Cardiac cycle

75 min 0.8 second.

0.1 0.3 0.5 0.7

Vent

Atria

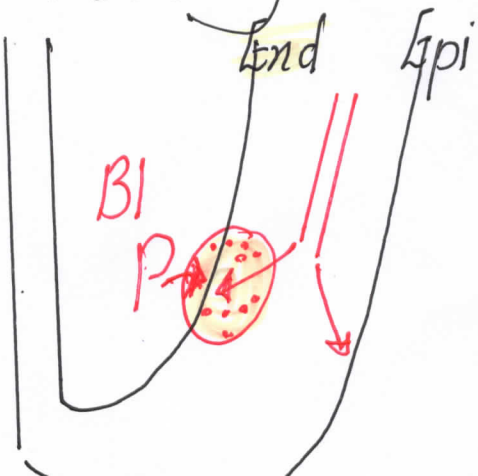
Systole Diastole مسئول MCQ

Pump

Fill

Rest

Coronary Bl Flow



Phases

1 Atrial systole

2 Isometric cont.

3 Maximum ejection
rapid ejection

4 Reduced ejection

Vent. Systole

5 Protodiastolic

6 Isometric relax

7 Maximum Filling
rapid Filling

8 Reduced Filling

Ventricular systole

2 isometric

3 & 4 isotonic

Ventricular diastole

5, 6 & 7 Early

8 Mid

1 Late

Cardiac cycle

8 phases 8 changes

1 **Atrial systole.**

2 Isovolumetric contraction.

3 Maximal (rapid) ejection.

4 Reduced ejection.

5 **Protodiastolic.**

6 Isovolumetric relaxation.

7 Maximal (rapid) filling.

8 Reduced filling.

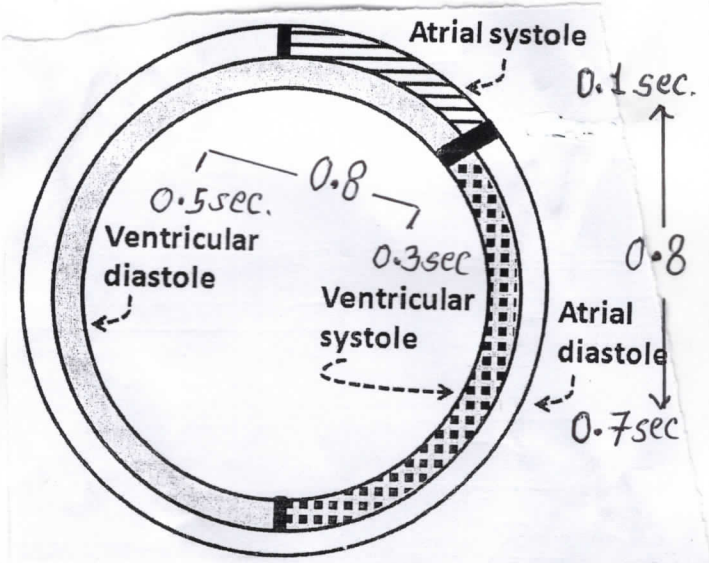
- **Ventricular systole** 0.3 sec.

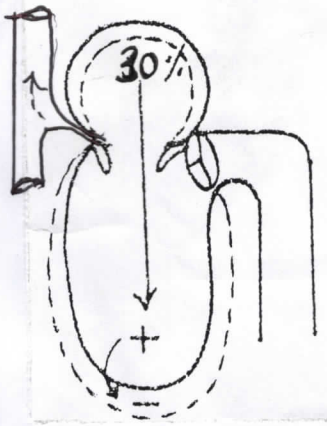
  phases 2, 3 & 4

- **Ventricular diastole** 0.5 sec.

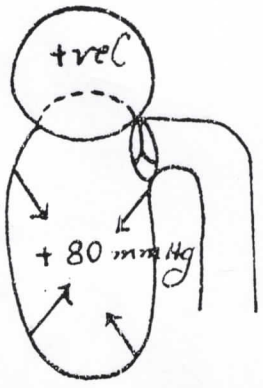
Early	Mid	Late
5, 6 & 7	8	1 Atrial systole

