

Echographic evaluation of aortic stenosis in patient with dialysis and AV fistula.

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Circulation

AHA SCIENTIFIC STATEMENT

Evaluation and Management of Aortic Stenosis in Chronic Kidney Disease

A Scientific Statement From the American Heart Association

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e1088 June 22/29, 2021

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SYMPTOMS in severe AS and CKD G5D

- Insufficient literature
- Atypical symptoms
- Dyspnea and presyncope : overlap ++ with other prevalent conditions in CKD G4 to G5D such as volume overload and anemia
- **Red-flags** : intradialytic hypotension, development of atrial dysrhythmias in the peridialysis period, and symptoms of extreme fatigue

→ maintain a high index of suspicion for this high-risk condition +++.

Definition of severe AS

- $AVA \leq 1 \text{ cm}^2$ or $0.6 \text{ cm}^2/\text{m}^2$ (continuity equation)
- $V_{\text{max}} \geq 4 \text{ m/s}$
- Mean pressure gradient $\geq 40 \text{ mmHg}$

- Doppler velocity index < 0.25 ($VTI_{\text{LVOT}} / VTI_{\text{Ao}}$)
- Visual assessment of aortic valve cusp calcification/mobility.
- Anatomic AVA by planimetry (2D/3D) $\leq 1 \text{ cm}^2$
- Acceleration time (AT) $> 110 \text{ msec}$.
- $AT/ET > 0.36$ (ET: ejection time)

Assessment of AS hemodynamic severity

- $V_{max} \geq 4$ m/s
- Mean pressure gradient ≥ 40 mmHg
- $AVA \leq 1$ cm² or 0.6 cm²/m² (continuity equation)
- Doppler velocity index < 0.25 (VTI_{LVOT} / VTI_{A0})
- Acceleration time (AT) > 110 msec.
- $AT/ET > 0.36$ (ET: ejection time)

• Measurements influenced by several factors :

- measurement errors
- low-flow state (CKD +++) or high-flow states (AVF in CKD)
- and increased left ventricular afterload caused by hypertension

$$AVA = 0.785 \times (LVOT)^2 \times VTI_{LVOT}$$

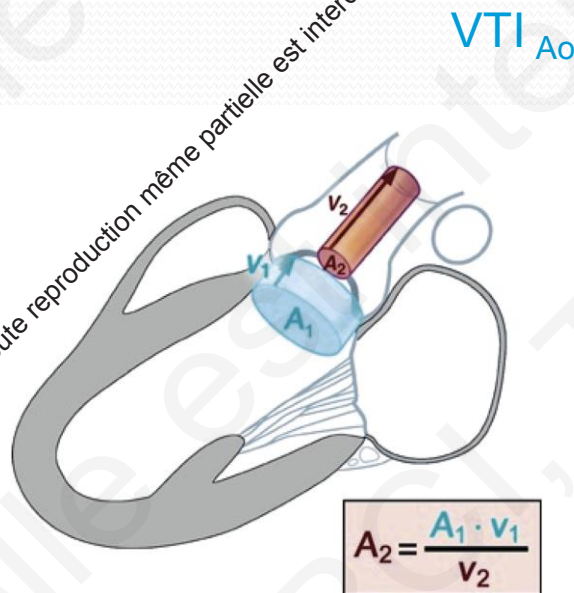
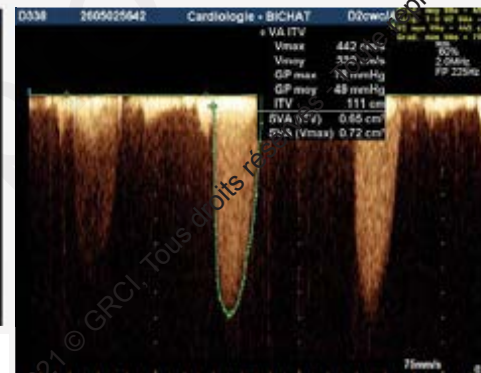
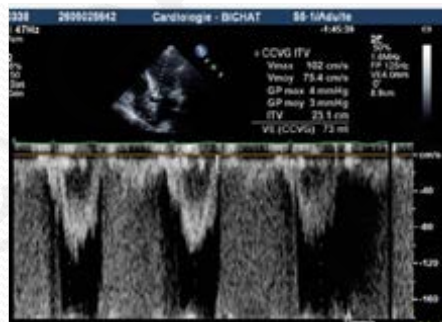
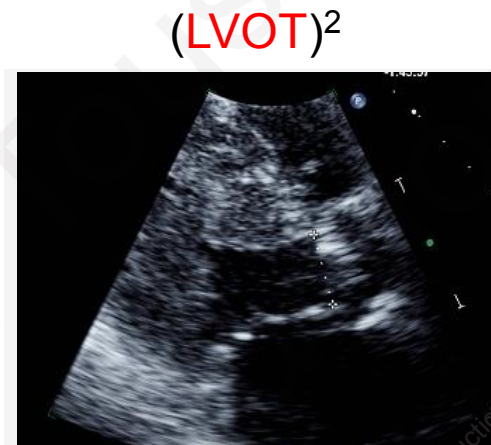


