



TAVI & thrombose de valve

Géraud SOUTEYRAND
CHU Clermont-Ferrand



Conflits d'intérêts

Consultant Terumo, Medtronic, Abbott, B Braun, Schockwave

THROMBOSE TAVI

Type of Bioprosthetic Valve Dysfunction?

Structural Valve Deterioration

Intrinsic permanent changes to the prosthetic valve, including:

- Wear and tear
- Leaflet disruption
- Flail leaflet
- Leaflet fibrosis and/or calcification
- Strut fracture or deformation

Non-Structural Valve Dysfunction

Any abnormality, not intrinsic to the prosthetic valve, resulting in valve dysfunction.

Paravalvular Regurgitation
see Table 16

Prosthesis-Patient Mismatch

If BMI < 30 kg/m²

Severity	Indexed EOA (cm ² /m ²)
Insignificant	>0.85
Moderate	0.85-0.56
Severe	≤0.65

If BMI ≥ 30kg/m²

Severity	Indexed EOA (cm ² /m ²)
Insignificant	>0.70
Moderate	0.70-0.56
Severe	≤0.55

Other
May include: leaflet entrapment by pannus, tissue, or suture; inappropriate positioning or sizing; dilatation of the aortic root after stentless bioprostheses or aortic valve sparing operations; and embolization

Thrombosis

Subclinical:
(See Table 14)
Imaging findings of HALT/RLM with absent or mild hemodynamic changes and no symptoms/sequelae

Clinically Significant:
(See Table 15)
(1) Clinical sequelae of thromboembolic event or worsening AS/AR **and** HVD Stage 2-3 **or** confirmatory imaging (HALT/RLM)
(2) In the absence of clinical sequelae, **both** HVD Stage 3 **and** confirmatory imaging (HALT/RLM)

Endocarditis

Meeting at least one of the following criteria:
(1) Fulfillment of the Duke endocarditis criteria
(2) Evidence of abscess, pus, or vegetation confirmed as secondary to infection by histological or microbiological studies during re-operation
(3) Evidence of abscess, pus, or vegetation confirmed on autopsy.

THROMBOSE TAVI

Les questions

Fréquent?

Diagnostic?

**Traitement anticoagulant
systématique?**

THROMBOSE TAVI

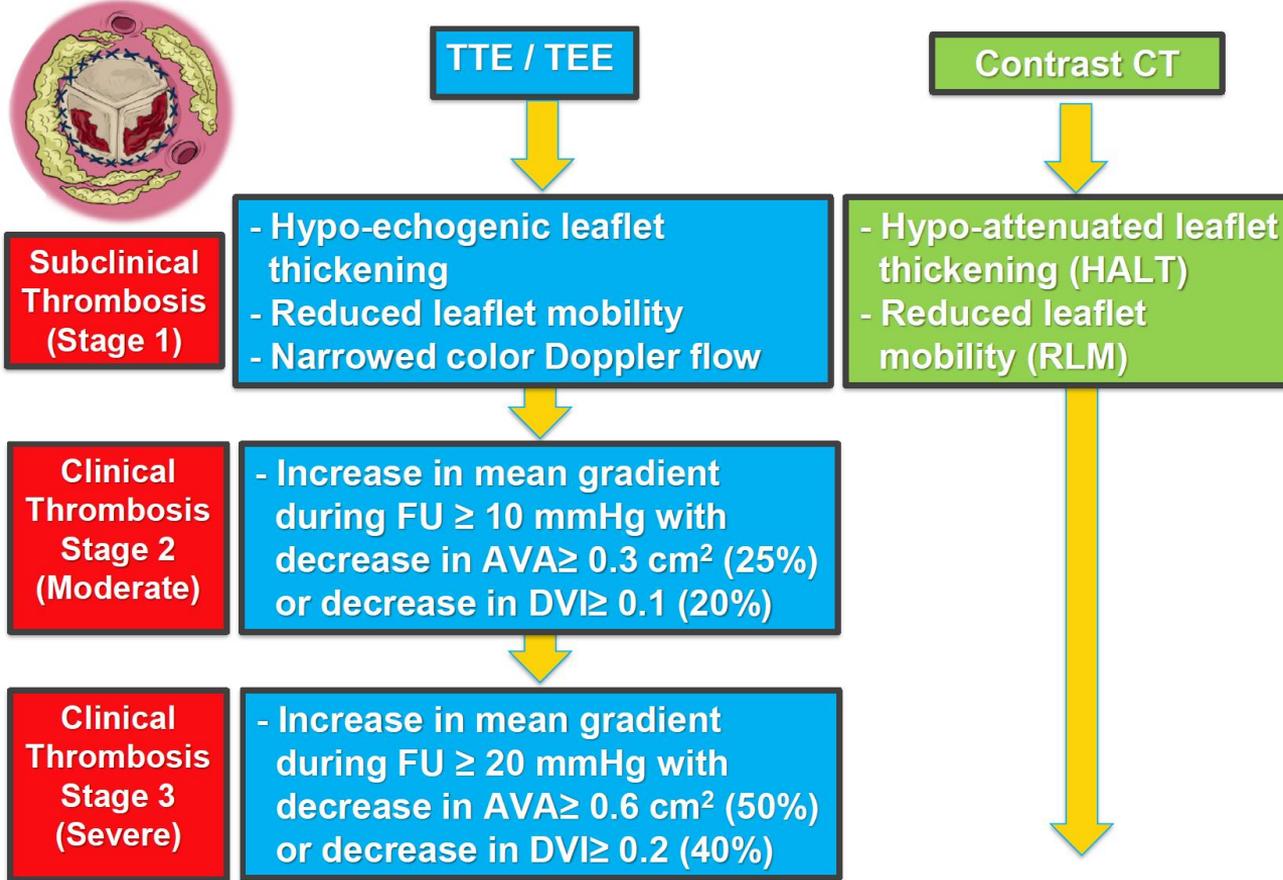
2 entités à différencier

Thrombose sub-clinique

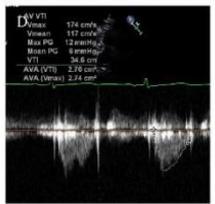
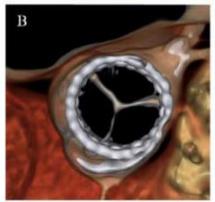
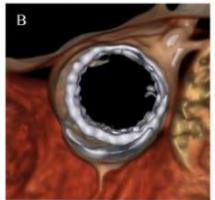
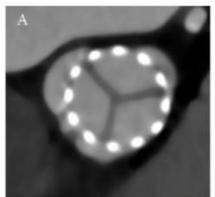
Thrombose clinique

