



## ROLE OF RADIONUCLIDE 99M-Tc MACROAGGREGATED ALBUMIN (MAA) SCAN IN DIAGNOSIS OF REVERSAL OF SHUNT IN LARGE SIZED VENTRICULAR SEPTAL DEFECT IN CHILDREN

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### ABSTRACT

Ventricular Septal Defect (VSD) is one of the cardiology cause of Pulmonary arterial hypertension (PAH) in pediatric age group. Early identification of the same is associated with a better surgical outcome. Often PAH may be drastically reduced and returned to baseline, following corrective surgery of VSD. The hyperkinetic PAH becomes fixed after a span of time and is frequently complicated by shunt reversal. So methods which can aid early detection can help the patient by contemplating early surgery which would be of considerable significance in a developing country like India. In the present study we propose to investigate the role of Radionuclide 99m-Tc in diagnosis of reversal of shunt in VSD

**KEYWORDS :** Ventricular Septal Defect (VSD), Pulmonary arterial hypertension (PAH), Radionuclide 99m-Tc MAA

### INTRODUCTION

Pulmonary arterial hypertension is defined as mean pulmonary arterial pressure 25 mm Hg at rest and 30 mm Hg during exercise. In the pediatric age group a cardiac etiology is often responsible for secondary PAH. This is particularly important for both a diagnostic and therapeutic standpoint as many lesions are readily reparable with corrective surgery. Often PAH may be drastically reduced and returned to baseline, following corrective surgery. Early identification of the same is associated with a better surgical outcome.

PAH in congenital heart diseases with a left to right shunt (ASD, VSD and PDA) are both due to increased volume of flow and sheer pressure forces that combine to damage the pulmonary vasculature. The hyperkinetic PAH becomes fixed after a span of time and is frequently complicated by shunt reversal (Eisenmenger syndrome). Once clinical manifestations become apparent with cyanosis and clubbing, the surgical outcome becomes dismal. So methods which can aid early detection can help the patient by contemplating early surgery which would be of considerable significance in a developing country like India where prioritization may help the cardiothoracic team. Khalil A et al in 1994 studied 10,964 consecutive live births weighing more than 500 grams and of more than 28 weeks of gestation. 43 of them had CHD, giving an incidence of 3.9 per 1000 live births. VSD constituted 34.4 % and had a incidence of 1.4 per 1000 live births. During follow up 34.9 percent of infants with CHD died.[1]

Results of surgical repair and somatic growth after this repair from India have decidedly improved with time. Vaidyanathan B et al in 2006 reported 90 consecutive infants, followed after VSD closure at referral centre in southern India and they studied children showed significant improvement from baseline, therefore of these children which were picked up by non invasive techniques, the outcome even in developing country seems to be promising. It is encouraging to note that age at surgery currently as reported by Vaidyanathan B et al was  $7.2 \pm 3.2$  months. The risk of death from congenital heart disease surgery has dropped from approximately 30 percent in the 1970s to less than 5 percent in most cases today. [2]

Noninvasive options for early detection are transthoracic echocardiography, transesophageal echocardiography and radionuclide study.

### MATERIAL AND METHODS:

The study was conducted in the Department of Pediatrics, Maulana Azad Medical College and associated Lok Nayak and GB Pant Hospital, New Delhi. The radionuclide study was

conducted at Institute of Nuclear Medicine and Allied Sciences (INMAS), Timarpur, New Delhi.

### Inclusion Criteria:

1. Children beyond 1 year of age
2. Large size VSD as assessed by
  - a) absolute size > 7 mm, and/or
  - b) relative size > 30 mm/m<sup>2</sup>
3. Large PDA as assessed by Qp:Qs ratio of more than 2.5

### Exclusion Criteria:

1. Established Eisenmenger syndrome as evidenced clinically by cyanosis and clubbing.
2. Primary parenchymal pulmonary disease.

After ethical committee approval 40 children were enrolled for the study.

Children with a history of breathlessness/ respiratory distress, feeding difficulties, and feeding diaphoresis were examined clinically for evidences of a left to right shunt. Those with evidence of arterial desaturation i.e. SpO<sub>2</sub> < 90 % and/ or clubbing were excluded from the study. All the recruited children had undergone a baseline spo<sub>2</sub>, chest x-ray, ECG, both 2-Dimensional and colour Doppler echocardiography and radionuclide study, after a detailed clinical evaluation.