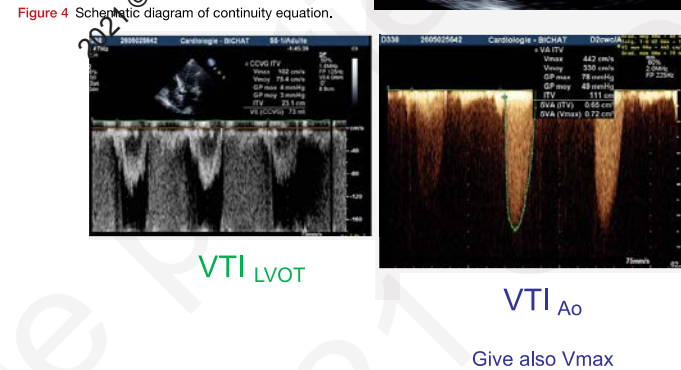
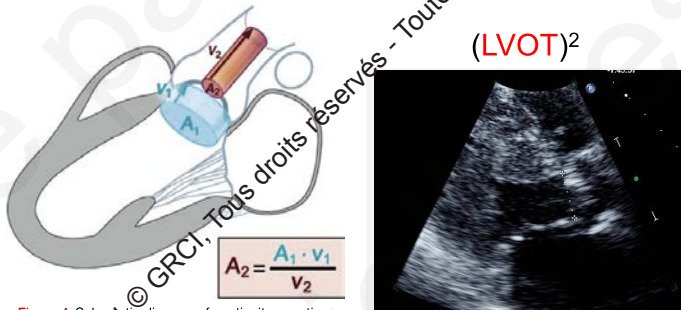
Figure 4 Schematic diagram of continuity equation.



Give also Vmax

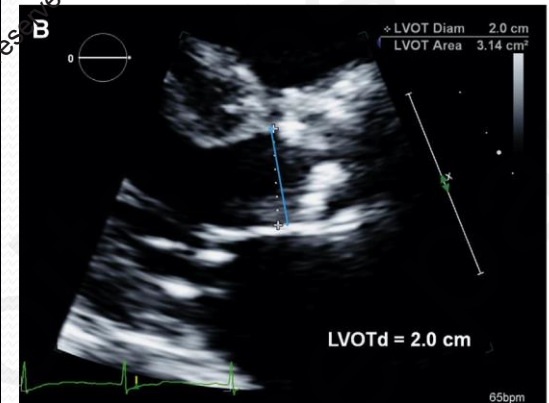
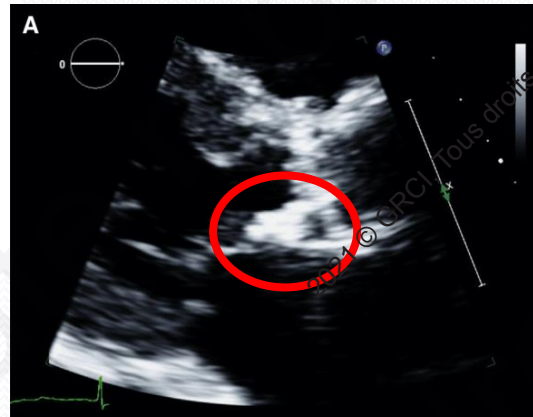
Pitfalls in AS evaluation in CKD patients

$$AVA = \frac{0.785 \times (LVOT)^2 \times VTI_{LVOT}}{VTI_{Ao}}$$



LVOT :

- Severe calcifications of the aortic annulus extending to the LVOT
- Frequent basal septal hypertrophy (ie, septal bulge), leading to underestimation of LVOT AND flow acceleration in the LVOT that invalidate AVA calculation by the continuity equation



Hybrid AVA

- To overcome the risk of underestimation of **LVOTd** by 2-dimensional TTE,
- Hybrid AVA can be calculated from the LVOT area obtained with 3-dimensional TEE/CMR and flow velocities measured by Doppler with TTE.
- Given that hybrid AVAs (especially those obtained by CT-Doppler imaging) are systematically and substantially larger than the standard AVA measured by TTE, **some studies suggest using a larger cutoff value of hybrid AVA to define severe AS ($\leq 1.2 \text{ cm}^2$ rather than $\leq 1.0 \text{ cm}^2$; Table 1)**