THROMBOSE TAVI

Stages of Bioprosthetic Valve Thrombosis

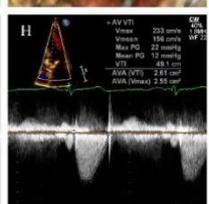
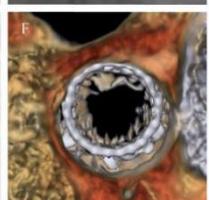
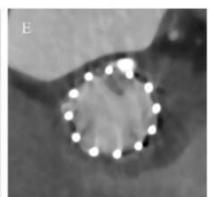


Normal

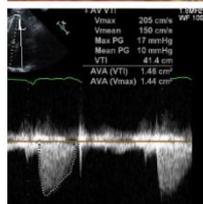
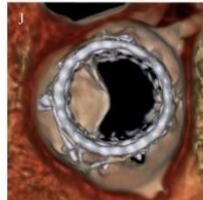
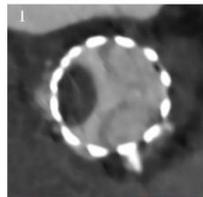


HALT-
RLM-

Subclinical Thrombosis (Stage 1)

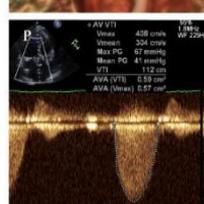
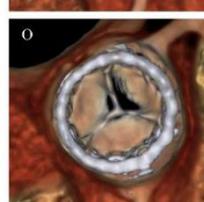
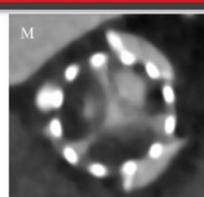


HALT+
RLM-



HALT+
RLM+
No change in ΔP

Clinical Thrombosis (Stages 2 – 3)



HALT+
RLM+
Increase in ΔP

THROMBOSE TAVI

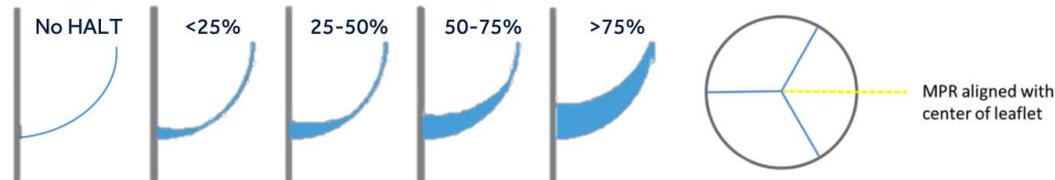
Diagnostic scannographiques

Epaisseur (HALT) +/- reduction de la mobilité des feuillets (RLM)

HALT

Hypoattenuated Leaflet Thickening

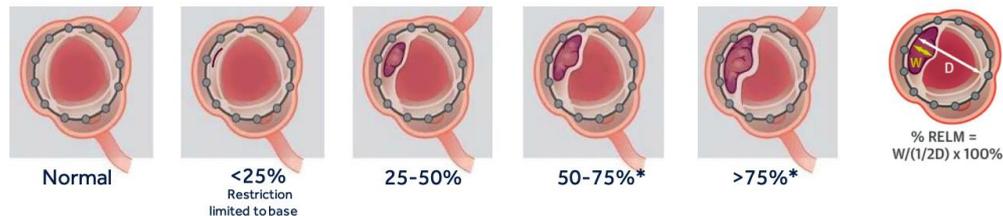
CT (2D MPR or 3D volume-rendering)



RLM

Reduced Leaflet Mobility

CT (2D MPR or 3D volume-rendering) and/or TEE



Jilahawi H. JACC Im 2017
Blanke P. JACC Im 2019

THROMBOSE TAVI

Subclinical leaflet thrombosis in surgical and transcatheter bioprosthetic aortic valves: an observational study

Registres RESOLVE & SAVORY

Entre 2014 et 2017, 931 patients suivis
Scanner dans les suites : 890 interprétables

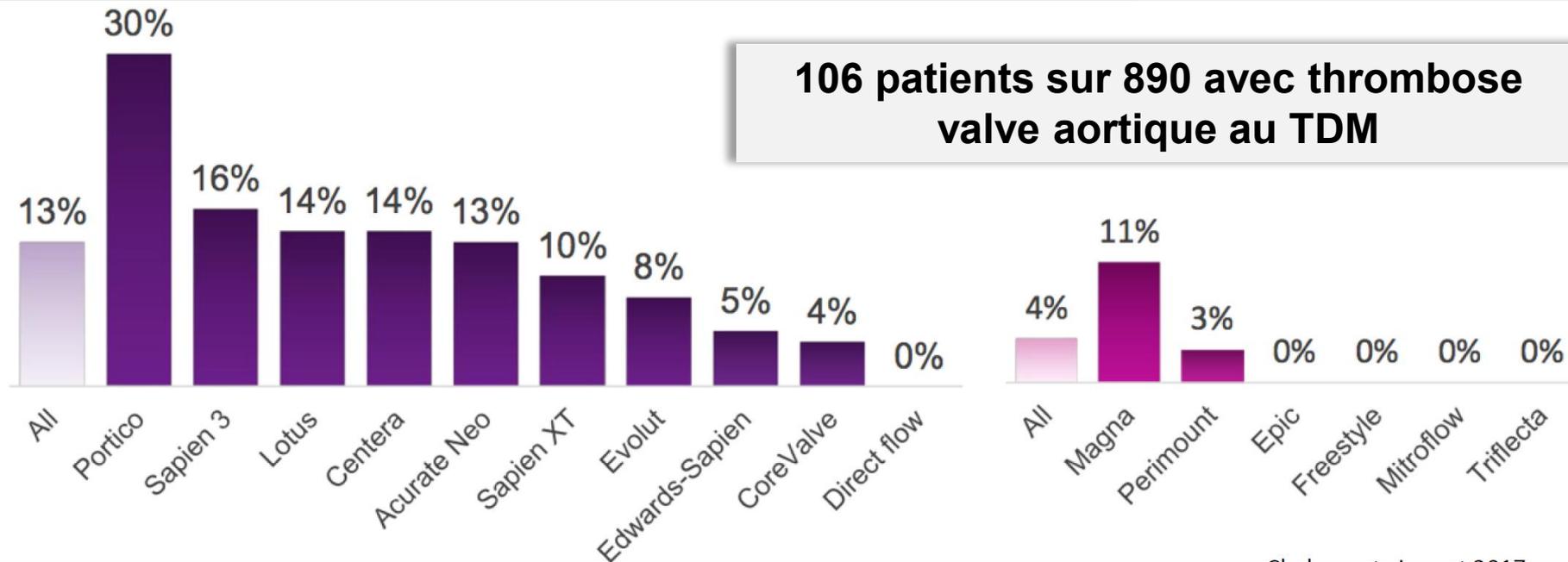
Délai scanner : 83 jours (33-281)

626 TAVI et 264 patients post chirurgie

- ▀ **thrombose infra-clinique :**
 - **4% groupe chirurgie : 5/138**
 - **13% groupe TAVI : 101/752**

THROMBOSE TAVI

Subclinical leaflet thrombosis in surgical and transcatheter bioprosthetic aortic valves: an observational study



THROMBOSE TAVI

Fréquent?