The radionuclide study have been done at INMAS. Radiocontrast material used for the radionuclide study was 99m - Tc labeled Macro Aggregated Albumin.

### Patient Preparation

All patient have been immobilized during procedure. A 23 gauge intra venous needle was inserted in the antecubital vein & secured. The patient was then positioned with the Gamma Camera viewing the chest from the anterior position. Accurate positioning was achieved using radioactive markers over the suprasternal notch and xyphoid ensuring that the chest was centered with the field of view of the Gamma Camera.

### Radionuclide

The children were given 0.2Ci/kg of MAA tagged with 99m-Tc with a minimum dose of 500 Ci

### RESULT & DISCUSSION

The study population included 40 children with large sized ventricular septal defect ( $\geq 7$ mm) during one year period.

### AGE DISTRIBUTION

Most common age group in the study population was 1 – 3 year (60%) followed by 3 – 5 year age group (15%). (Table 1)

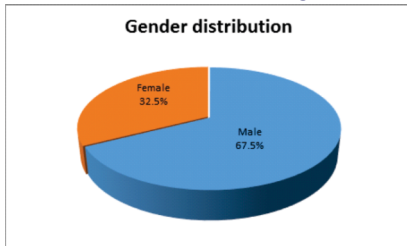
**Table 1: Age distribution**

Age group ( in years)	Number of patient	% of total cases
1 - 3	24	60 %
3 - 5	6	15 %
5 - 7	4	10%
7 - 9	4	10%
≥ 10	2	5%
Total	40	

**GENDER DISTRIBUTION**

67.5 % of the study population were male and 32.5 % were female. (Graph 1)

**Graph No. 1: Gender distribution of Large sized VSD**



**CLINICAL FEATURES**

Most common clinical symptom present in study population was cough (95%) followed by fever (52.5%), recurrent chest infections (42.5 %), suck-rest-suck cycle (42.5%) and feeding diaphoresis (40%). Respiratory distress was present in only 35 % of study population.

**CHEST X-RAY FINDINGS**

In our study 65 % of the study population, had cardiomegaly and left ventricular enlargement in CXR. Left atrium enlargement was present in 32.5 % of the patients. Right ventricular enlargement on CXR was present in 22.5 % of the study population. No child in our study population had right atrium enlargement. Pulmonary vascular plethora was present in 55 % of the study population. Pulmonary arterial

prominence was present in 30 % of the patients.

**ECG FINDING**

Left ventricular hypertrophy (LVH) was present in 62.5 % of the patients. Left atrium hypertrophy was present in 32.5 % of the patients. Right ventricular hypertrophy was present in 20 % of the study population. Right atrium hypertrophy was not present in any child. There is significant correlation between severity of reversal of shunt detected by radionuclide scan and left ventricular hypertrophy, left atrium hypertrophy and right ventricular hypertrophy (p<0.005).

Syamasunder Rao P et al in 2005, found that the electrocardiogram may be normal in very small defects or may show evidence for left ventricular hypertrophy in small to moderate defects while it may show biventricular or right ventricular hypertrophy in moderate to large defects. Electrocardiographic signs of left atrial enlargement may also be seen. Severe right ventricular hypertrophy may be seen if pulmonary vascular obstructive disease develops, that means as the severity of reversal increased, right ventricular hypertrophy dominated. This study results matches with our study results.[3]

**ECHO FINDINGS**

LVH in ECHO was present in 77.5 % of the study population. RVH was present in 20 % of the study population. 35 % of the patients had LAH. PAH was present in 20 % of the patients. No child in the study population had right atrium hypertrophy.