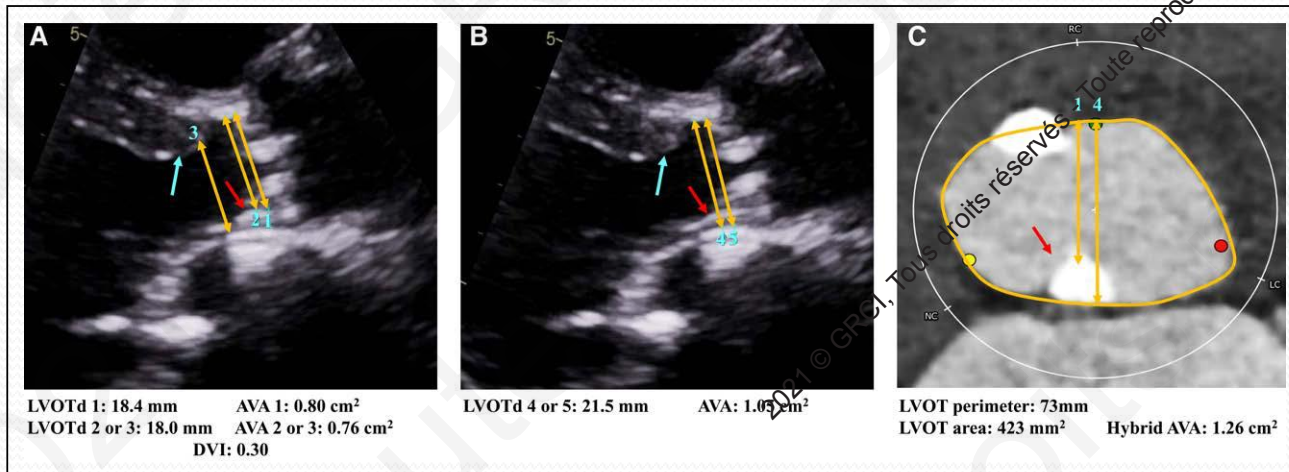
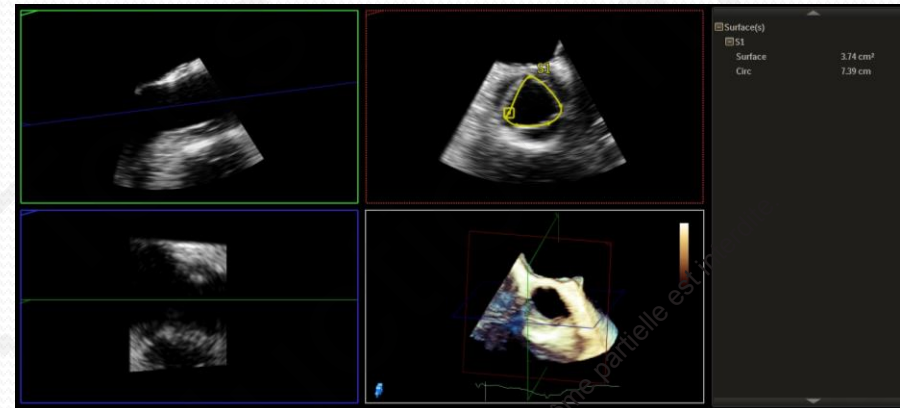
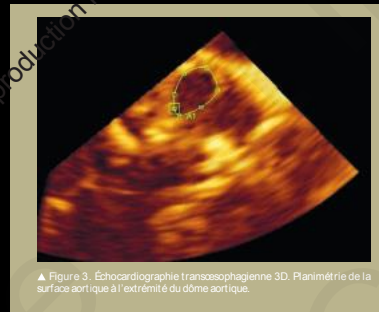


Figure 3. Measurement of left ventricular outflow tract (LVOT) diameter (LVOTd) in patients with aortic stenosis (AS) and chronic kidney disease (CKD).

Assessment of anatomic AVA

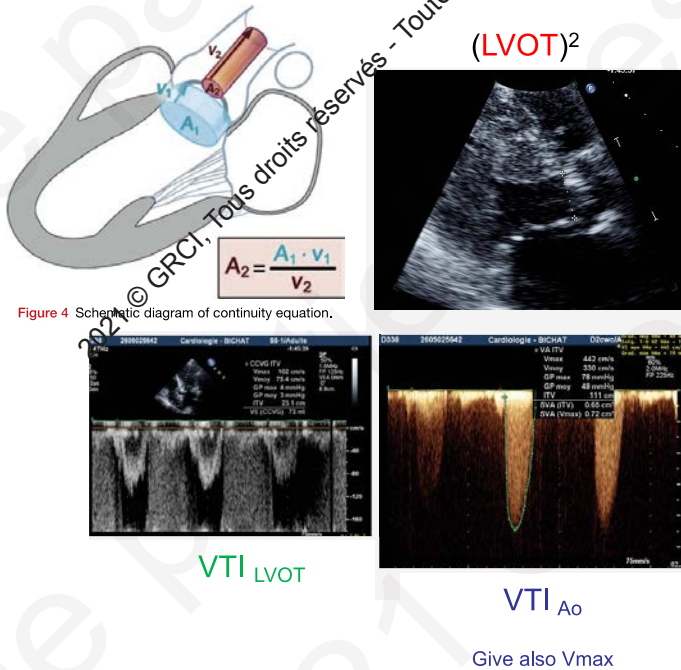


- 3D TEE : more accurate ; measurement of the smallest and more restrictive valve orifice
- **Planimetry challenging and inaccurate in case of extensive cusp calcifications (CKD ++, dialysis ++)**
- Anatomic AVA : to be used with caution and integrated into a multiparametric approach because it may underestimate AS severity compared with hemodynamic parameters.

