Demographic Data

Table (I): Physical characteristics of the patients.

Case No.	Age (years)	Sex	Weight (Kg)	Height (cm)	2D Echocardiographic diagnosis
1	12	M	25	120	Artificial aortic valve
2	8	M	25	116	HOCM, subaortic membrane
3	6	M	23	107	Interrupted IVC, ASD??
4	5	F	15	105	TOF
5	2	M	8	85	TOF, Dilated aorta
6	11	F	35	130	Post Glenn, RVH.
7	11/12	M	6.5	55	ASD, PDA
8	2	M	10.5	90	Subaortic VSD, Subaortic membrane
9	15	M	45	155	Interatrial aneurysm, ASD
10	7	M	19	114	ASD
11	10	F	22	140	SABE vegetations on aortic valve
12	4.5	M	16	112	PAPVR
13	7	F	25	115	Tricuspid atresia, ASD
14	5	M	14	100	TOF
15	8	M	20	120	Tricuspid atresia, ASD
16	8/12	F	6.5	45	ASD, PDA
17	6	M	20	102	D-TGA, VSD
18	5	M	20	105	Dextrocardia, VSD
19	5	M	14	99	Complex CHD, Dextrocardia
20	10	M	35	141	Cleft MV, MR
21	10	F	28.5	133	Complex CHD, DORV
22	12	F	37	144	Big ASD + PH.
23	6	F	18	112	LSVC draining to coronary sinus
24	8	F	30	116	Big ASD+PH
25	12	M	35	146	RVD, PS.
Mean ±SD	7.12 ±3.75	16M 9F	22.12 ±10.11	112.28 ±25.88	

Table (II): Symptoms and signs among the patiens undergoing the study:

Case No.	FTT	Dyspnea	Cyanosis	Clubbing	Spell	RCI	Abnormal feature
1	-	+	-	-	-	-	-
2	-	+	-	-	-	+	-
3	-	-	-	-	-	-	-
4	-	+	+	+	+	-	-
5	-	+	+	+	+	-	-
6	-	+	-	-	-	-	-
7	+	-	-	-	-	-	-
8	-	+	+	-	-	+	-
9	-	+	-	-	-	-	-
10	-	+	-	-	-	+	-
11	-	+	-	-	-	+	-
12	-	+	-	-	-	-	-
13	-	+	+	-	-	-	-
14	+	+	+	+	+	-	-
15	-	+	+	-	-	+	-
16	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-
19	+	+	+	+	+	-	-
20	-	-	-	-	-	-	Mongoloid
21	-	+	-	-	-	+	-
22	-	+	-	-	-	+	-
23	-	-	-	-	-	-	-
24	-	+	-	-	-	-	Coarse
25	-	+	-	-	-	-	-
Sum	**3**	**18**	**7**	**4**	**4**	**7**	**2**
%	**12%**	**72%**	**28%**	**16%**	**16%**	**28%**	**8%**

Table (III): Patient's data (Investigations)

Case No.	ECG						X-ray		
	Rhythm	RV	LV	LA	RA	Others	C-T ratio	Lung-field	Chambers
1	Irregular	-	↑	↑	-	PVCs	↑	oedema	LVE, LAE
2	R	-	↑	-	-	T-wave inversion	↑	congestion	LVE
3	R	↑	-	-	↑	-	↑	-	RVE /RAE
4	R	↑	-	-	↑	-	N	oligemia	RVE
5	R	↑	-	-	-	-	N	oligemia	RVE
6	R	↑	-	-	-	-	↑	oligemia	RVE
7	R	↑	↑	-	↑	-	↑	-	LVE
8	R	↑	-	-	-	-	↑	congestion	RVE
9	R	-	-	-	-	-	N	-	-
10	R	↑	-	-	↑	-	↑	congestion	RVE, RAE
11	R	-	↑	↑	-	-	↑	congestion	LVH
12	R	↑	-	-	-	-	N	congestion	RVH, RAH
13	R	-	↑	↑	↑	-	N	oligemia	LVE
14	R	↑	-	-	-	-	N	oligemia	RVH
15	R	-	↑	↑	-	-	↑	congestion	LVH
16	R	↑	-	-	↑	-	N	-	LVH
17	R	-	↑	-	-	-	↑	-	LVH
18	R	-	-	-	-	-	Dextro cardia	-	-
19	R	-	Q-wave	-	-	-	Dextro cardia	-	Gastric bubles
20	R	-	↑	↑	-	-	N	-	-
21	R	↑	↑	-	↑	-	↑	Plethora	RVE
22	R	↑	-	-	↑	-	↑	Plethora	RVE
23	R	-	-	-	-	-	N	-	-
24	R	↑	-	-	↑	-	↑	-	RVE, RAE
25	R	↑	-	-	-	-	N	-	-
		14	9	5	9		13		