Méta-analyse thrombose de valve après TAVI

20 études (15 observationnelles)

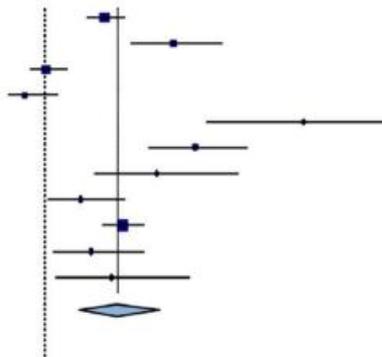
12128 TAVI

Study/subgroup

Prevalence , % [95% CI]

Subclinical leaflet thrombosis

Chakravarty et al.	13.4 [11.1; 16.1]
De Backer et al.	22.6 [17.0; 29.1]
Hansson et al.	5.7 [3.6; 8.4]
Leetma et al.	2.9 [0.8; 7.2]
Makkar et al., (Pooled analysis)	40.0 [27.0; 54.1]
Makkar et al., (PARTNER 3 CT substudy)	25.5 [19.4; 32.5]
Marwan et al.	20.5 [12.2; 31.2]
Pache et al.	10.3 [6.0; 16.1]
Ruile et al.	15.9 [13.4; 18.7]
Vollema et al.	11.7 [6.7; 18.6]
Yanagisawa et al.	14.3 [7.1; 24.7]
Subtotal (random effects)	15.1 [10.0; 20.9]
Subtotal heterogeneity, $I^2= 91%$	

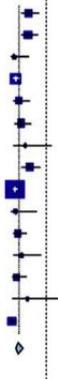


Study/subgroup

Prevalence , % [95% CI]

Valve thrombosis

Basra et al.	2.8 [1.6; 4.4]
Chakravarty et al.	2.6 [1.6; 4.1]
De Backer et al.	0.5 [0.0; 2.8]
Franzone et al.	0.7 [0.3; 1.3]
Hansson et al.	1.2 [0.4; 2.9]
Holy et al.	1.6 [0.7; 3.0]
Huchet et al.	2.2 [0.5; 6.4]
Jose et al.	2.9 [1.7; 4.5]
Latib et al.	0.6 [0.4; 0.9]
Leetma et al.	0.7 [0.0; 3.9]
Mack et al.	1.0 [0.3; 2.3]
Makkar et al., (PARTNER 3 CT substudy)	1.6 [0.3; 4.7]
Mangieri et al.	0.9 [0.2; 2.3]
Marwan et al.	2.6 [0.3; 9.0]
Popma et al.	0.1 [0.0; 0.8]
Subtotal (random effects)	1.2 [0.8; 1.8]
Subtotal heterogeneity, $I^2= 77%$	



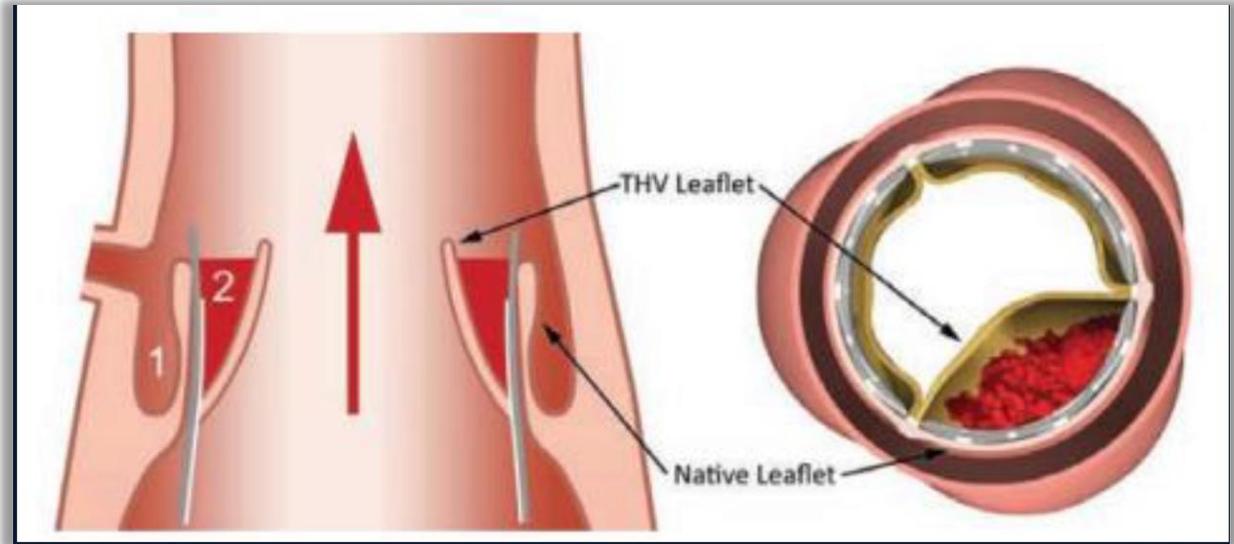
Subclinical leaflet thrombosis (SLT) = 15.1%

Clinical valve thrombosis = 1.2%

T. RHEUDE. Am J Cardio 2021

Pourquoi plus fréquent après TAVI?

1. Néo sinus
2. Sinus natif



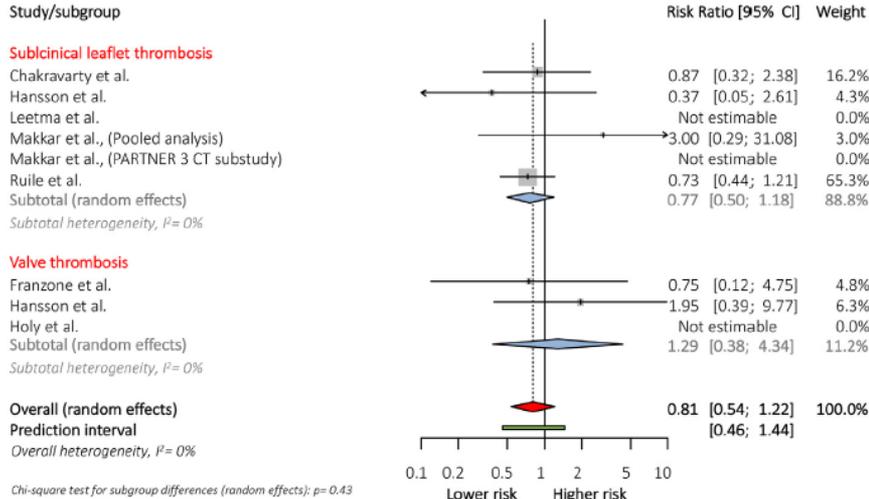
Le néo-sinus entre valve native et feuillet valvulaire du TAVI ou thrombus a été observé