Impact of AV fistula in AS assessment.

AVF → preload, cardiac output, and transvalvular flow.

$$AVA = \frac{0.785 \times (LVOT)^2 \times VTI_{LVOT}}{VTI_{Ao}}$$

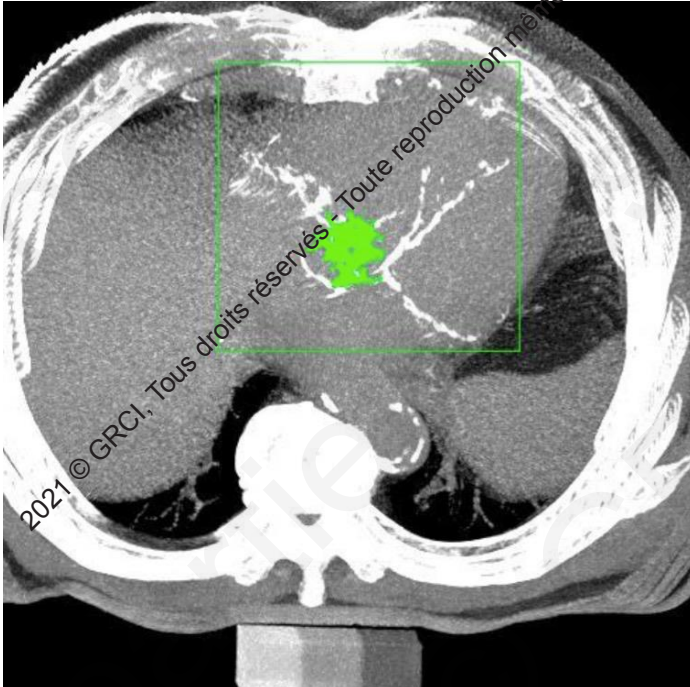


- In a high-flow state, VPeak and ΔPm are → and may overestimate the severity of AS.
- AVA and Doppler velocity index are → and may underestimate the severity.
- AVF fistula compression theoretically interesting to reassess AS severity during the TTE examination but not recommended because of higher thrombotic complications.
- If presence of AS-related symptoms or left ventricular systolic dysfunction and a high-flow state showing a severe ΔPm (≥40 mm Hg) or VPeak (≥4 m/s) → consider hemodynamically significant AS.

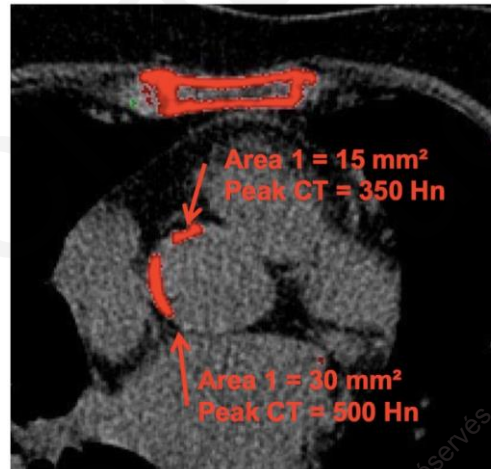
Impact of AV fistula in AS assessment.

- The high-flow state induced by AVF may cause **right ventricular** overload, dilation and dysfunction in patients undergoing hemodialysis.
- **In CKD G5HD, the AVF artificially increases left ventricular preload and may mask an underlying low-flow STATE.**
- Patients with CKD G4 to G5D often have :
 - ▶ impaired myocardial contractility
 - ▶ limited contractile/flow reserve during dobutamine stress echocardiography, sometimes limiting the ability to normalize their flow rate with dobutamine.
- **For CKD G5HD, the TTE examination for the assessment of AS should ideally be timed on the day after hemodialysis when hemodynamics are presumably optimized.**