Table (IV): Patient's Echodata in Echocardiography Room:

No.	TTE	TEE
1	- Left ventricular (LVE) LVEDD=5.5 LVES=3.9 FS 26% - Moderate to severe AR - Paravalvular aortic Leak.??	- Mild impairment of LV function. - LA dilated 2.9 cm - Moderate to sever aortic regurge paravalvular around the annulus of the artificial valve. - **The picture improved by TEE.**
2	- LVH, predominantly affecting the interventricular septum. - Systolic anterior motion of anterior leaflet of the mitral valve. - Premature closure of aortic valve.	- Subaortic membrane with localized hypertrophy 5 mm below aortic valve with turbulence on colour Doppler, - Valve is normal. - Pressure gradient at subaortic area 90mmHg. **(Sub aortic membrane not appeared by TTE)**
3	- Small high ASD 0.3 cm (Secondum versus sinus venosus defect. - Mildly dilated RA, RV - Moderate TR, EPAP 37 mmHg. - There is possibility of partial anomalous PVR, RT. upper PV could not be seen with?? drained in dilated coronary sinus. - Persistent LSVC - Left Sided aortic arch	- IAS looks intact. - Persistent LSVC drainage into hugely dilated coronary sinus. - At least 2 pulmonary veins draining into LA. - Size of RA, RV within normal. - Hemiazygous continuation of IVC into LSVC. - Hepatic vein drained into RA - **Dilated coronary sinus TEE superior over TTE.**

No.	TTE	TEE
4	- Large unrestricted VSD: 1.6 cm è bidirectional shunt. - Dilated Ao. Root, overriding by 40-50%. - Sever valvular and subvalvular PS. - RVH – Trivial TR - Good LV function.	- Good LV function - VSD 1.5 cm bidirectional - **Small PFO** - Mild TR - Pulm valve annulus 1.5cm è no stenosis - **Sever infundibular stenosis.** - Trivial AR
5	- RVH - Large VSD - Overriding aorta - Intact IAS - valvular and infundibular PS.	- Large unrestricted VSD 15.7 X 16.2 mm. - Valvular and subvalvular PS è PG 50 mmHg - Aorta overriding by 50% - RVH – intact IAS - Good ventricular function. - **Small coronary branch crossing RVOT.**
6	- Patient has a very difficult echowindows. - Functioning Glenn. - VSD 1.7 cm inlet type. - PG across PS 50 mmHg - RVH mild	- Study confirmed the presence of straddling of the mitral valve, the valve apparatus is half into the RV with attachment of the cordae to the Rt. Side of IVS. - Mild MR, Moderate RVH, Mild TR. - Aortic valve is tricuspid and normal and ant. to PA. - Intact IAS - There is turbulence of the pulmonary valve level. - Patent Glenn pathway è no turbulence on colour.

No.	TTE	TEE
7	- Moderate valvular PS - Small ASD, with aneurysm formation of IAS. - Mild AR, bicuspid Ao valve. - Small PDA.	- Study confirmed the presence of slight aneurysm of the IAS and moderate ASD secondum 1 cm è left to right shunting. - Mild RAH and RVH. - The aortic valve is **tricuspid and dilated aortic sinus** 1.9cm and dilated ascending aorta 1.7 cm – (similar to pt. è connective tissue disease). - Mild AR- no LVD - There is turbulence at PV level.
8	- Subaortic ridge causing LVOTO PG 52 mmHg - Mod. LVH - Subaortic VSD perimembranous 6 mm left to right PG 69 mm Hg - Small PFO - No PH	- **Intact IAS** - Moderate LVH and normal function. - **Intact IVS** with no evidence of VSD. - There is marked turbulence at the subaortic area è small echogenic ridge and small subaortic VSD è obstruction of LVOT.
9	- Large interatrial aneurysm with no apparent shunts. - RA and RV seemed of normal size è no hypertrophy. - LV showed normal contractility è FS 42%.	- The study confirmed the presence of large interatrial aneurysm measuring 2.3 cm è vertical access of 1.2 cm. - There is tiny hole at the inferior rim of the aneurysm 5-6 mm è left to right shunt. - **LA appendage seen è no abnormalities.**