**CORRELATION OF SEVERITY OF REVERSAL AND CLINICAL PROFILE OF PATIENT WITH VSD:**

There was not significant correlation between severity of reversal of shunt and number of children presenting with cough & fever. There was significant correlation between severity of reversal and children presenting with Respiratory distress, Suck-rest-suck cycle, recurrent chest infections and requirement of decongestive measures (p<0.001). As severity of reversal increased, all above mentioned symptoms increased. The temporal change in symptomatology in the period just preceding the scan was not available with a definite index of reliability in the study group. (Table No. 2)

**Table No. 2: CORRELATION OF SEVERITY OF REVERSAL AND CLINICAL PROFILE OF PATIENT WITH VSD**

SEVERITY OF REVERSAL	% OF RIGHT LEFT SHUNT ≤ 10% ( N= 27)		% OF RIGHT LEFT SHUNT = 10-20% ( N= 7)		% OF RIGHT LEFT SHUNT > 20%( N= 6)		P VALUE
	No.	% of cases	No	% of cases	No	% of cases	
Cough	26	96.2 %	6	85.7 %	6	100 %	NS
Fever	14	51.8 %	4	57.1 %	3	50 %	NS
Respiratory distress	4	13.7 %	6	85.7 %	4	66.7%	<0.001
Suck-rest-suck cycle	7	25.9 %	5	71.4 %	5	83.3 %	<0.001
Feeding diaphoresis	7	25.9 %	4	57.1 %	5	83.3 %	=0.02
Recurrent infection	6	22.2 %	6	85.7 %	5	83.3 %	<0.001
Decongestive measures	7	25.9 %	5	71.4 %	6	100%	<0.001
Past H/O hospitalization	8	27.5 %	6	85.7 %	2	66.7 %	=0.01
Willingness for surgery	8	27.5 %	4	57.1 %	2	33.3 %	NS

**RADIONUCLIDE SCAN RESULTS**

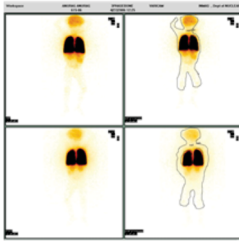
**Table No. 3: Distribution of reversal of shunt on Radionuclide scan**

Radio Scan Result	No.	% of cases
Shunt Reversal ≤ 10 %	27	67.5%
Shunt reversal > 10 – 20 %	7	17.5%
Shunt reversal >20%	6	15%

No reversal of shunt detected by echocardiography in the study population. Effective reversal of shunt (>10 %) found in

13 patients (32.5 %) of the study population on radionuclide scan (Figure 1). Children with reversal of shunt were divided into two groups. 1<sup>st</sup> group containing shunt reversal of 10-20 %. And 2<sup>nd</sup> group containing shunt reversal of > 20 %. 17.5 % of the study population belonged to 1<sup>st</sup> group. 15 % of the study population belonged to 2<sup>nd</sup> group. 67.5 % of the study population had no reversal of shunt ( ≤ 10 % ), as detected by radionuclide scan. There is significant correlation between severity of reversal of shunt detected by radionuclide scan and LAH, RVH & Pulmonary arterial hypertension (p<0.001).

**Figure No. 1: MAA Scan showing a positive case of Right to Left reversal of shunt with 3.1% uptake**



In 8 out of all the 40 patients, who had right ventricular dominance and PAH with pulmonary pressure gradient  $\geq 55$  mm Hg, demonstrated reversal of scan on Tc-MAA scan, suggested that they already had gone on obliterative phase of PAH as evidenced by right ventricular hypertrophy and therefore in full blown obliterative phase, echocardiography detected reversal of shunt. However in remaining 5 patients, who had reversal of shunt detected by MAA scan, echocardiography could not detect reversal of shunt. PAH was not present in these 5 patients. So we concluded from our study that Radionuclide scan by Tc-MAA is more sensitive than echocardiography in early detection of reversal of shunt in large sized VSD.

## CONCLUSION

Following conclusions can be drawn from our study

- Age of the 60% patients of our study were less than or equal to 3 years. So patients presented to us with clinical symptoms in early age.
- Most common clinical presentation with which patients came was cough, followed by fever, recurrent chest infection, suck-rest-suck cycle.
- There was significant correlation between reversal of shunt and Respiratory distress, suck-rest-suck cycle and requirement of decongestive measures in the past.
- There is significant correlation between severity of reversal of shunt detected by radionuclide scan and L.V.H, L.A.H, & R.V.H. in ECG ( $p < 0.005$ ). So ECG findings can predict the chances of reversal.
- ECHO did not detect reversal of shunt in any child of our study.

So we concluded from our study that Radionuclide scan by Tc-MAA is sensitive diagnostic modality for early detection of reversal of shunt in large sized VSD. Every child with VSD, must be evaluated by Radionuclide scan by Tc-MAA before planning for the surgery to predict the post surgery effect.

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