Méta-analyse thrombose de valve après TAVI

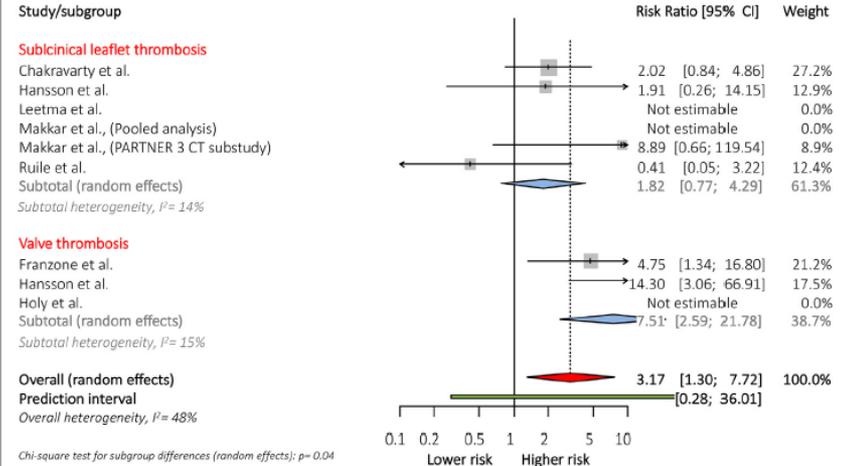
20 études (15 observationnelles)

12128 TAVI

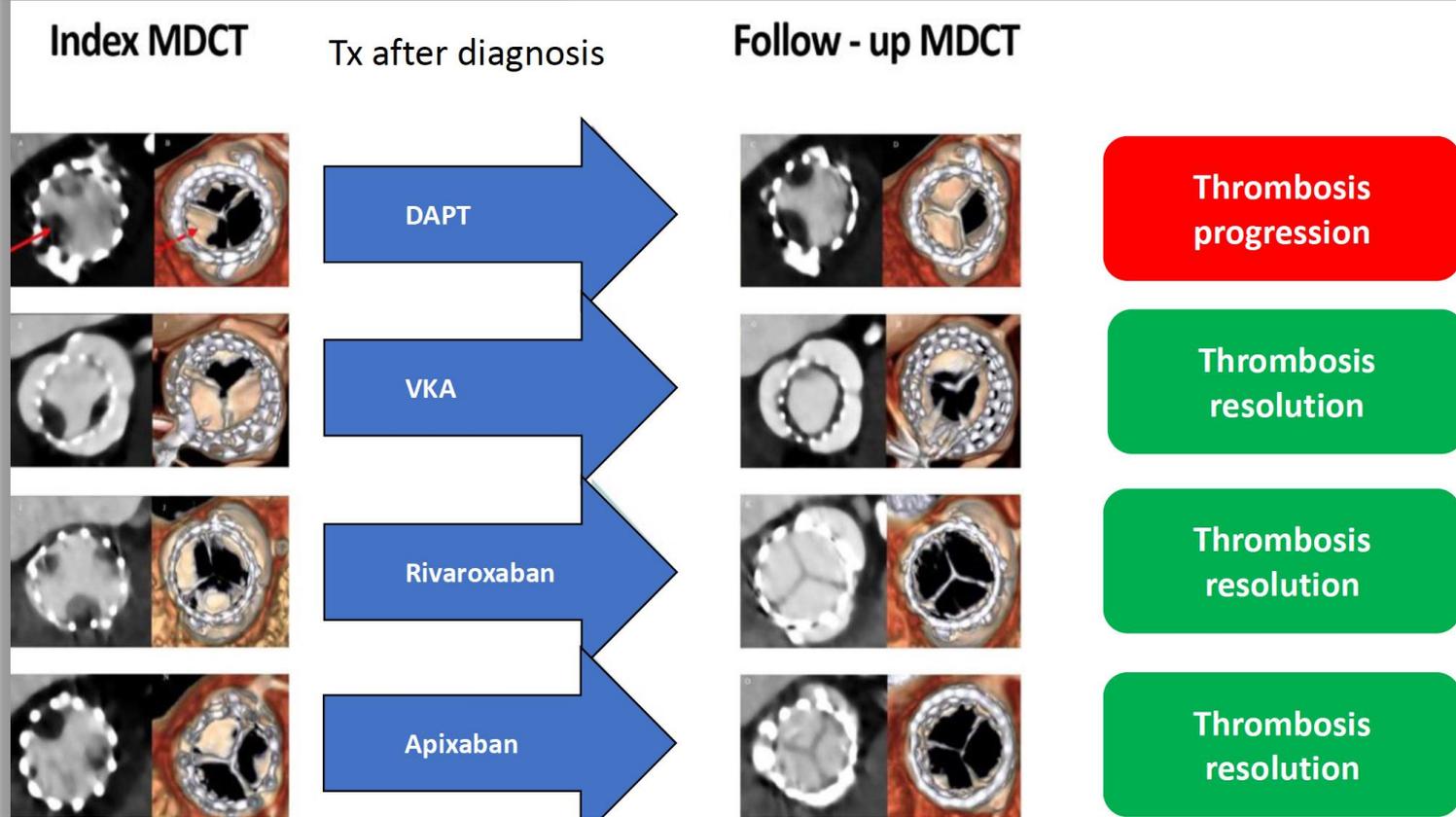
All-cause death



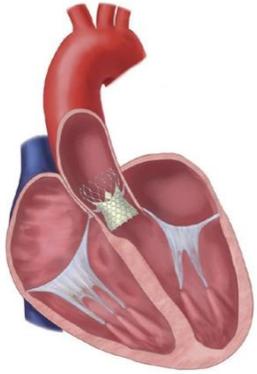
AVC



Intérêt de l'anticoagulation?