No.	TTE	TEE
10	- Moderate secondum ASD 1-1.2 cm è left to right shunt. - Mild to moderate RAH and RVH - Mild AR - Paradoxical septal motion of LV. - **Suitable for device closure.**	RVH and RAH. Good IV function Mild TR. SPAP=40mmHg Large secondum ASD 1.8cm with **deficient superior rim around 0.4 cm** (to support a device) **for surgical repair.**
11	- Multiple masses inside heart at interus of IVC at RA-on sides of TV. - Another mass in out wall of aorta aortic abscess??	- **Mitral Reg** - LVD - AS and Co Ao - **Vegetations of SABE**
12	- Large sinus venosus è left to right shunt. - Only LPV drawing into LA. - Rt. Pulmonary veins not seen well. - Moderate RAH and RVH. - Mild TR	- The study confirmed the presence of large sinus venosus 1.5 cm è large left to right shunting. - LPV draining normal into LA. - There is one right plum-vein draining direct into LA. - The second RPV is not seen. - Mild TR è ESPAP=35 mmHg. - Good LV function. - **For surgical repair**

No.	TTE	TEE
13	- single ASD - Tricuspid artesia - VSD - Hypoplastic RV - PS	- Artesia of right sided AV valve. –hypoplastic RV - VSD 1 cm size. - LV function is good. - **Fenestrated IAS, multiple ASDs.** - IAS bulging to the left side indicating high pressure in RA.
14	- Not apparent - PS	- **Aortic valve has 4 cusps.** - Adequate size LV è good function. - Small PA branches (RPA 0.6 cm, LPA 0.9 cm) - Ao 1.2 cm. - **Total correction not suitable.**
15	- Tricuspid valve atresia - ASD - VSD - PS - Good function Glenn operation.	- ASD - VSD - PS - **Mild MV prolapse è no regurge** - No obstruction of IVC
16	- Long high secondum ASD 1.3 cm bidirectional flow mainly left to right. - RAD - RVD - Left pulm vein draining into LA however RPV drain into SVC PAPVR	- No PAPVR could be detected - ASD 1.7 cm - Mild to moderate PR è dilated PA. - Moderate size PDA 0.4 cm - TR grade II

No.	TTE	TEE
17	- transposed ventriculo-arterial connections. - VSD (multiple) left pulmonary artery stenosis at its origin.	- D-TGA aorta is anterior and to the right of the pulmonary artery - No obstruction to RVOT. - LPA origin appears small than distally origin 6.3 mm distally 7.4 mm.
18	- is very difficult - LA is right sided opening to a right sided RV. giving rise to A0 - The left sided atrium is the systemic atrium opening to LV giving rise to PA è no abnormal PG. - There is small VSD.	- Heart on right (situs solutes) - Dextrocardia. - LA opening in LV - RA opening in a Small RV. - No considerable PG across the PA - small VSD
19	- Situs inversus - Dextrocardia, DOLV - Sever PS - Left sided right atrium is opening to the left sided RV. - The Rt. sided Lt. atrium is opening to a right sided LV. - Large non restrictive VSD - Ao arising anteriorly and to the right from LV. - PA arising posteriorly overriding the VSD. - Subvalvular and valvular PS.	- RV is smaller than the left but is not rudimentary. - The attachment of the left AV valve to the septum verifying that the left sided ventricle is the RV. - The out let of the ventricle è the - pulmonary overriding the septum could not be adequately visualized.

No.	TTE	TEE
	- PG across PA is around 91mmHg. - The Echowindows are very difficult. TEE is recommended to sorout the degree of pulm. overriding to the septum and to visualize clearly the chordal attachment at the tricuspid valve whether straddling to the septum or not and to detect the size of RV for taking decision for univentricular repair.	
20	- Cleft mitral valve MR grade III - LAD - LVD è good function. - Subaortic VSD completely closed by aneurysm. - **Intact IAS (difficult).** - PAP 34 mmHg.	- The cleft in the anterior mitral leaflet is more clear **(better view)** moderate MR. - VSD pouch is clearly seen completely closing the defect è no residual shunt. - **Clearly seen intact IAS**
21	- Complex CHD. - DORV è malposed great vessels, VSD, PS, Juxtaposed left atrial appendage to the right. - Ao. asise from RV anteriorly - PA asise from RV. posteriorly è valvular PS and PG 65 mmHg. - MPA and branches are dilated.	- DORV with malposed great vessels. - VSD, PS, juxtaposed left artrial appendage to the right. - Valvular and sub valvular PS chordal attachment of the tricuspid valve to the right side of septum and out, but no

