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Case Report

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Rescue Balloon Aortic Valvuloplasty for Malignant Ventricular Arrhythmias and Cardiogenic Shock

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ABSTRACT

Introduction: Severe Calcific Aortic Stenosis (AS) remains a major cause of morbidity and mortality in aged population. Asymptomatic with reduced LVEF has high risk of sudden death.

Aim: To study the complexity of clinical course of Severe Calcific AS with LV Dysfunction.

Case Report: A Seventy-Six-year-old male was admitted with ACS, NSTEMI, LVEF 35% and Severe Calcific AS. With plan of AVR, CAG was done and showed Mild CAD. Post procedure he had sequence of catastrophic clinical events that includes, A systolic Cardiac Arrest (reverted after CPR) and Protracted Pulmonary edema (Connected to Mechanical Ventilation). Later had Malignant Ventricular Arrhythmias, treated with 34 times DC Shocks. He was not suitable for Surgical AVR or TAVI. After high-risk consent, he successfully underwent emergency Aortic Balloon Valvuloplasty (ABV) with significant drop in AV gradients. Post ABV, also had Paroxysmal AF. Arrhythmias were also treated with Beta blocker, Antiarrhythmics, Digoxin and Potassium supplementation. Gradually stabilized, discharged and followed up.

Discussion: Aortic stenosis, a disease of elderly age group. Symptomatology varies widely. It has limited management options. In our case, Post CAG critical illness was probably due to "Pre -CAG" LV dysfunction with sub clinical symptoms. ABV used as bail out procedure in high-risk patients.

Conclusion: ABV is considered as a viable palliative option, with introduction of smaller profile balloons, rapid pacing and vascular closure devices. ABV can safely used as bridging procedure before Surgical AVR or TAVI in high-risk patients.

Key Words: Aortic Balloon Valvuloplasty, Surgical Aortic Valve Replacement, Trans Aortic Valvular Implantation, Malignant Ventricular Arrhythmias

INTRODUCTION

Severe Calcific aortic stenosis remains a major cause of mortality and morbidity in the aging population.[1] Surgical replacement remains the treatment of choice. Balloon aortic valvuloplasty was introduced as a palliative procedure.[1]

We report an unusual clinical course of Severe Calcific Aortic Stenosis in a Seventy-Six-year-old male. He had fairly healthy active life till now and daily walks about 6 to 8 kms. He came with history of retrosternal chest pain for one day with one episode of vomiting. His clinical examination was unremarkable except Grade 3/6 Ejection Systolic murmur in Aortic Area and radiates to Carotids. Preliminary investigations include ECG and 2D Echo. ECG shows Sinus Rhythm with ST depression and T Wave inversion in Inferior leads. 2D Echo confirms presence of RWMA, Moderate LV Systolic Dysfunction with LVEF of 35% and Severe Calcific Aortic Stenosis (PPG / MPG = 74/48 mm of Hg)**(Fig 1 – Complete 2D Echo stills) and (Fig 2 –Complete Doppler Echo stills)**. In view of these observations, he was advised AVR after coronary evaluation.

Next day he underwent conventional Coronary Angiogram, reported as Mild CAD for Medical Management **(Fig 5 A - CAG)**. Immediately following Coronary Angiogram, he had Asystolic Cardiac Arrest. Cardiac activity returned after brief period of CPR done as per ACLS protocol, followed by Flash Pulmonary Edema. As he did not respond to anti failure measures (Oxygen, Lasix and Nebulizations), he was then electively intubated for Mechanical Ventilation support. IV Noradrenaline infusion started in view of persistent hypotension. CXR showed Pulmonary edema and ABG readings suggestive of Hypoxia. Mechanical Ventilation was continued under IV Sedation (IV Vecuronium + IV Fantaline + IV Medazolam) **(Fig 3-ECGs, CXR and ABG)**. After 24 hours

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of Mechanical Ventilation support - while we are planning for extubation, he had Recurrent VT (Ventricular Tachycardia), which continued for next two more days. He had recurrent VT about 34 times **(Fig 4A- Recurrent VT)** and reverted to Normal Sinus Rhythm after receiving DC shocks(150 Joules) each time. Initially DC shocks were given manually and then by Automatic Electronic Defibrillator (AED) paddles used externally. Also received IVAmiodarone, IV Lignocaine, IV Metoprololand oral Potassium supplementation. To rule out electrolyte and hormonal imbalances - S.Ca^{+}, S. Mg^{+},S. K^{+} and thyroid functions were checked, monitored and none found abnormal.