CALCIUM SCORING



- No contrast enhancement, no β Blocker
- Agagston method



Peak density score

Hn	X Factor
130-199	1
200-299	2
300-399	3
> 400	4

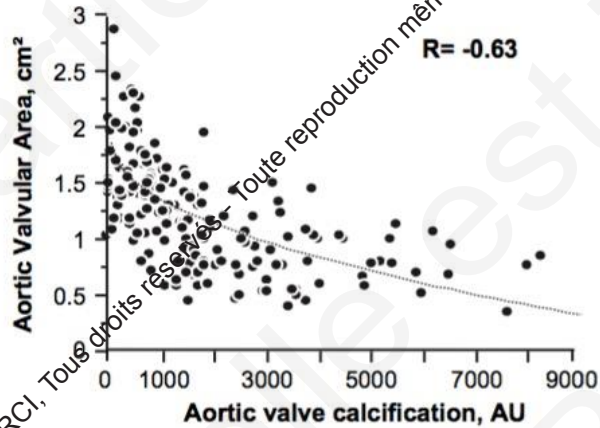
Region 1. Score = 15 * 3 = 45

Region 2. Score = 30 * 4 = 120

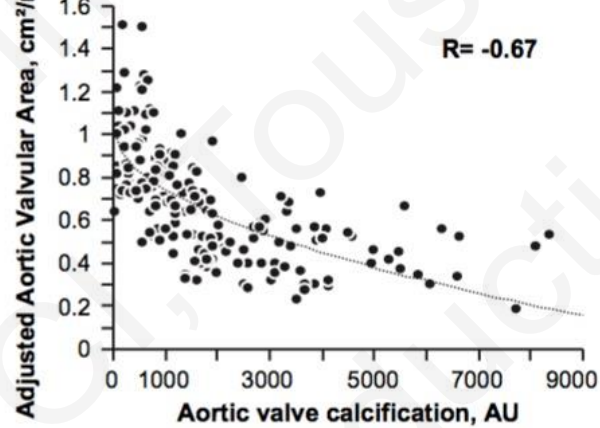
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CALCIUM SCORING and AS severity