No.	TTE	TEE
	- Large subpulmonic non restrictive VSD è two or three smaller defects along remaining portion of the septum. - The tricuspid valve overrides the septum è no straddling. - It is aligned in such a way that it is in the pathway between the LV and both vessels. - LV dilated è good function. - RV small and acts as an outlet chamber. - **Interatrial septum is difficult seen from the subcostal view.**	chordal attachment to the left side. - Although the tricuspid valve is not straddling the defect yet it appears to be in the way of a Rastelli patch. - **Intact interatrial septum demonstrated clearly.** - The juxtaposition **of left atrial appendage is seen clearly.** - RV is small - **The TEE added a lot to the diagnosis and decision of operation.**
22	- There is a big ASD secondum about 21 mm. - Intact IVS - TR è ESPAP about 50 mm Hg. - RAD and RVD. - Paradoxical septal motion	- No IASD was detected only septal aneurysmal motion for cardiac catheterization.
23	- Intact IAS and IVS - Normal cardiac valves - The coronary sinus appears dilated è a persistent LSVC draining into it. - The roof of coronary sinus is intact è no right to left shunt.	- TEE was done to exclude presence of any septal defect whether interatrial or inter ventricular. - Also to make sure of the **unroofing of the dilated coronary sinus.** - **This was proved well using the**

No.	TTE	TEE
	- The RSVC is present è no innominate vein detected and appear smaller than usual - Trivial TR (normal for age) - Normal aortic arch. - Good vent. functions.	**TEE.**
24	- Dilated right atrium and right ventricle. - TR è EPAP 45 mmHg - Intact IVS - **Suspected IAS Communication** (streaked FO versus ASD) - Good myocardial activity	- ASD secondum 7 mm in **diameter was confirmed.**
25	- RVD- pulmonary valvular - TR-stenosis. PG 30 mmHg. - **IA communication.** - Intact IVS	- **No inter atrial communication.**

The study was performed on 25 paediatric patients after approval of the medical ethics committee, Faculty of Medicine Cairo University.

By analysis of the statistical data obtained from history, clinical examination, investigations and echocardiographic examination of the patients of our research we reached the following results:-

- 16 patients were males (64%), while 9 patients were females (36%).

Sex distribution

Fig. (9) : Showing sex distribution

- Two patients were dysmorphic, constituting 8% of the study population.
- Reviewing the history and examination of the patients revealed the major complaint of dyspnea on exertion which occurred in (18) patients of the study, cyanosis was confirmed in (7) patients, clubbing affected (4) patients, spells affected (4) patients, repeated chest infection affecting (7) patints and FTT (3) patients.

Table (V): Showing symptoms and signs of the studied cases:

Symptom and signs	Dyspnea	Cyanosis	Spells	Clubbing	FTT	Repeated chest infection
No.	18	7	4	4	3	7
%	72%	28%	16%	16%	12%	28%

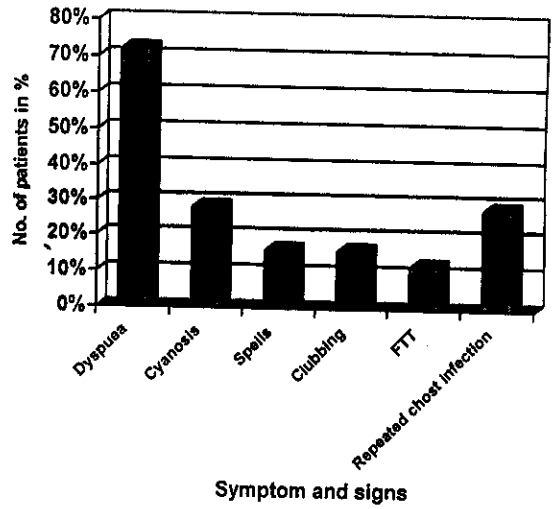

Fig.(10) : Showing signs and symptoms.