Meanwhile in view of his critical condition, had detailed discussion with patient's relatives. Counselled for Emergency high risk Surgical AVR, TAVI and ABV. CTVS opinion was taken and they ruled out possibility of undergoing Surgical AVR (Aortic Valve Replacement), because of his elderly age and current critical illness. Immediate TAVI (Trans Aortic Valvular Implantation) was also not possible, because of lack of Pre TAVI assessment like CT Aorta. So the only bail out option was ABV (Aortic Balloon Valvuloplasty), which can be done as bridging therapy for future Surgical AVR or TAVI if symptom recurs. After detailed discussion with relatives, agreed for high risk ABV. With help of Cardiac Anesthetist, both CVP and Arterial lines were placed. Strict Intake / Output were monitored with the help of CVP line, Arterial line, NG tube and Foleys Catheterization.

Intervention

On 3rd day of admission and after high-risk consent, underwent successful ABV. Procedural detailsas follows. Procedure was done via Left Femoral approach using 2 sheaths - 12F sheath via Left Femoral Artery for actual procedure and 6F sheath via Left Femoral vein for TPI (Temporary Pacing Implantation). TPI tip was positioned at RV apex. Prior to Balloon inflation, AV gradients by 2D Echo and decreased waist (Internal stenotic AV area) by Aortogram done in Cathlab. Then via 12F sheath and by Seldinger technique over the guide wire, 20 x 40 mm of Mammoth OTW Balloon was placed across the stenotic Aortic Valve. Balloon was inflated with simultaneous rapid RV pacing at 250 beats by TPI. Balloon was inflated using 16 cc of fluid (1:5 dilution of Contrast and Normal Saline). The procedure was repeated until waist at Aortic Valve disappeared. Post Balloon inflation, AV gradients were again noted by 2D Echo in Cathlab. Immediate fall in Aortic gradients were noted from Pre to Post procedure (from 80 mm of Hg to 40 mm of Hg). Complete details of Pre and Post procedural AV gradients of both 2D Echo and Cathlab readings were mentioned in **Table 1. (Fig 2-Complete 2D Echo AV gradients) (Fig 5-CAG and Pre & Post ABV Cath Cine Stills)**. Procedure ended successfully without any further complications.

Post Intervention

IV Noradrenaline infusion, gradually tapered and stopped. All supports were continued. Post Procedure frequency of VT has come downdrastically and gradually. Later he developed Paroxysmal AF**(Fig 4 B -Paroxysmal AF)**. He was again treated with IVAmiodarone, IV Digoxin, IV Metoprololand Oral Potassium supplementation.His arrhythmias were gradually controlled from Recurrent VT →to Ill-Sustained VT → AF with Fast Ventricular Rate →Paroxysmal AF → Normal Sinus Rhythm. Arrhythmias drastically improved after oral Potassium supplementationand we frequently monitored Serum Potassium level too. On 4th day of Post ABV procedure, he was gradually weaned from Mechanical Ventilation and then extubated. Post extubation, no recurrence of arrhythmias was noted. Both bedside mobilization and increased food intake were done gradually. Also treated with Antiplatelets, Statins, Diuretics, Antibiotics, Ipravent & Budecort Nebulizations, N-Acetyl Cysteine and IV Fluids.In view of Mechanical Ventilation support and rise in RFT, cross consultations weredone with both Pulmonologist and Nephrologist - managed conservatively. At discharge, relatives were again counselled for TAVI or Surgical AVR, if he became symptomatic again.

