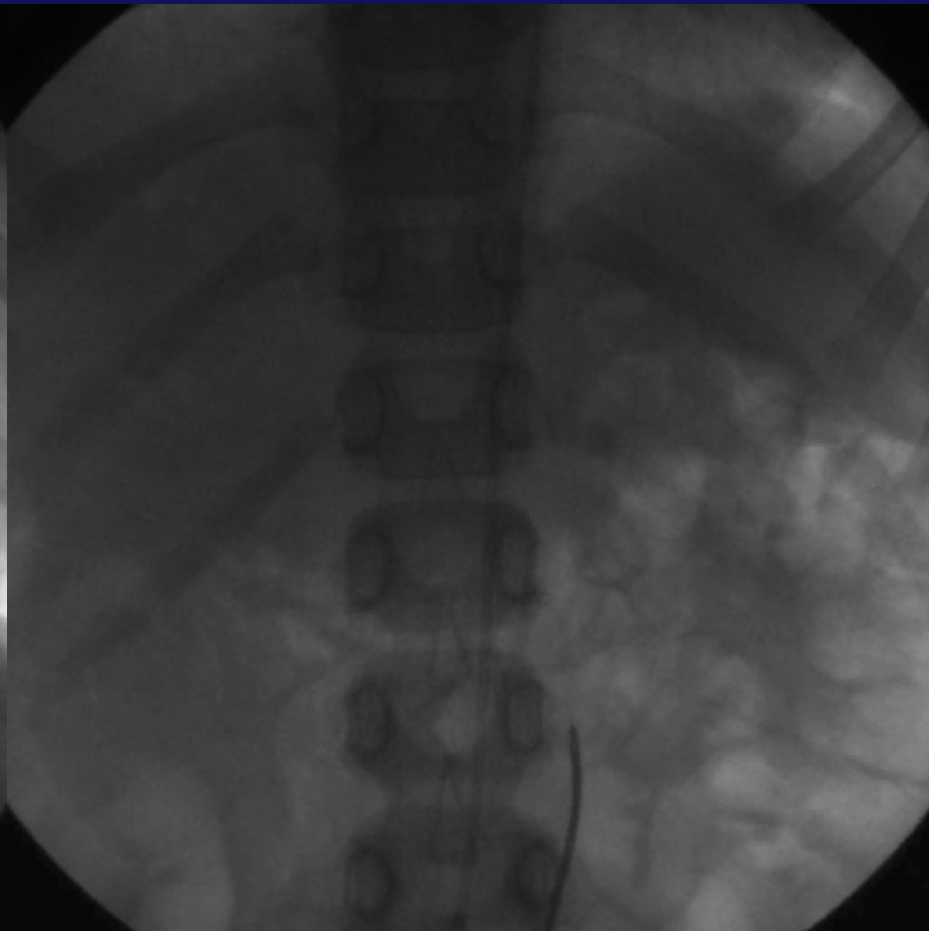
- No consensus about type & duration of anticoagulation

s/p AP Fontan

s/p EC Fontan



Markedly dilated RA
& flow stasis



Laminar flow in strait
& tubular conduit

Experience of Thrombo-Embolism In Fontan Patients

Sejong Hospital

Patients

■ 1996.8 - 2005.2

■ EC Fontan Op.	183	
Fenestration	82	(45 %)

Detection of TE

- Intraop. TEE
- TTE before discharge
- F/U TTE
- Angiography
- CT angiography

TE after Fontan

- OPD FU (Mean) 3.6 yr (1m - 8.8yr)
F/U cath. 87 pts (49.2%)

- TE Incidence

6.6% (12/183)

2 Events per 100pts - yr

Patients with TE Events (I)

➤ Localization of TE

CVA or systemic TE	2
SVC, PA or conduit	9
Both	1

➤ Interval from op

Immediate	9
Late 4.7yr)	3 (6m, 10m,

92% < 1yr after Fontan

Patients with TE Events (II)

➤ Potential Predisposing Factors

Stenosis in Fontan pathway	4
Protein C deficiency	2
Immobilization	2
Arrhythmia (AET, SAN dysfunction)	2

✓ in Systemic TE (n=3)

Fenestration & high CVP,VEDP	1
Fenestration & thrombus in conduit	1
Patent MPA stump	1

Patients with TE Events (III)

➤ Antithrombotic Agent at Detection

Aspirin	8
Heparin	2
Warfarin	2

➤ Treatment

Op.	6
Heparinization	4
Thrombolytic Tx (UK)	1
No Tx	1

Patients with TE Events (IV)

➤ Outcome

Complete resolution	66%
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(8/12)

Minor neurologic sequelae	17%
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(2/12)

Others	17%
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(2/12)

Antithrombotic Prophylaxis

Antithrombotic prophylaxis

Aspirin	91%	(159/174)
Warfarin	9%	(15/174)

Warfarin Ix (n=15)

Prior TE Hx	7
(Including coagulopathy 2)	
High Rp or PAP, high VEDP	3
Fixed stenotic lesion in pathway	2
Flow stasis (SEC on Echo)	2
Mechanical valve	

Strategies for TE Prevention

- PV obliteration
No blind pouch
- Avoidance of fenestration in good hemodynamics
High spont. closure rate (74%)
Active coil embolization
- Others
Avoidance of PA distortion
Early removal of central line
Early IV heparin infusion
Early extubation
Evaluation of coagulopathy



Conclusion

✓ Good hemodynamic

No fixed stenosis of PA

No arrhythmia

No high CVP

No coagulopathy

✓ No MPA stump or blind pouch in ventricle

“Aspirin” and Fenestration closure as soon as possible



Thromboembolism Incidence

F/U cath. 87 pts (49.2%)

Mean F/U dur. 4.7 yr (4m - 8.8yr)

Overall TE 4.5% (4/87)

1 events 100 pts per year

CVA or arterial TE 1.1 %(1/87)

0.2 events 100 pts per year

effect of anticoagulation on fenestration ?

- Histologic findings of fenestration
 - : no thrombus
 - : hole closure consisted of vascularized fibrous tissue, marked inflammatory cell response, calcium deposition
- anticoagulation therapy delay and not prevent closure of fenestration

Thrombo - Embolism Incidence after Fontan op.

■ Incidence

Venous TE 3 - 20% (33% on TEE)

Stroke 3 - 19%

- Variable d/t modification of Op.
FU duration
Dx method (TTE vs TEE)

- No consensus about type & duration of antithrombotic prophylaxis

by many literatures from 1971 to 2000
(51 studies)

Major Bleeding by Warfarin

- Major bleeding associated with warfarin
0.7% per patient-year
- Intracardiac thrombus
0.09% per patient-year