Table (VI): Congenital heart lesions studied in 25 cases:

Congenital heart lesion	Number studied	Percent
- Tetralogy of fallot	3	12%
- Complex CHD	2	8%
- Atrioventricular canal	2	8%
- Situs inversus	1	4%
- TGA	2	8%
- IA aneurysm	1	4%
- Interrupted IVC	1	4%
- HOC M	1	4%
- SABE	2	8%
- VSD (isolated and others)	4	16%
- ASD	4	16%
- PAPVR	1	4%
- Abnormal LSVC	1	4%

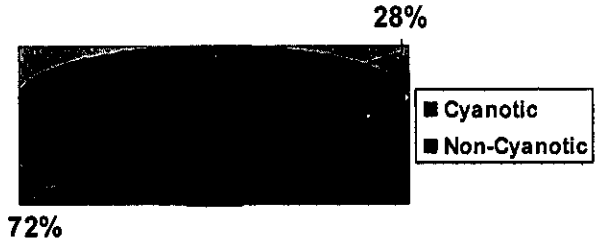

Fig. (11) : Percentage of cyanotic and non-cyanotic heart disease among study population.

X- Ray Findings:

Table (VII): showing the X-ray findings

Finding	↑CT-ratio	RVD	LVD	RAD	LAD	Dextrocardia
No.	13	11	8	4	1	2
%	52%	44%	32%	16%	4%	8%

- Increased cardio-thoracic ratio in (13) case.
- Dextrocardia without situs inversus totalis in (2) patients.
- Regarding lung field vasculature, lung plethora was detected in (2) cases, lung oligemia observed in (6) patients, lung oedema in (1) case, increase bronchovascular marking (lung congestion) in (6) cases and normal lung vasculature was detected in (10) patients.
- Right veutricular dilatation was detected in (11) patients.
- Left veutriculaz dilatation was detected in (8) patients.
- Right atrial dilatation was detected in (4) cases.
- Left atrial dilatation was detected in (1) case.

Table (VIII): Showing lung field

Finding	Lung plethora	Oligemia	Oedema	congestion	Normal vasculature
No.	2	6	1	6	10
%	8%	24%	4%	24%	40%

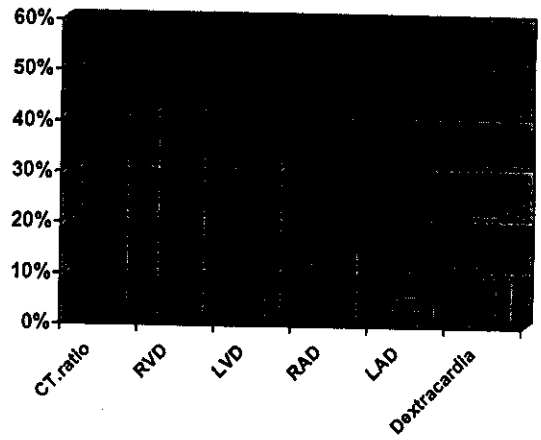

Fig.(12): Showing the X-ray finding in all patients.

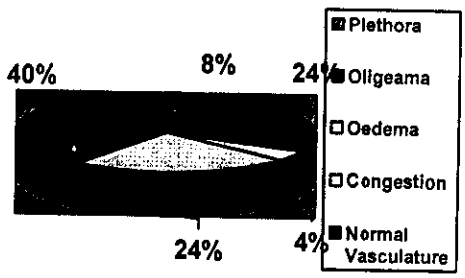

Fig (13): Shows the lung vasculature in all patients

ECG findings:

Table (IX): showing the ECG finding in all patients

Finding	RVH	RAD	LAD	Bivent	P-axis +90+180
No.	14	9	5	2	1
%	56%	36%	20%	8%	4%

- Normal regular sinus rhythm in 24 patients.
- Irregular rhythm in one patient in the form of multiple PVCs.
- RVH in (14) patients
- RAD was demonstrated in (9) patients.
- LAD was demonstrated in (5) patients.
- Biventricular heypertrophy was detected in (2) patients.
- P-axis was detected to be in the right lower quadrant denoting that the right atrium is to the left in (1) patients.

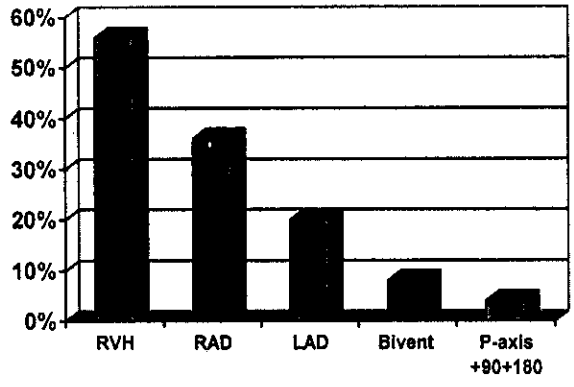

Fig (14): Shows the ECG findings

Evaluation of TEE in the echocardiography lab:

- all of my cases done in the echocardiography lab. Revealed the following:
- Positive data in 22 patients out of the 25 patients constituting (88%).