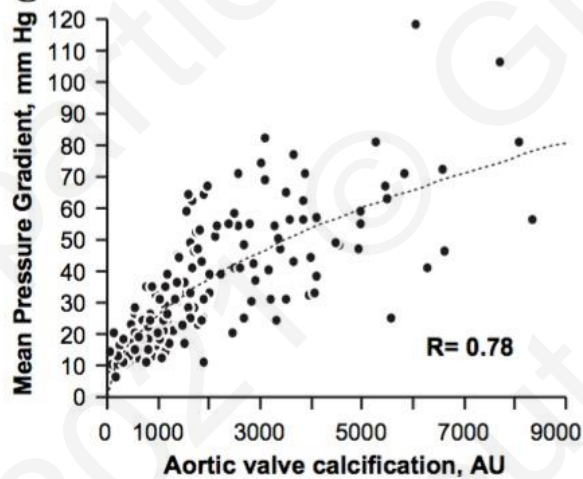
A



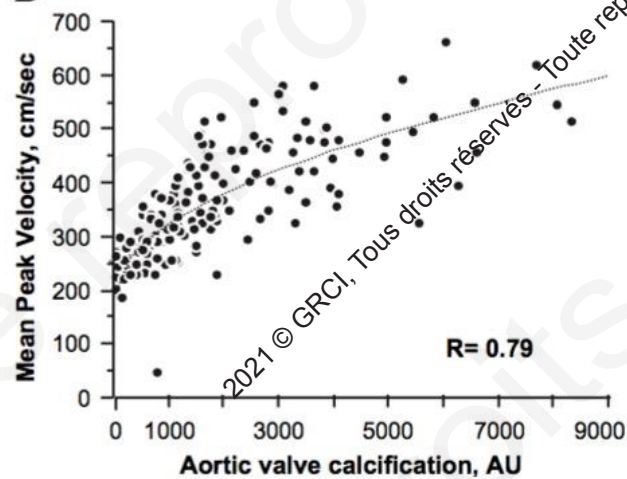
B



C



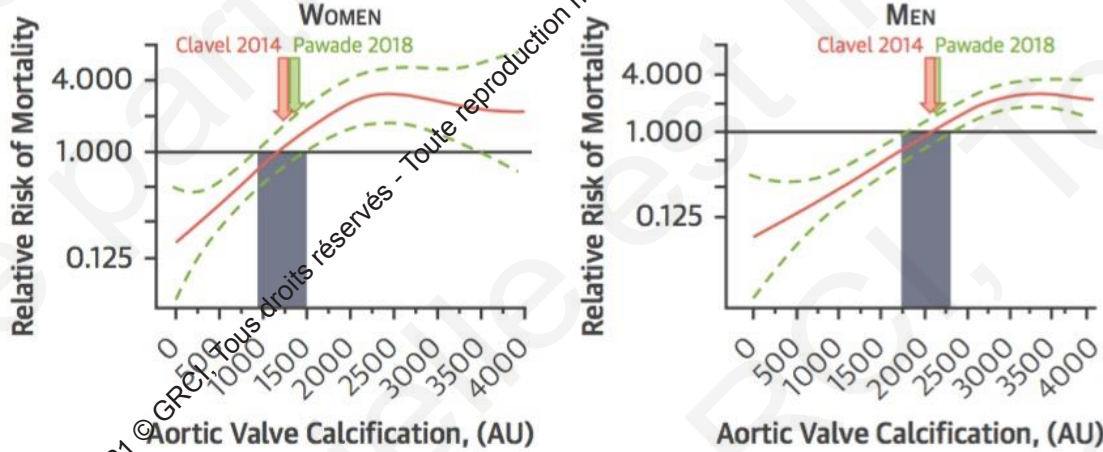
D



CALCIUM SCORING and AS prognosis

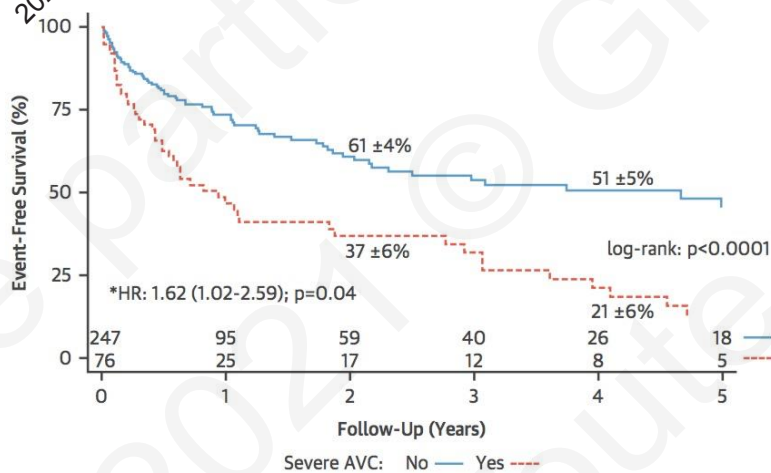
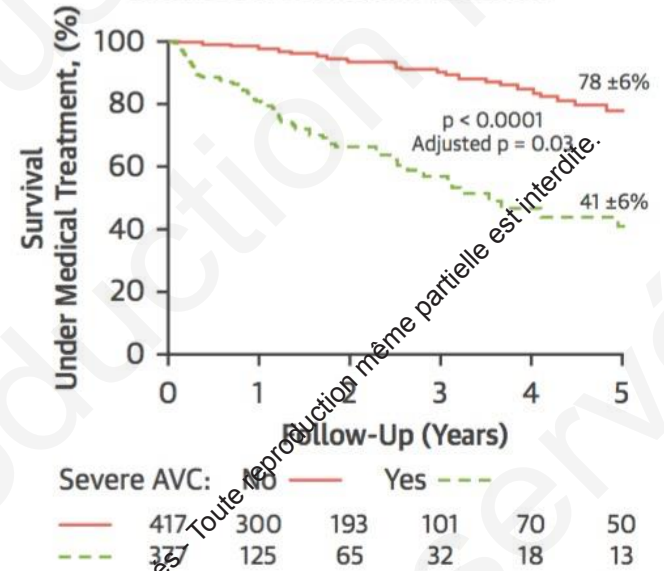
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Impact of AVC Burden on Mortality in Patients with AS, by Sex