++ HR ⟶ more -- in diastole

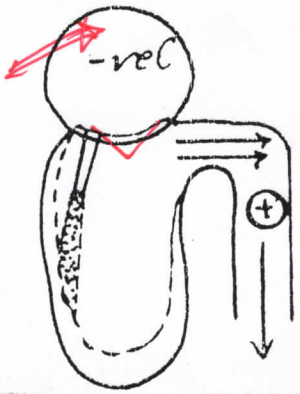




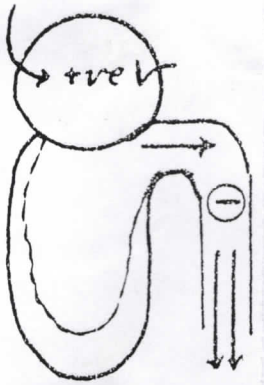
A. systole



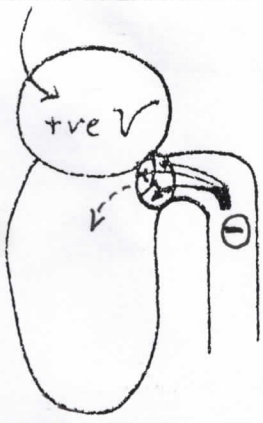
Isometric cont.

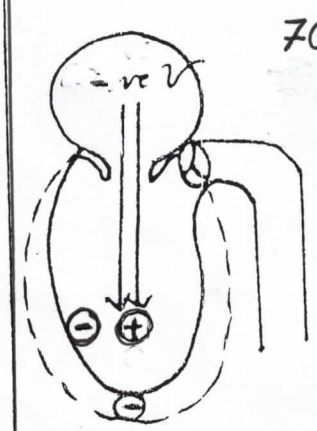


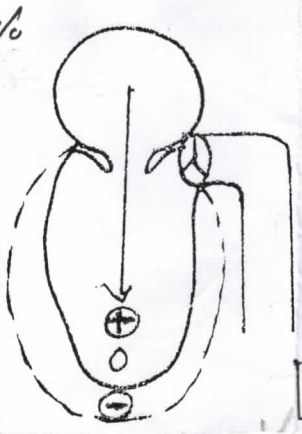
Rapid ejection

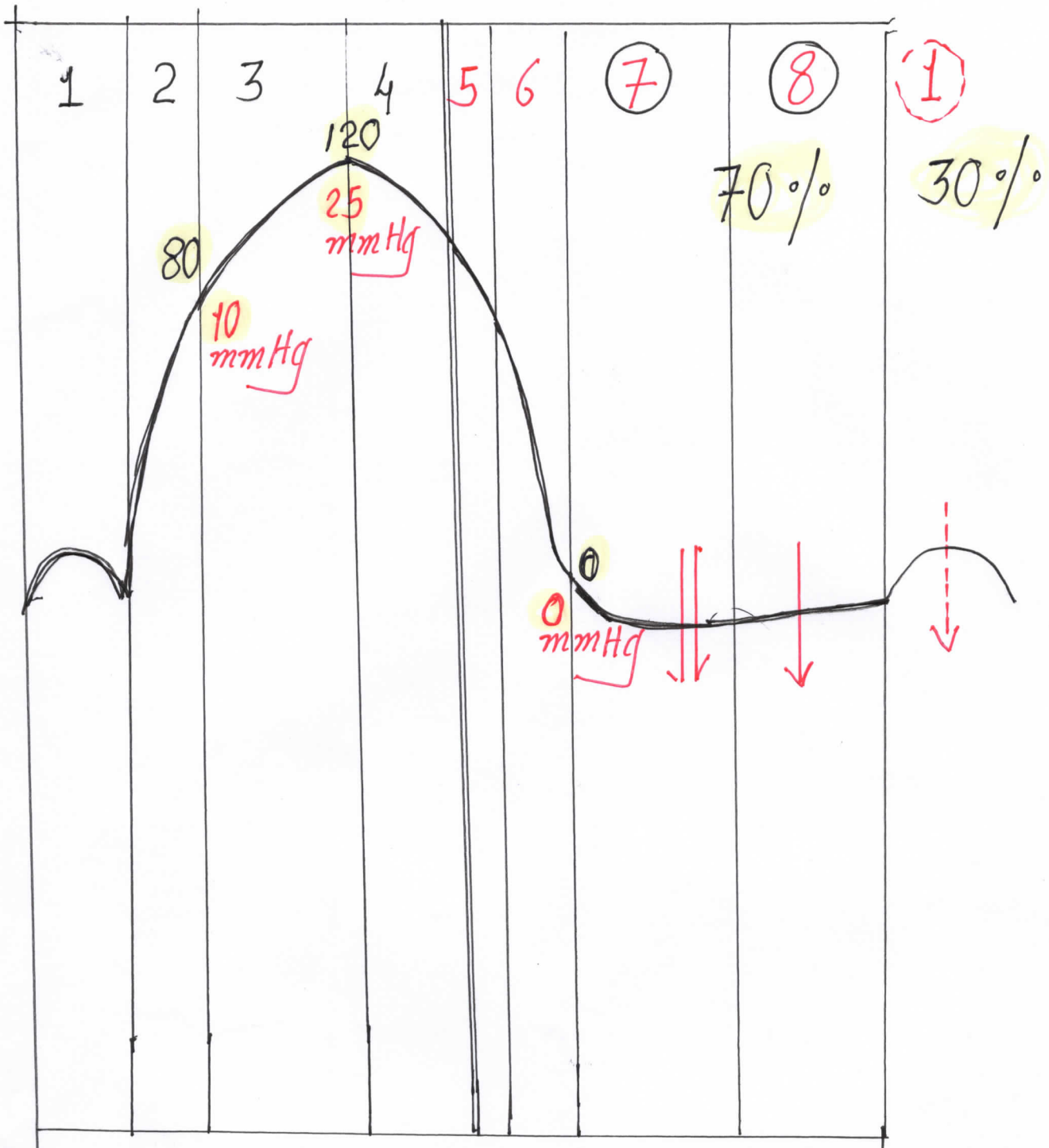


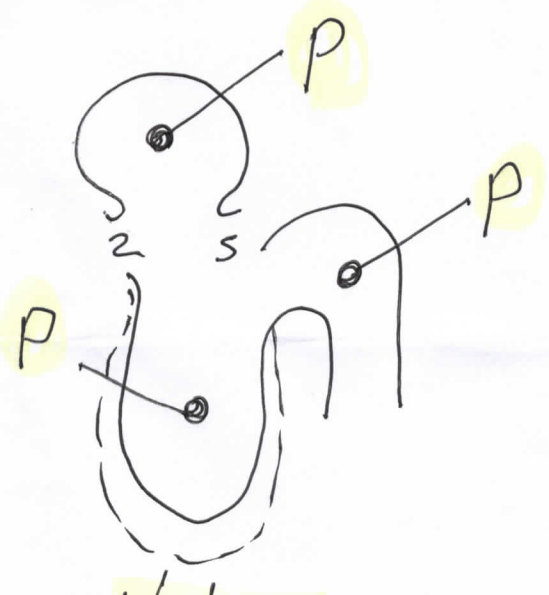
Reduced ejection





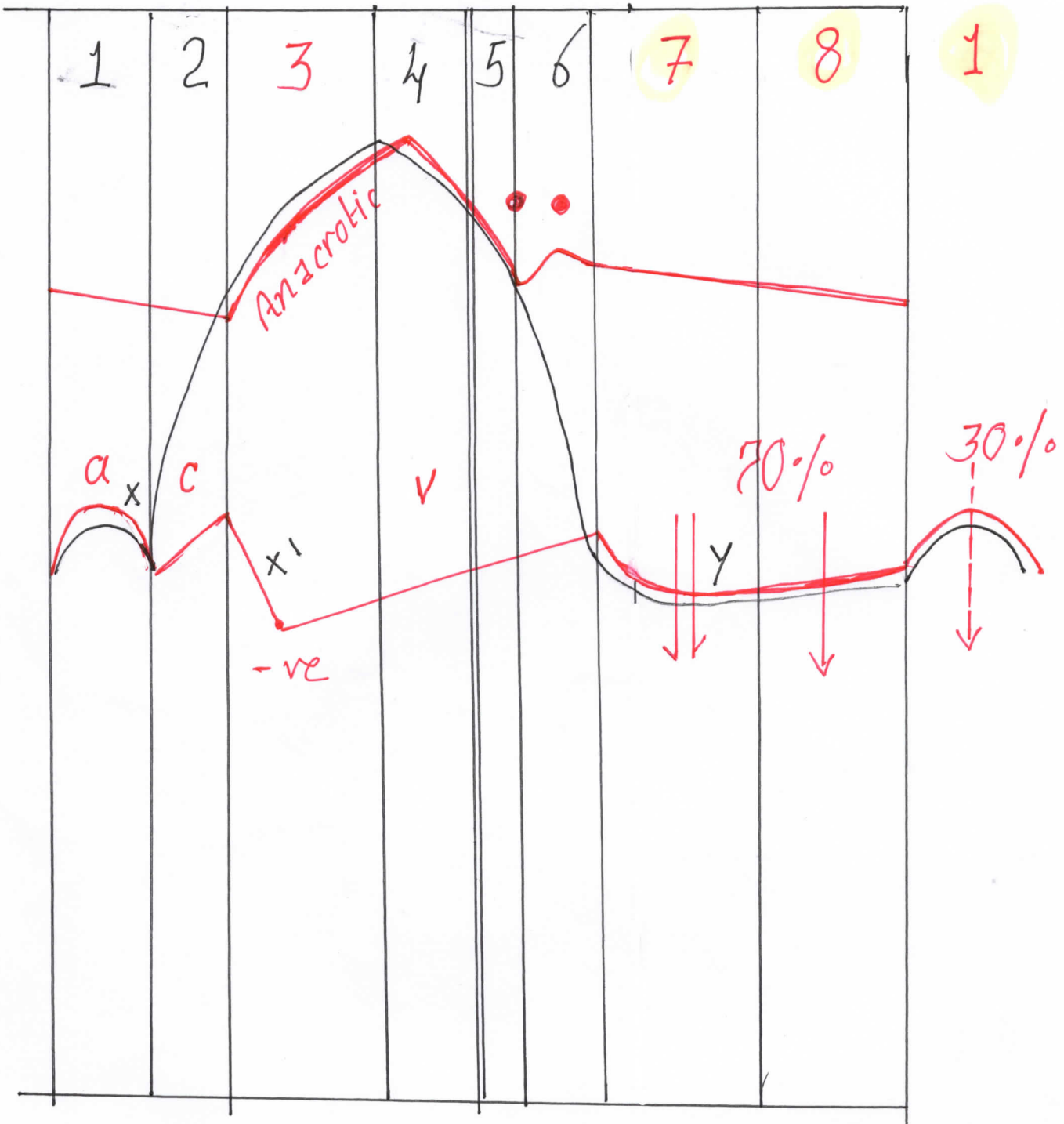


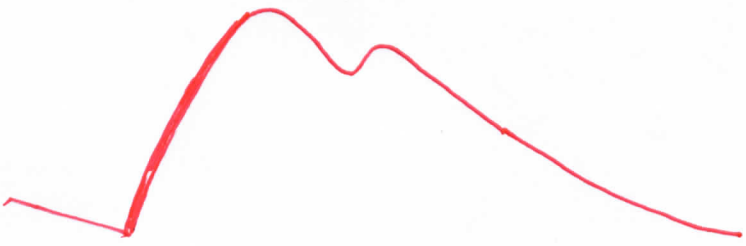


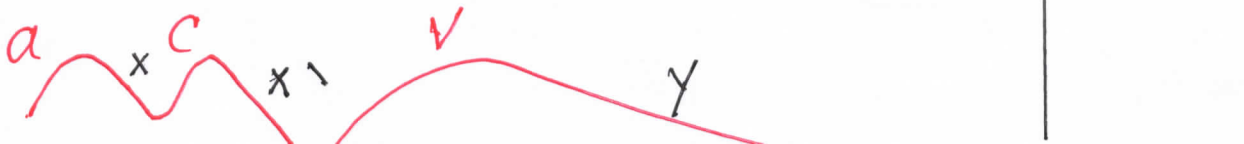


5 Valves
6 HS
7 CBF
8 ECG

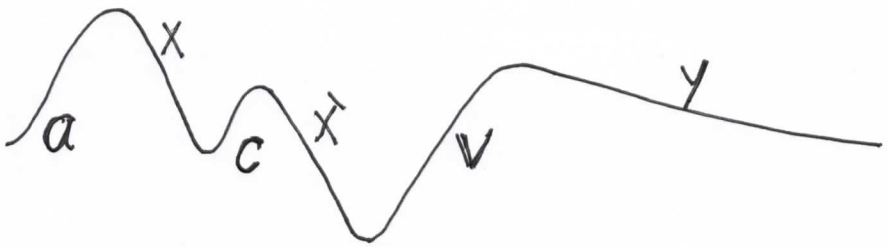
Phase / Change	Late diastole	Ventricular Systole			Early diastole			Middias