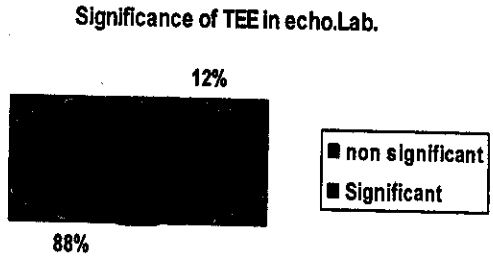

Fig (15): Showing significance of TEE in the echo.lab.

- (8) patients with IAS problem had gained the most benefits from use of TEE followed by two patients with complex CHD.
- No added data in 3 patients (12%), these patients included, cleft mitral valve and subaortic membrane, sinus venosus.

ASD diagnosis:

Included (8) patients of the study having isolated ASD & associated with other lesions. TEE showed more positive data in (6) patients out of the (8) patients comprising 75% of ASDs.

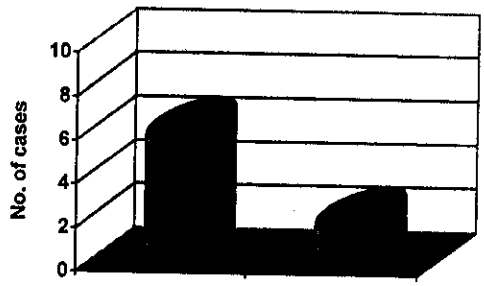

Fig.(16): showing the more positive data of TEE in ASD cases

The dropout done by the TTE in diagnosis of ASD was corrected by TEE which revealed presence of multiple ASDs (fenestrated IAS) who was diagnosed single ASD by TTE. (Patient No. 13).

Another two patient was diagnosis by TTE as having ASD secondum 21 mm, while TEE proved intact IAS (patient No 22 and No. 3). A fourth patient with TTE suspected IAS communication while TEE proved the presence of secondum ASD 7mm in diameter (patient No. 24) and also small PFO (patient No. 4). Three patients had relatively the same measurments between the TTE and TEE.

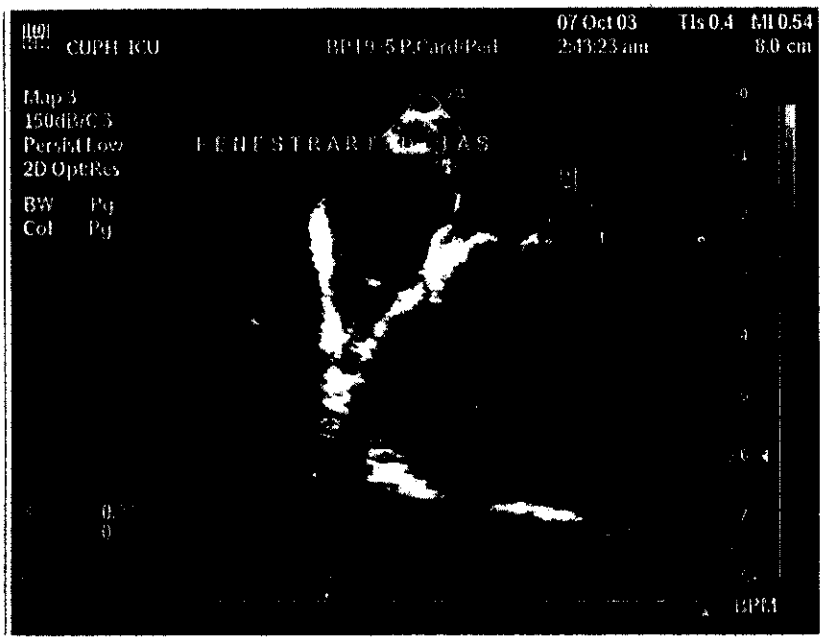

Fig. (17): TEE of the left to right flow across an fenestrated IAS.

In diagnosis of subaortic VSD:

Although the patient had pectus excavatum which did not allow for better views by TTE the use of TEE exclude IVSD and reveal no evidence of VSD.

Another patient with subaortic VSD completely closed by aneurysm is the same view also by TEE.