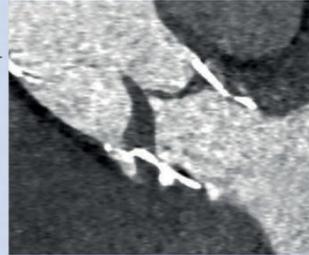


TAVR
(11,098 patients
from 25 studies)



potentially
associated
with

Presence of SLT
(6% overall
occurrence)



if untreated,
associated with

**Increased
stroke risk**
(RR 2.54)



OAC therapy

**99% increase
in odds for
SLT resolution**

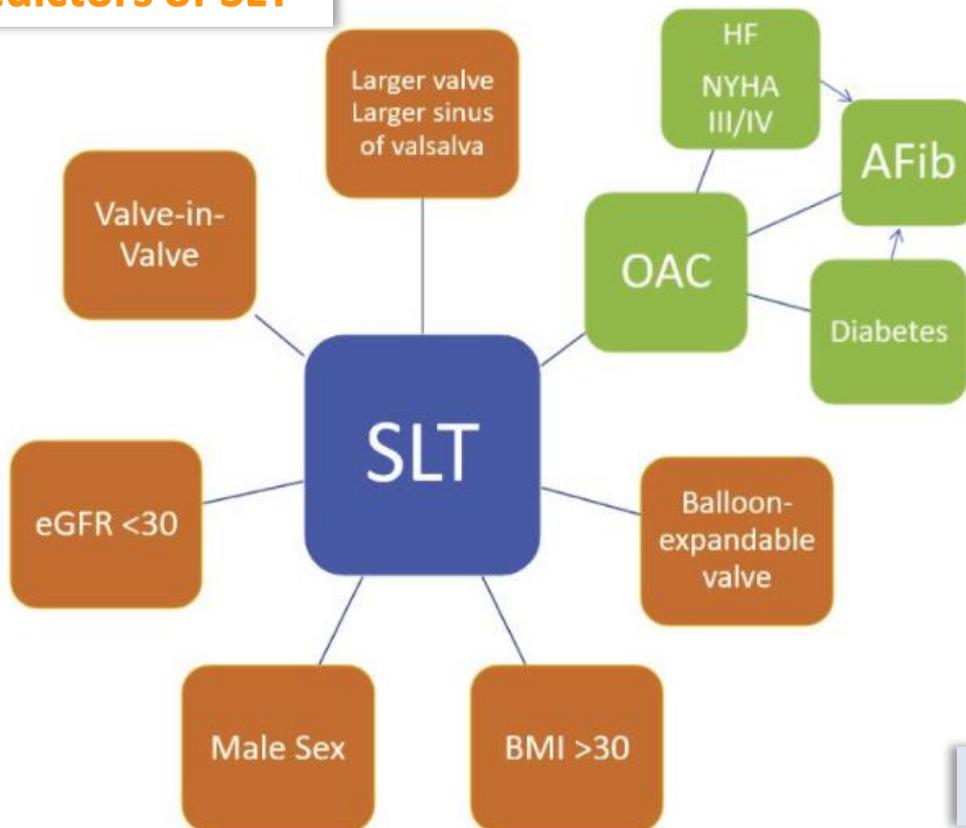


Main risk factors:

- Intra-annular TAVR (RR 2.03 compared to supra-annular TAVR)
- SAPT/DAPT only (RR 0.42 with OAC)

Facteurs associés à thrombose sub-clinique

Positive predictors of SLT



Negative predictors of SLT

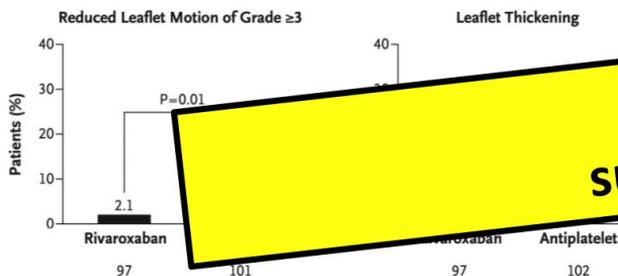
Intérêt de l'anticoagulation?

Etudes randomisées anticoagulation ou non

Galileo 4D CT

RCT substudy

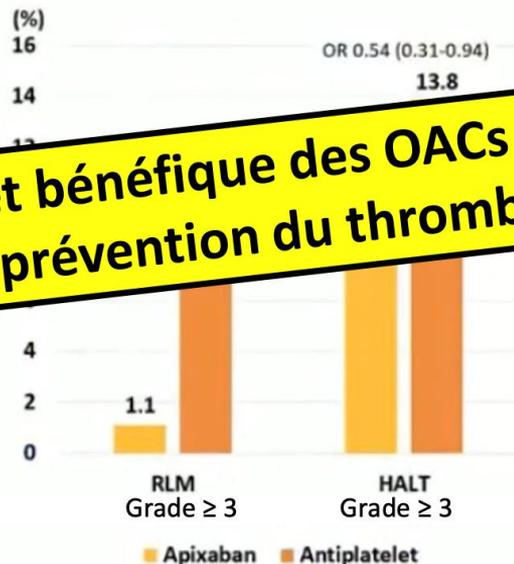
Rivaroxaban (\pm ASA) vs. DAPT/SAPT



Atlantis 4D CT (stratum 2)

RCT substudy

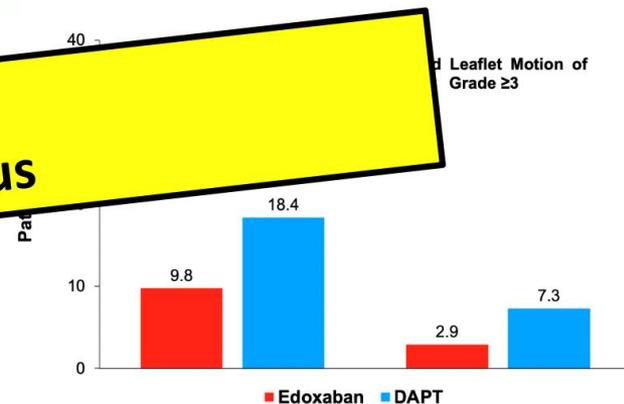
Apixaban vs. DAPT/SAPT



ADAPT TAVR

RCT

Edoxaban vs. DAPT

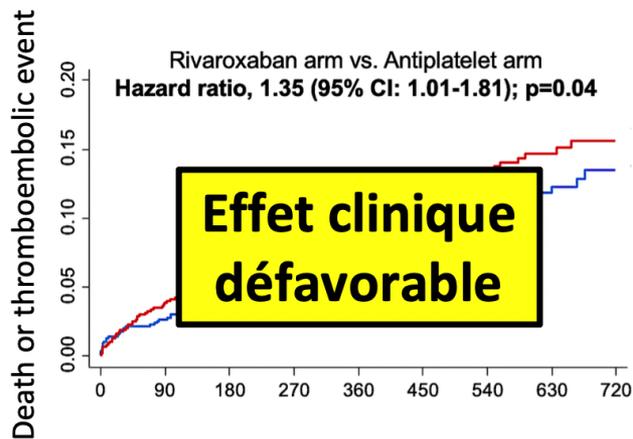


Effet bénéfique des OACs sur la prévention du thrombus

Intérêt de l'anticoagulation?