D

Effects of AVC Burden on Survival in Patients with AS Under Medical Treatment

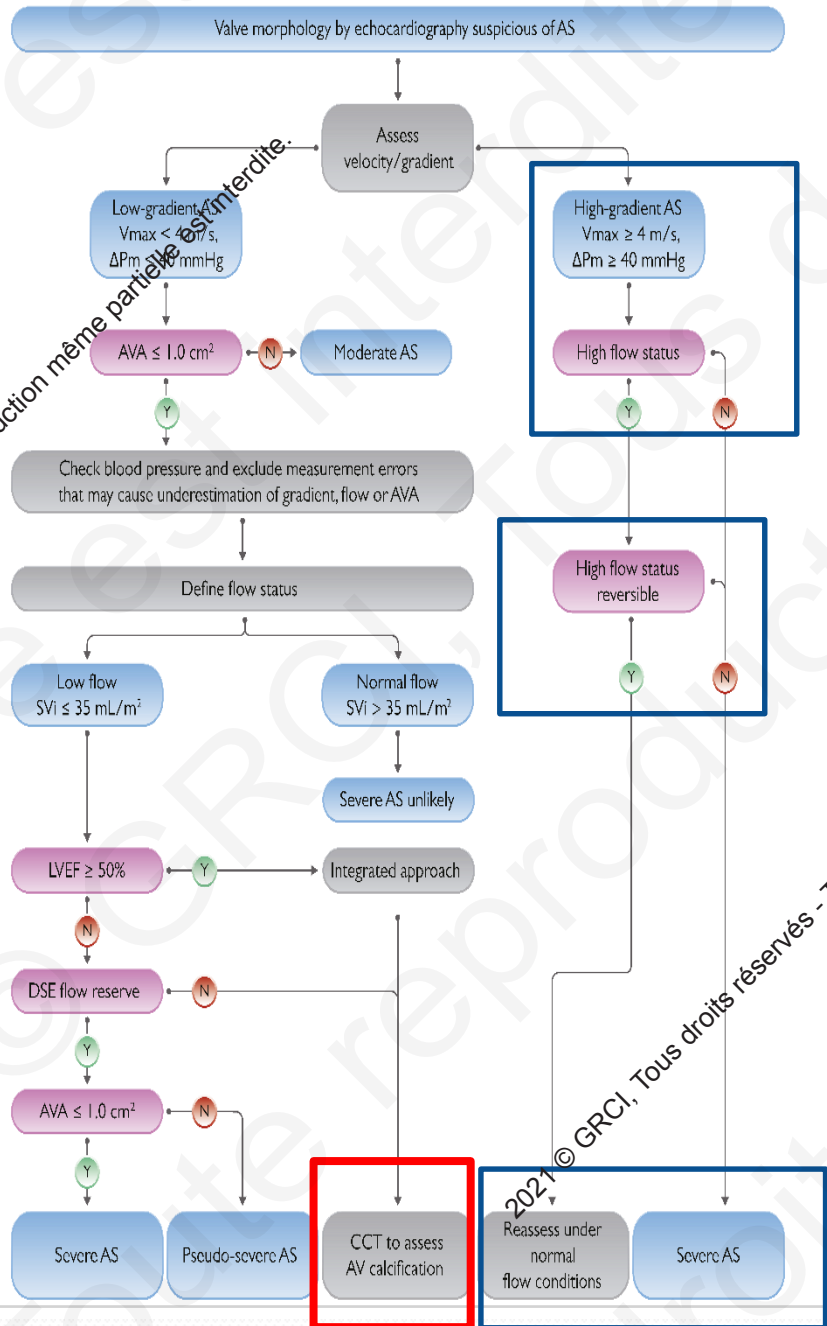


Clavel JACC 2014
Pawade Circ Card Imag 2018

Cut-offs for definition of severe AS using calcium scoring :

- Women 1200 UA
- Men 2000 UA

Tastet JACC 2017



DIALYSIS

ESC
GUIDELINES
2021

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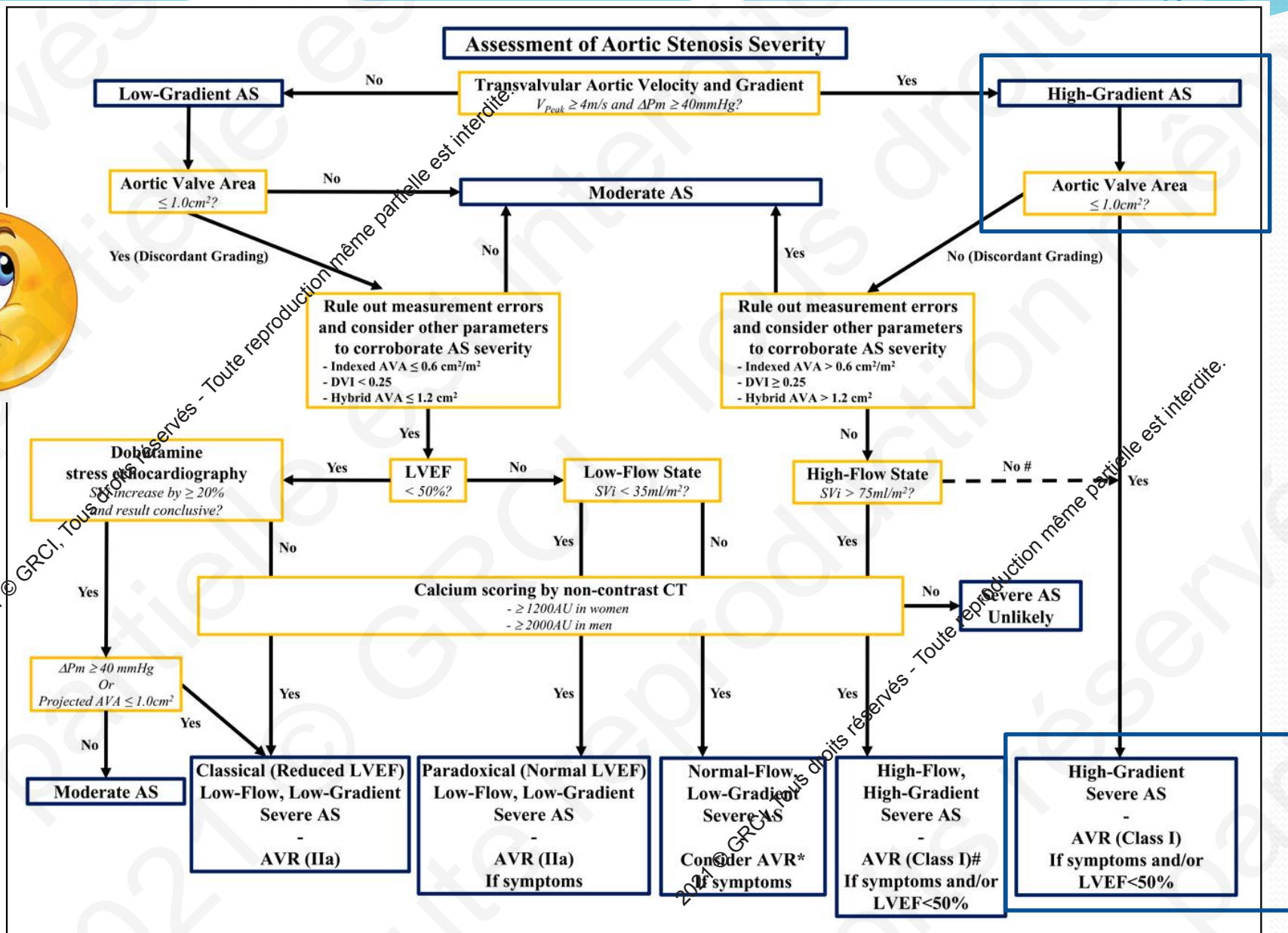
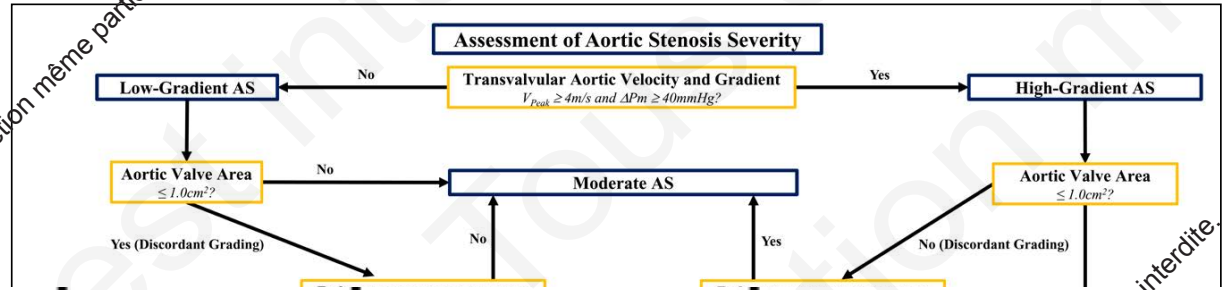