	1 A. systole	2 Isometric (isovol) cont.	3 Maximum (rapid) ejection	4 Reduced ejection	5 Proto diastolic	6 Isometric (isovol.) relax.	7 Maximum (Rapid) filling	8 Redu Fillin
	0.1 sec.	0.05 sec.	0.15 sec.	0.1 sec.	0.04 sec.	0.06 sec.	0.1 sec.	0.2 sec
1 Ventricular Pressure	(++) due to A. systole then (--) due to V. diastole	(++) to 80 mmHg Lt V. 10 mmHg Rt V. ends by opening of semilunar valves	(++) to maxim. 120 mmHg Lt V. 25 mmHg Rt V.	(--)	(--)	(--) to 0 mmHg Lt. V. 0 mmHg Rt V	- Early (--) V. relax > V. filling - Then (++) Vent. filling > V. relax Rate of vent. fill Rapid	Sl
2 Ventricular Volume	Increased 30% EDV 130 ml	Constant	Decreased rapidly	slowly ESV 60 ml	Constant		Increase rapidly 70%	slo
3 Aoric Pressure	Catacrotic Blood leaves aorta Aortic p. drops to minimum	80 mmHg by end of this phase	Ascending Anacrotic Bl. ejected in aorta > Bl leaving aorta 120 mm Hg	(Des Bl enters aorta < Bl leaves » aortic p. exceeds vent. p.	cendi Dicrotic notch (incisura) sudden closure of aortic valve	wave ++ elastic recoil of aorta	ng) Blood leaves ao to peripheral vess	
4 Atrial Pressure	a +ve Atrial systole / X -ve Bl leaves atria to vent.	C +ve Bulge A-V cusps	X -ve Decline	V +ve Accumulation of VR in atrium			Y -ve Passage of VR from atria to vent	
5 A-V valves	open	C	L	O	S	E	D	open
Semilunar ,,	C l o s e d	open	open	open	open	C l o s e d		
6 Heart Sounds	4th HS (S_4) vent. filling by A. systole	1st HS (S_1) Sudden closure of A-V valves Long Low pitch LUB				2nd HS (S_2) closure of aortic & pulm. valves	3rd HS S_3 rapid vent. filling	
