

A Novel Method of Deriving Bicuspid Aortic Valve Calcium Score Using Contrast CT-Scans

A Weighted, Luminal Attenuation Based Stratification Strategy

Iad Alhallak, MD

On behalf of: **Muhammad J Khan, MD**, **Ken Chan, APRN**, **Xena Moore, MD**, **Catalin Loghin, MD**,
Deepa Raghunathan, **Abhijeet Dhoble, MD**



Disclosure of Relevant Financial Relationships

I, [Iad Alhallak] DO NOT have any financial relationships to disclose.

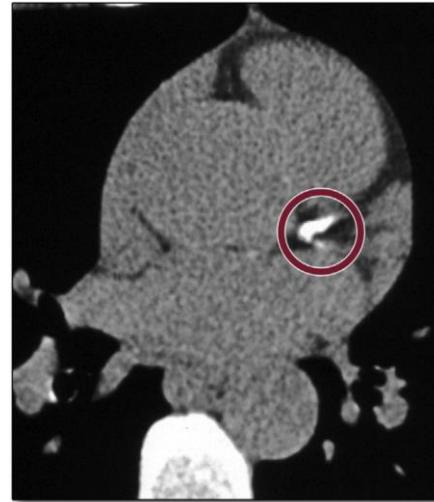
Background

- Patients with bicuspid aortic valves (BAV) generally present with more severe calcification than those with a tricuspid AV
- We want to see if there are accurate ways to calculate AV calcium score using contrast enhanced-CT

Calculation of the Agatston Score

Agatston Lesion Score = Lesion Area x Density Weighting Factor

Total Agatston Score = Σ Lesion Scores



Peak
Attenuation
Weighting Factor

Hounsfield Units

130** - 199	1
200 - 299	2
300 - 399	3
>400	4

Left Coronary Descending
Area = 15 mm², Peak = HU = 450
Lesion Score = 15 x 4 = 60