Galileo

Rivaroxaban (\pm ASA) vs. DAPT/SAPT

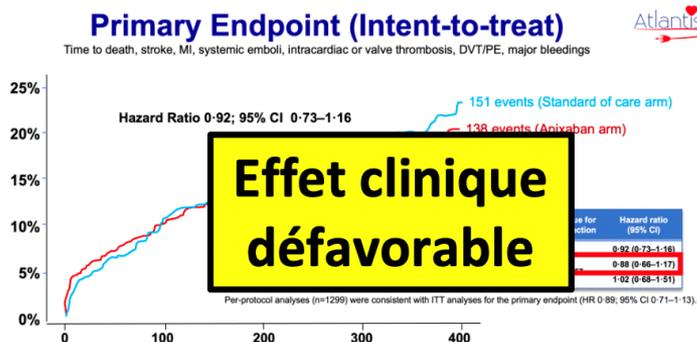


Low dose rivaroxaban \pm ASA Increase in life-threatening and disabling bleed

Dangas et al N Engl J Med 2020

Atlantis (stratum 2)

Apixaban vs. DAPT/SAPT

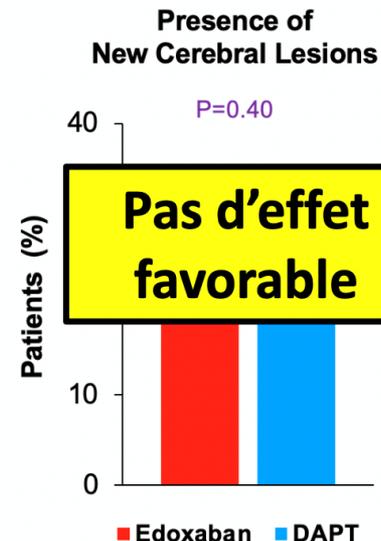


Apixaban associated with increase in the rate of Non CV death

Collet JP et al. ACC 2021

ADAPT TAVR

Edoxaban vs. DAPT



Park DW et al. Circulation 2022

Intérêt de l'anticoagulation?

Sous-étude PARTNER 3

Analyse TDM patients bas risque

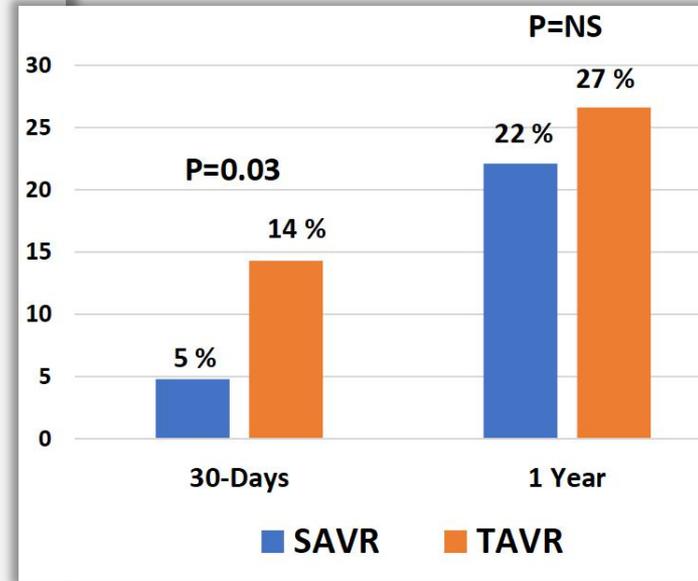
408 patients chir et TAVI

Prévalence 10% à 30 jours et 24% à 1an

! 50% HALT disparaissent spontanément sans anticoagulant

20% nouveaux HALT à 1 an

Suivi : pas corrélation HALT/ AVC, IDM et décès à 1 an



THROMBOSE TAVI

2 entités à différencier

Thrombose sub-clinique

Thrombose clinique

THROMBOSE TAVI

De mars 2018 à juillet 2019, inclusion de **54 patients** avec thrombose clinique de TAVI

TAVI implantés de août 2011 à juillet 2019 dans 17 centres français



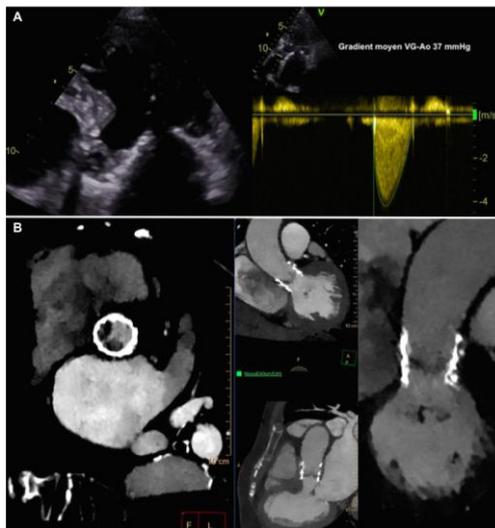
L'INSTITUT
MUTUALISTE
MONTSOURIS

T. Mouyen CCI 2020

Thrombose clinique

	Thrombosis (n=54)	Control (n=113)	p Value
Age (years)	80.2	81.6	0.25
Male	69%	47%	0.009
Anticoagulant treatment before TAVR	5.6%	36.3%	<0.001
Platelet before TAVR (G/L)	142	168	0.021
Valve in Valve	9.2%	<1%	0.014
Femoral access	93%	80%	0.048
Predilatation	57.4%	87.6%	0.021
Prothesis type			0.06
Balloon-expanding (Edwards Sapien)	78%	54%	
Self-expanding (Medtronic Corevalve)	22%	43%	
Mean gradient LV-Aorta mmHg post TAVR	11.8	8.1	<0.001

Thrombose clinique



Thrombosis (n=54)	
Median time from procedural to diagnosis (days)	169.5
Acute	7.4%
Sub acute	31.5%
Late	24.1%
Very late	37.0%
Asymptomatic	25.9%
Severe complications (Heart failure, cardiogenic shock, cardio embolic events)	31.5%
Mean gradient LV-Aorta (mmHg)	38.4
CT performed	70.4%
Treatment at time of diagnosis	
Aspirine only	61.1%
Dual antiplatelet therapy	27.7%
Anticoagulant	5.55%

Thrombose clinique

Multivariate analysis using a logistic regression model	OR	95% IC	p Value
Male	2.25	0.85 - 5.97	0.10
BMI > 30 kg/m ²	3.35	1.19 - 9.42	0.02
Hemoglobin > 15 g/dL	2.98	0.74 - 11.4	0.12
Thrombocytopenia < 150 G/L before TAVR (G/L)	9.96	3.26 - 30.4	< 0,001
Creatinine clearance < 60 mL/min	4.84	1.71 - 13.7	0.003
LVEF < 40% before TAVR	2.91	0.74 - 11.3	0.12
No predilatation	5.67	1.91 - 16.8	0.002
Anticoagulant treatment at discharge	0.12	0.02 - 0.53	0.005
Mean transvalvular gradient > 10 mmHg immediately post TAVR	3.36	1.28 - 8.82	0.01

Thrombose clinique

Suivi 2 ans

96% normalisation gradient moyen sous traitement anticoagulant

7% thrombose dans les 3 jours post-procédure

1 patient nouvelle thrombose après arrêt du traitement (sur 4)

Thrombose clinique

Mr C. 82 ans

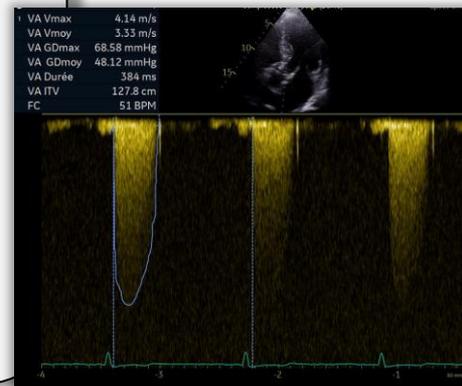
IDM latéral sur occlusion Cx en 1999

Rao serré en 2021. FE 45%.