DISCUSSION

Aortic stenosis, a disease of elderly age group.[1]It has wide spectrum of clinical presentations with limited management options, includes Medical Therapy, Surgical Replacement and Catheter Interventions.[2] (Catherine M. Otto, 2020)Aortic Balloon Valvuloplasty (ABV) was once considered as palliative option, but now trend changing with introduction of smaller profile balloons, rapid pacing and closure devices.[2] Complete clinical spectrum of Asymptomatic severe AS-mentioned in **Table 2 (Clinical Spectrum of Asymptomatic Severe AS)**.[2] It summarizes that irrespective of symptoms and LV function, AVR has better survival rate.[2] In our case the probable reasons for **Cardiac Arrest** and followed by **Acute LV failure** was Vasovagal, Critical engagement of coronary ostia during CAG, Preexisted LV dysfunction, Decreased Myocardial tissue perfusion and elderly age. **Recurrent arrhythmias** were probably due to Decreased Myocardial tissue perfusion (because of Mild CAD), IV Noradrenaline (causes Vasospasm and +ve ionotropic effect) and Stress (due to restlessness). Initially all Antiarrhythmics were failed. One should remember that all Anti arrhythmics are Pro arrhythmics. We used Potassium supplementation as Anti arrhythmics, because of its good negative ionotropic effect. It was given orally and then serial serum level was monitored. K+ supplementation should never be given as direct IV, as heart may stops suddenly in Diastole due to its good negative ionotropic effect. He also developed **Acute Kidney Injury** (AKI) as suggested by rise in RFT. This is

probably due to Elderly age, Mechanical Ventilation, Cardiogenic Shock, IV Noradrenaline infusion, Diuretics and Myolysis probably due to repeated DC Shocks. He survived after ABV, a bridging therapy for future Surgical AVR or TAVI advised, if symptoms recur. Currently on regular clinical follow up.

CONCLUSION

Severe AS with LV dysfunction represents a unique entity that poses clinical dilemmas to physicians worldwide very frequently in clinical practice.[3] (V Tsampasian, 2022) In elderly patients with severe but asymptomatic AS, mild symptoms may be difficult to detect, particularly when their mobility is impaired and severe symptom onset is common.[4] (Robert Z, 2017) The meta-analysis by Tsampasian V et al. shows that the data from the two recent large randomized controlled trials and previous observational studies demonstrate a favorable outcome in the group of patients treated with early intervention rather than conservative management.[3] Less symptom or Low AV gradient across Aortic Valve associated LV dysfunction and so one should intervene Aortic Stenosis management as early as possible with care.[1]

Learning Points

- Unexpected clinical course to be expected inAortic Stenosis with LV dysfunction
- Remember all Anti Arrhythmics are Pro Arrhythmics
- Must monitor Thyroid Function Tests, Serum Electrolytes, Calcium and Magnesium
- With intractable arrhythmias, we can use Potassium supplementation with caution and serum potassium monitoredfrequently.

Limitations- because of his critical illness, unable to undergo:

- Speckle Tracking Test / Cardiac MRI perfusion scan
- Cardiac CT
- Electro Physiologic (EP) study

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Authors contributions:

Chandra Shekara Reddy as First Author prepares, edit and submit complete manuscript, Arun Srinivas as Corresponding Author provides complete proof correction of manuscript, Siddarth Kumar Chawath guides complete journal search and publication guidelines. Nithin Bharadwaj provides 2D Echocardiographic Clips and Raju provides CAG and ABV Cath Cine Clips.

Note:

- This is neither Human nor Animal study and hence Ethical clearance letter not provided
- Informed consent taken although this is retrospective clinical analysis
- References prepared as per IJCRR guidelines