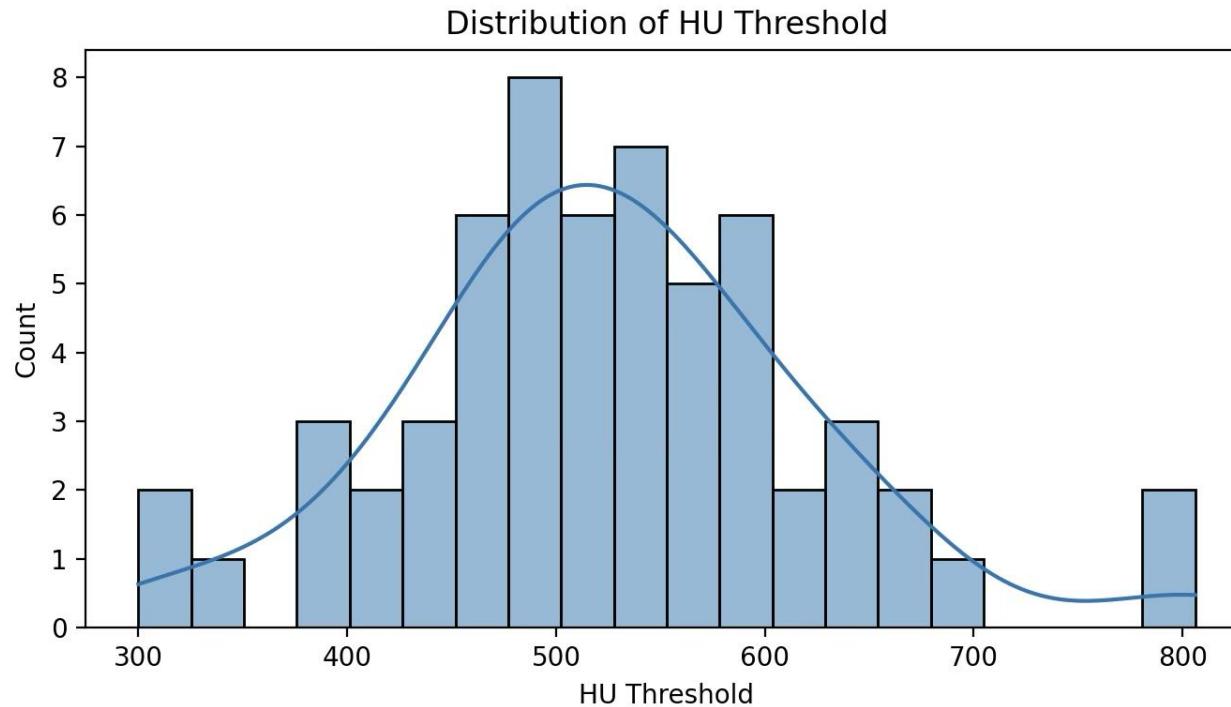
Prior Studies and Limitations

Study	Modality	Hounsfield (HU) Threshold/Cut-off	Notes
Kamo et al (2020)	Non-contrast 320-det CT	≥130 HU (≥ 3 contiguous pixels)	Modified Agatston method
El Garhy (2022)	Contrast CT	~600 HU fixed	Recognized possible underestimation on contrast CT.
Jilaihawi et al (2014)	Non-contrast + contrast-enhanced CT	450, 650, 850, 1050, and 1250 HU	HU-850 threshold offer a similarly high predictive value
Bettinger et al (2017)	Contrast-enhanced CT prior to TAVR	Adaptive: LA +100 HU (best); fixed 650/850 HU tested	Adaptive threshold relative to luminal attenuation showed better prediction.
Pandey et al (2020)	CTA vs Non-contrast CT	Standard Agatston vs Aortic Lumen HU + factor of standard deviation	Correlation between non-contrast and CTA excellent (correlation coefficient, $r = 0.9679$; $P < 0.001$)
Angelillis et al (2021)	Non-contrast CT vs contrast-enhanced CT	Standard Agatston vs 450 HU, 850 HU Prob + HU "Probe Luminal + 100" HU	450 HU vs 850 HU with highest correlation based on LVOT Calcium Density

Methods

- Retrospective analysis
- Cohort of 60 BAV patients undergoing TAVR
- Single Center - 2022–2024
 - Inclusion: Pre-TAVR imaging both nc-CT and ce-CT
 - Exclusion: Patients with prior aortic surgery, aortic dissections, prior pacemakers or inadequate imaging.
 - Prior to 2022 our institution only performed ce-CT for TAVR workup

Results - Distribution



Results – Stratified Conversion Groups

Group	Statistical Range	Detection Threshold (HU)	Conversion Factor (k)	N	R ²
1	< Mean – 2×Std	< 334	1.86	2	0.999
2	Mean – 2×Std to Mean – 1×Std	335 – 429	2.27	6	0.910
3	Mean – 1×Std to Mean	430 – 526	2.58	22	0.913
4	Mean to Mean + 1×Std	527 – 623	2.76	21	0.918
5	Mean + 1×Std to Mean + 2×Std	624 – 720	3.68	6	0.917
6	> Mean + 2×Std	> 721	5.82	2	0.998

Result

- Calcium volume inversely proportional to detection threshold
- Stratified into six groups ($k=1.86\text{--}5.82$)
- Strong linear correlation between Agatston and contrast AVCS ($R=0.91\text{--}0.99$, $p<0.01$)
- Minimal bias (-4.8%) and low MAE ($0.11\%\text{--}4.8\%$)

Take Home Points

- BAV calcium score can be **accurately** derived from contrast-enhanced CT scans by applying a stratified, luminal attenuation-based conversion strategy.
- → **Reliable** conversion across all calcium densities and contrast timings.
 - As it factors for luminal contrast density.
- Further studies warranted to evaluate external validity in a larger cohort of BAV population.