8/2021 TAVI Edwards® 26mm par voie fémorale droite

Evolution simple.

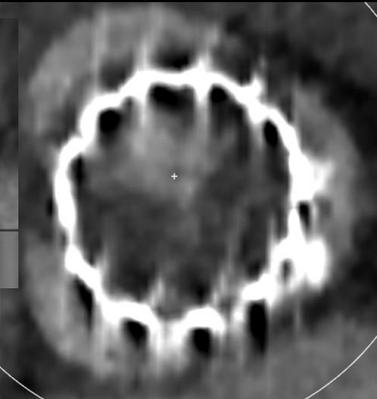
Sortie à J2 gradient moyen 9mmHg



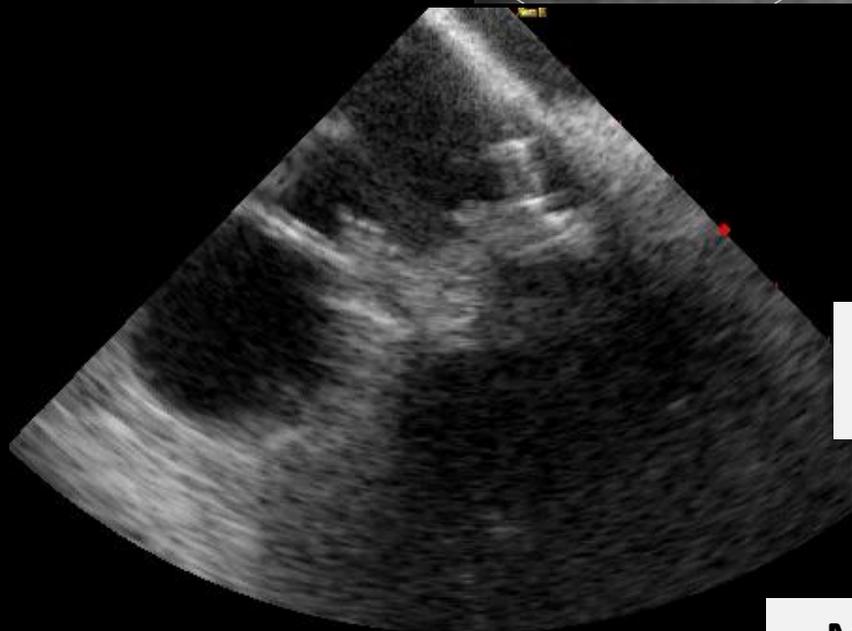
A 3 mois dyspnée d'effort
ETT gradient moyen à l'ETT à
45mmHg



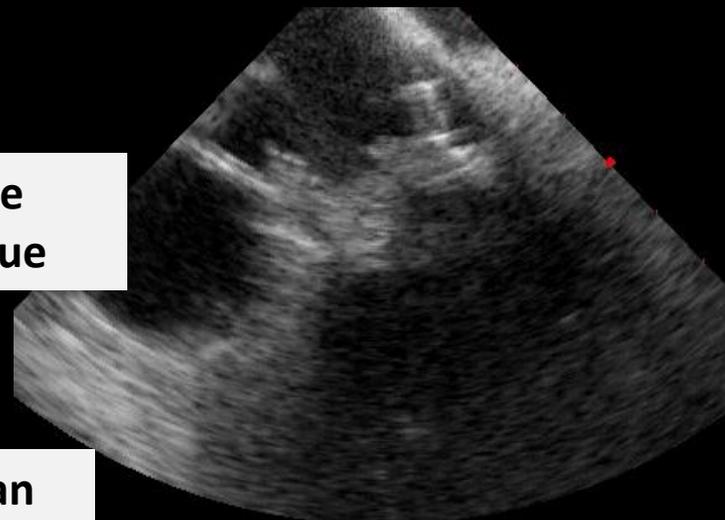
Scanner thoracique



ETT



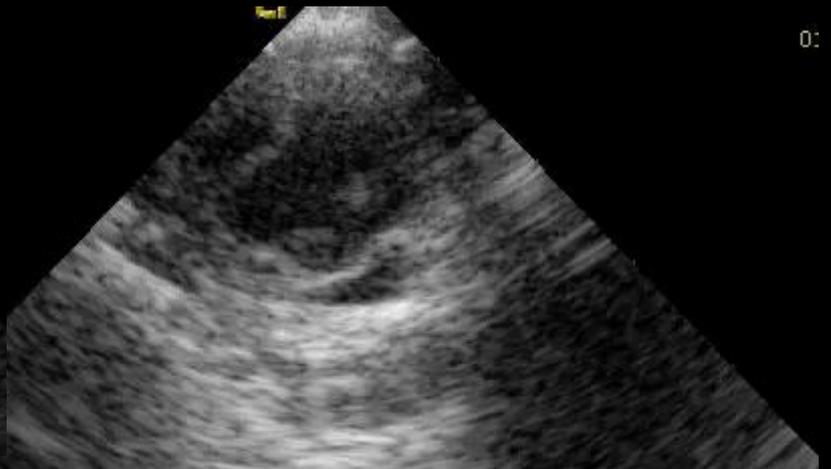
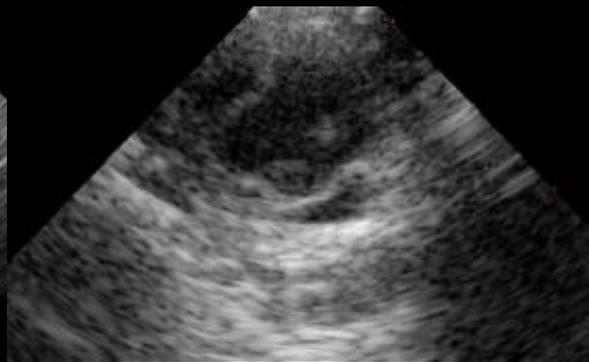
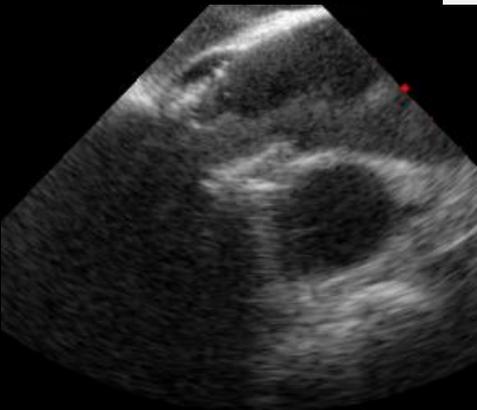
**Echographie
intracardiaque**