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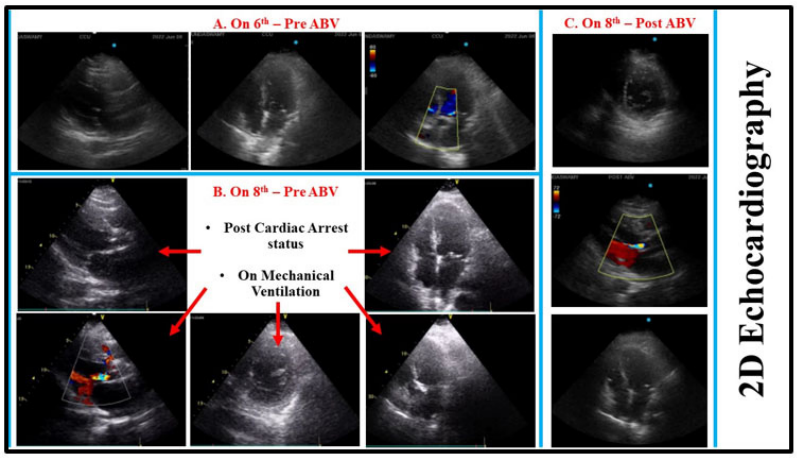
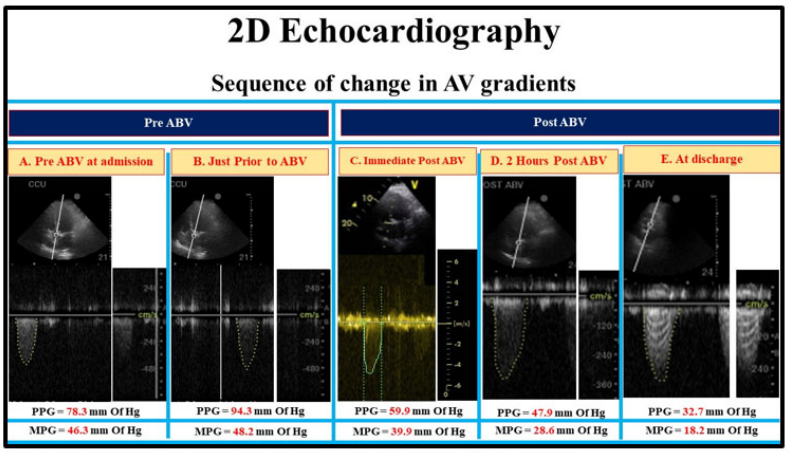
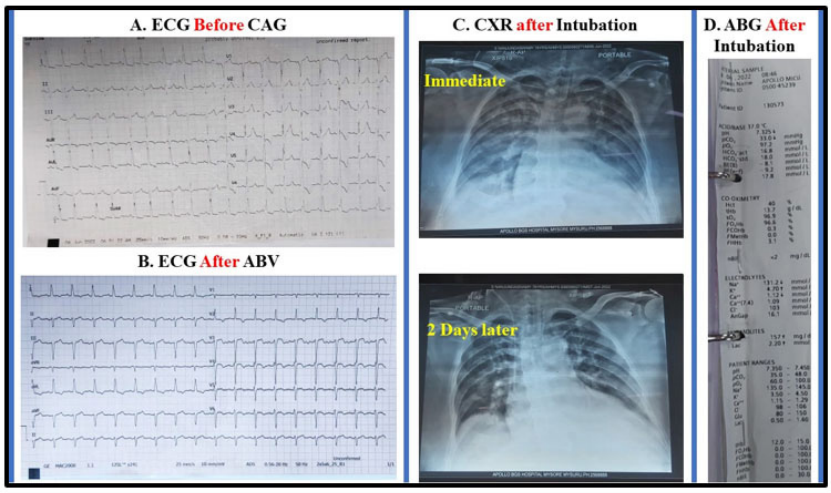


Figure 1: Complete 2D Echocardiographic stills.



ABV = Aortic Balloon Valvuloplasty: PPG = Peak Gradient: MPG = Mean Gradient

Figure 2: Complete sequence of change in AV gradients.
ABV = Aortic Balloon Valvuloplasty, PPG = Peak Gradient, MPG = Mean Gradient.



ECG = Electrocardiogram: CXR = Chest X Ray: ABG = Arterial Blood Gas Analysis: CAG = Coronary Angiogram: ABV = Aortic Balloon Vavuloplasty

Figure 3: ECGs, CXR and ABG.
ECG = Electrocardiogram, CXR = Chest X Ray, ABG = Arterial Blood Gas Analysis, CAG = Coronary Angiogram, ABV = Aortic Balloon Vavuloplasty.