Figure 2. Suggested algorithm to confirm aortic stenosis (AS) severity and to classify the hemodynamic pattern in patients with chronic kidney disease (CKD). Shroff and al. Circulation 2021



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Calcium scoring by non-contrast CT

- ≥ 1200 AU in women
- ≥ 2000 AU in men

Severe AS Unlikely

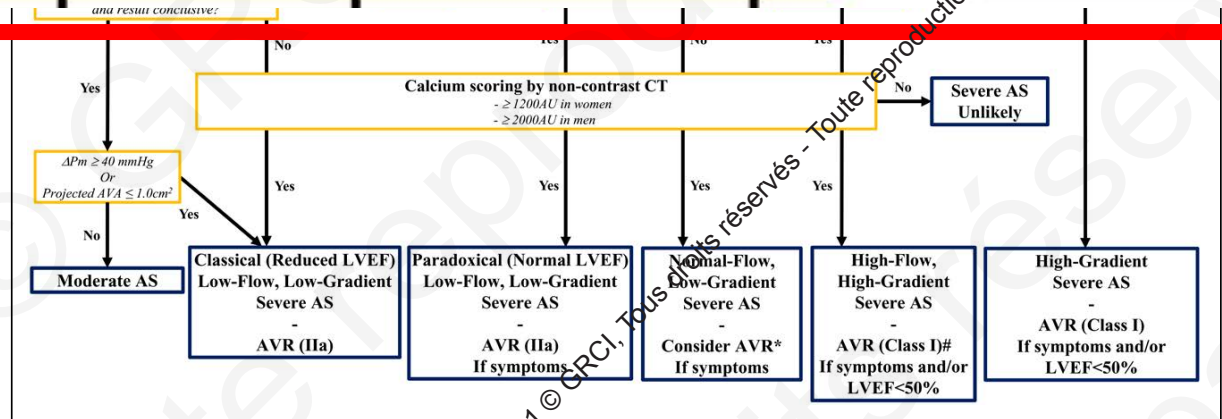


Figure 2. Suggested algorithm to confirm aortic stenosis (AS) severity and to classify the hemodynamic pattern in patients with chronic kidney disease (CKD).



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Conclusion

- Assessment of AS severity difficult in case of AVF
- Multiparametric assesment :
 - $V_{max} \geq 4$ m/s and mean pressure gradient ≥ 40 mmHg
 - LVEF
 - Calcium scoring ++
 - $AVA \leq 1$ cm² or 0.6 cm²/m² (continuity equation) or planimetry
- Annual progression of echographic parameters ++
- Symptoms (remember the red flags)
- Heart-Kidney Team : therapeutic project (transplantation ; TAVI/SAVR), expected quality of life, comorbidities.

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Merci

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