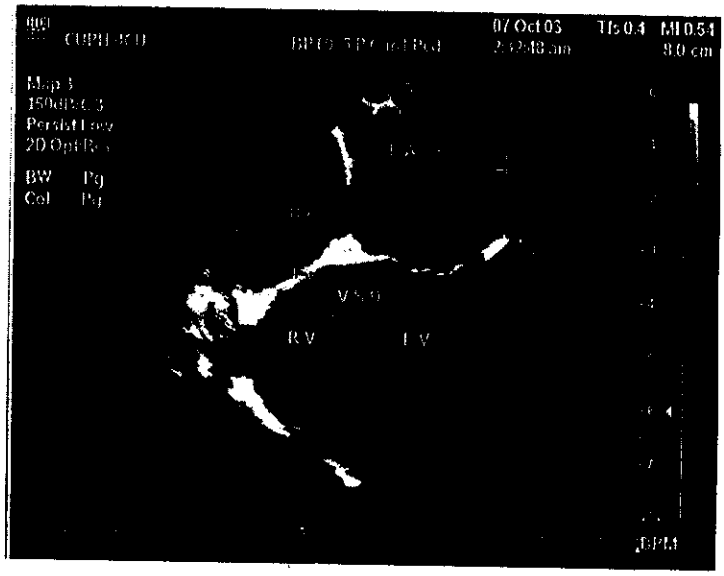

Fig. (18): TEE showing VSD with bulging IAS to left

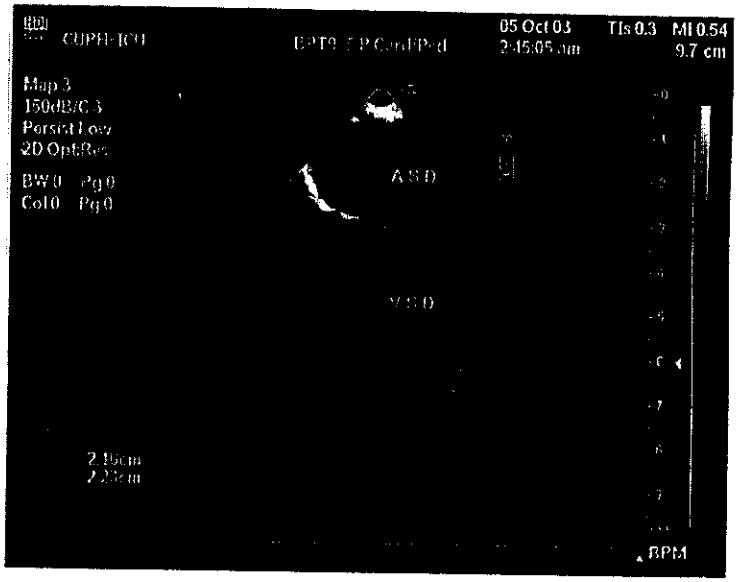

Fig. (19): TEE showing VSD with ASD

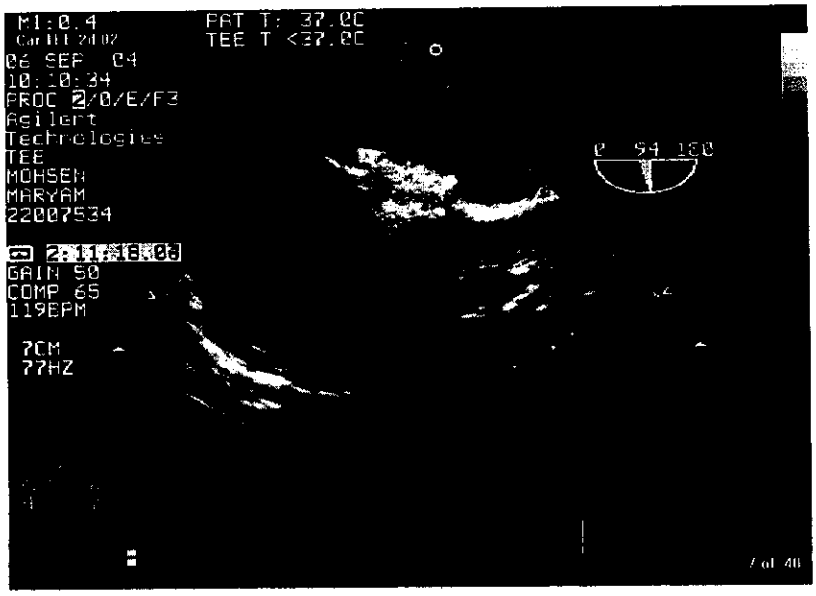

Fig. (20): TEE hypoplastic LV with VSD

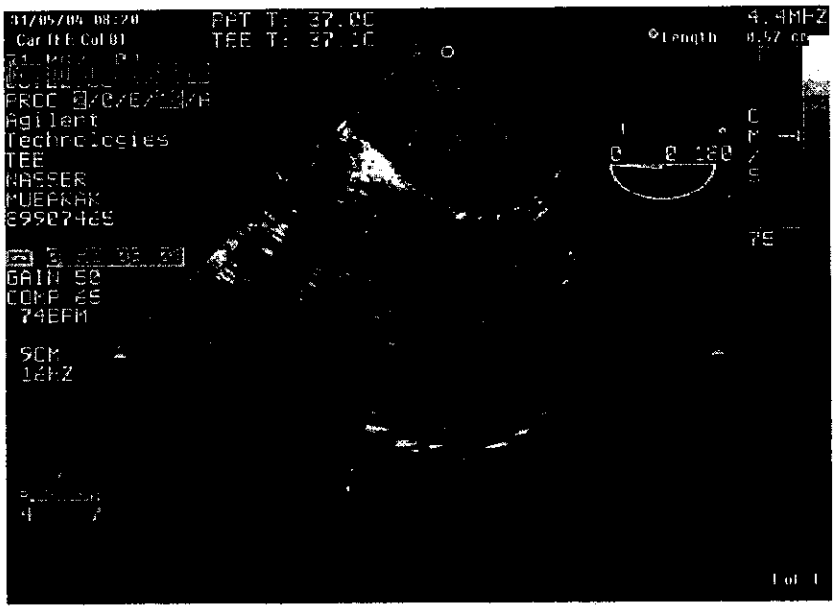

Fig. (21): Color TEE showing VSD

In two patients with complex congenital heart disease:

In the form of DORV, TEE was mandatory done to demonstrate that the tricuspid valve is not straddling the VSD to decide the size of the VSD and relation to aortic valve to decide to do a Rastilli operation or not. So, the use of TEE was completely beneficial and mandatory in patient No. 21.

Another patient with Dextrocardia and complex congenital heart disease:

The patient No. 19 with greatly malformed anatomy, TEE was indicated to figure out the degree of pulmonary overriding of the septum and to visualize clearly the chordal attachment at the tricuspid valve whether straddling to the septum or not and to detect the size of RV for taking the decision of univentucular or biventricular repair. With the use of TEE we demonstrated that RV is smaller but not rudimentary, attachment of LV-AV valve to the septum verified that the left. Sided ventricle is the RV. The rest of examination was not completed because of anesthetic problem. However, TEE proved to be complement to the TTE examination.

One patient with cleft mitral valve: Had been subjected to TEE which proved to have excellent views. Patient No. 20 the same patient è intact IAS (difficult seen) by TTE while clearly seen by TEE.

One patient with interrupted IVC, hemiazygous continuation of IVC into LSVC and dilated coronary sinus è hepatic vien drained into RV. The view is more clear by TEE and the dilated coronary sinus more