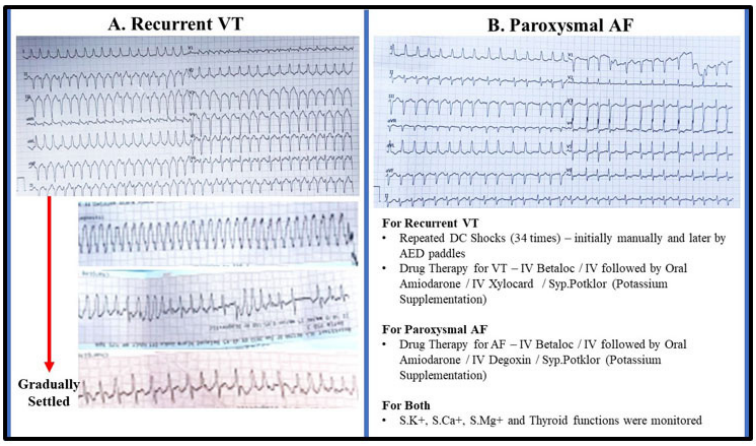
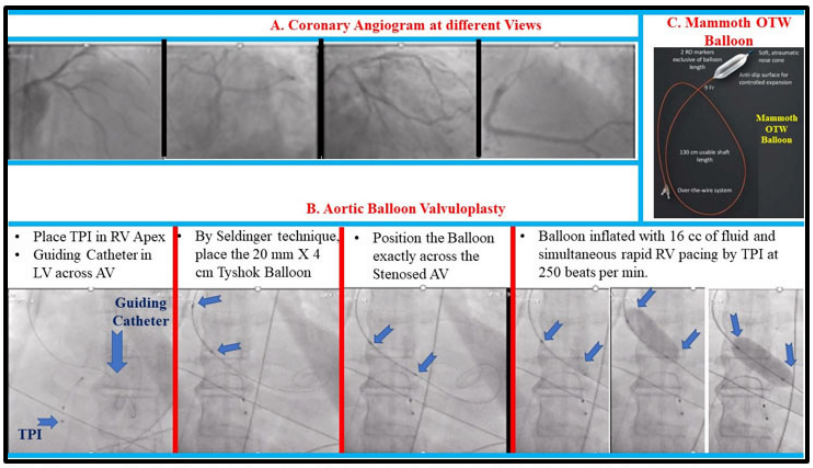


Figure 4: Complete Arrhythmias.



TPI = Temporary Pacing Implantation: RV =Right Ventricle: LV =Left Ventricle: AV =Aortic Valve

Figure 5: Coronary Angiogram and Aortic Balloon Valvuloplasty.
TPI = Temporary Pacing Implantation, RV =Right Ventricle, LV = Left Ventricle, AV = Aortic Valve

Table 1: Complete AV Gradients

Cath gradients		
Pre ABV	80 mm of Hg	
Post ABV	40 mm of Hg	
2D Echo gradients (mm of Hg)		
	PPG	**MPG**
Pre ABV		
A. At admission	78	46
B. Prior to ABV	94	48
Post ABV		
C. Immediately Post ABV	60	40
D. 2 Hours after ABV	48	29
E. At Discharge	33	18

PPG = Peak Gradient: MPG = Mean Gradient: ABV = Aortic Balloon Valvuloplasty

Table 2: Clinical Spectrum of Asymptomatic Aortic Stenosis[2]

Definition / Type	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
Asymptomatic Severe Aortic Stenosis	Severe leaflet calcification/fibrosis or congenital stenosis with severely reduced leaflet opening	Aortic V_{max} ≥4 m/s or mean ΔP ≥40 mm Hg AVA typically is ≤1.0 cm^2 (or AVAi 0.6 cm^2/m^2) but not required to define severe AS Very severe AS is an aortic V_{max} ≥5 m/s or mean P ≥60 mm Hg	LV diastolic dysfunction Mild LV hypertrophy Normal LVEF	None Exercise testing is reasonable to confirm symptom status
Asymptomatic Severe Aortic Stenosis with LV systolic dysfunction	Severe leaflet calcification/fibrosis or congenital stenosis with severely reduced leaflet opening	Aortic V_{max} ≥4 m/s or mean ΔP ≥40 mm Hg AVA typically ≤1.0 cm^2 (or AVAi 0.6 cm^2/m^2) but not required to define severe AS	LVEF <50%	None

V_{max} = Maximum Velocity m/s = meters per second, ΔP = Pressure Gradient, AVA = Aortic Valve Area, cm^2 = Square Centimeters, AVAi = Aortic Valve Area Index