Mis sous apixaban

Contrôle à 6 semaines
Gradient moyen VG-
aorte à 12mmHg

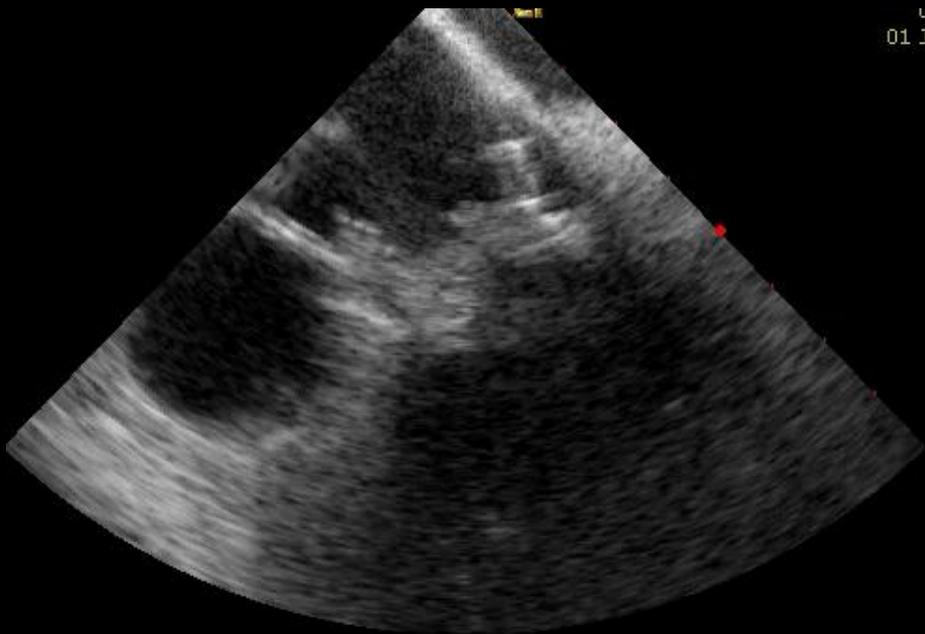
Echographie
intracardiaque



m

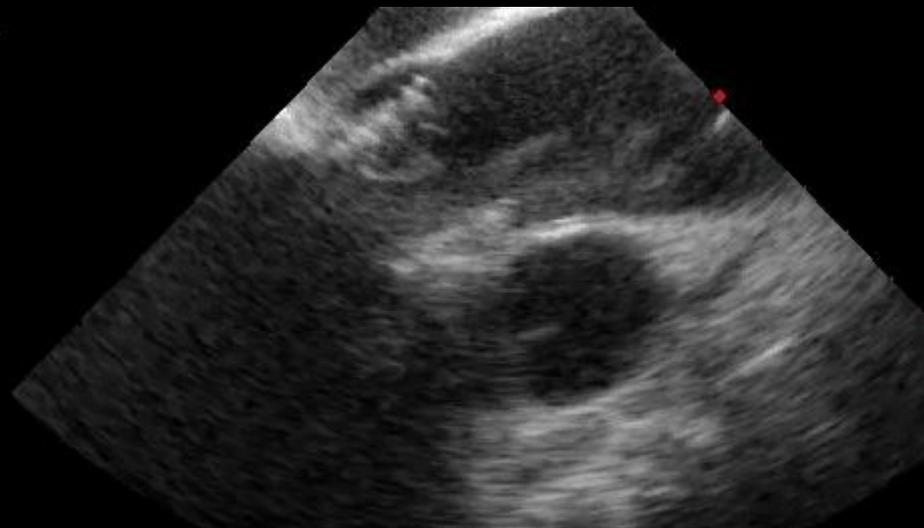
0:

Echographie intracardiaque



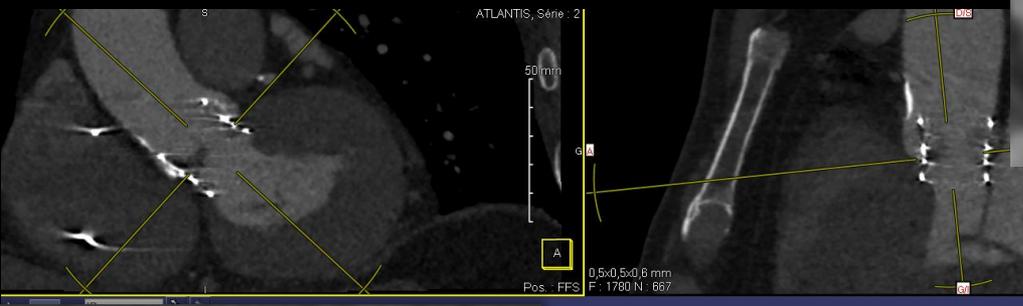
00:26
01 Jan 2

m

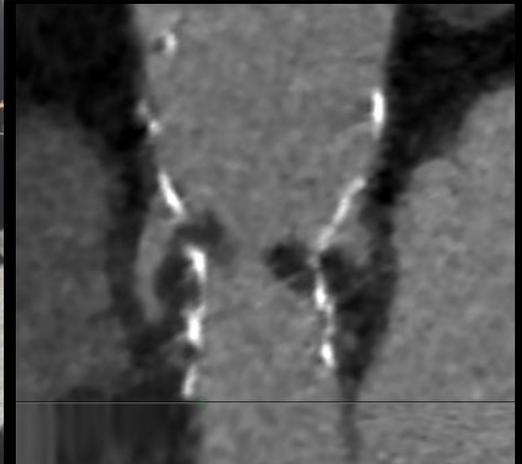
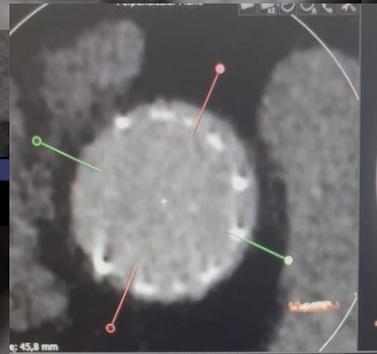


thromboses à CT-FD

Mr P thrombose
à 1 mois



Mr C. TAVI VIV
thrombose à 3 mois



Conclusions

Thromboses sub-cliniques fréquentes

**∅ d'intérêts d'un traitement anticoagulant
systématique**

**Penser au scanner centré sur la valve devant
↑ gradient à l'ETT**

Questions en suspens

Certains patients mauvaise réponse aux NACO

Traiter certains patients de manière préventive?

Rôle du scanner systématique?

Etude POPULAR TAVI