clear also Rt. upper PV could not be seen with TTE appear within normal è TEE. (Patient No. 3).

One patient with dilated coronary sinus receiving LSVC: had been subjected to TEE to detect the presence of any septal defect whether interatrial or interventricular, were over TEE made certain the unroofing of the dilated coronary sinus. (Pt. No. 23).

One patient with familial HOCM and Subaortic obstruction: These is also subaortic membrane è localized hypertrophy below aortic valve which not appeared by TTE. (Pt. No.2).

One patient with TOF: TEE reveal small coronary branch crossing RVOT. (Patient No. 5).

One patient with difficult echowindows with functioning Glenn: TEE confirmed the presence of straddling of the MV and turbulance at the pulmonary valve level, also aortic valve is tricuspid and dilated aortic sinus while TTE reveal bicuspid AV. (Patient No. 6).

One patient with SABE by TEE the view is more clear and confirm while the vegetations accompanied. è intracardiac abcess or not. (Patient no. 11).

One patient with AV has four cusps by TEE the picture not apparent by TTE (patient No 14).

The overall incidence of complications encountered in this study population was 8% (2 patients), one patient with termination of the procedure earlier than what was planned because of reaching maximum dose of sedation and the patient was still alert and another one desaturotion during the procedure.

Table (X): showing the complication.

Desaturation	Further need of sedation
1 case	1 case
4%	4%

No significant bleeding or nasopharyngeal trauma was evident in that patient with TEE-probe insertion failure.