7 ECG	P starts 0.02s before A cont	QRS starts 0.02s before V. cont		T wave begins				
8 Coronary bl. Flow		MINIMUM	Slight ++ with ++ aortic p	Slight -- with -- aortic p		MAXIMUM		


1
2
3
4
5
6
7
8
1
Anacrotic
a
x
c
x1
v
-ve
y
70%
30%




a
x
c
x1
v
y

Rt atrial pressure (Jugular venous pulse)



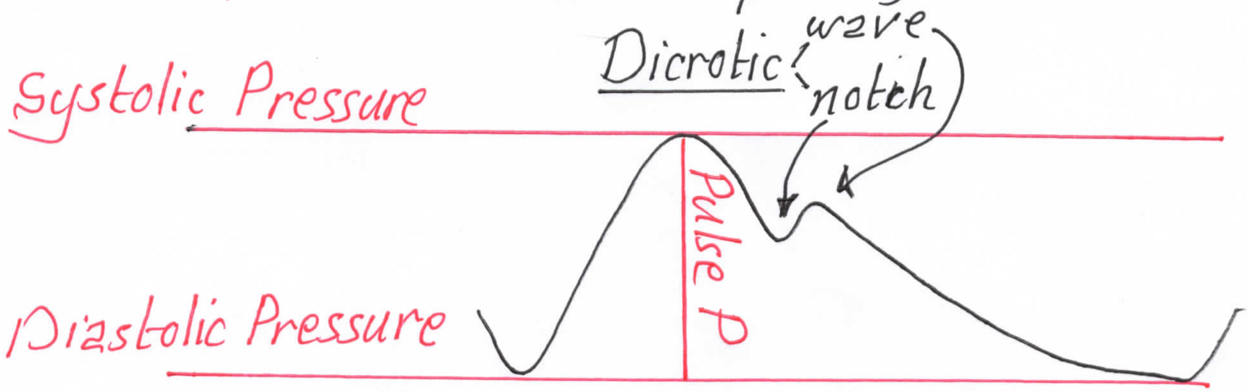
Clinical importance

1 No a A fibrillation

2 Cannon a wave A-V dissociation
e.g 3rd degree heart block
V tachycardia

3 a wave represents atrial cont
c wave represents vent cont
So, a-c interval = P-R interval in ECG

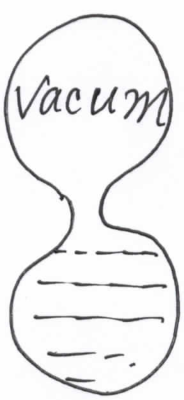
Aortic pressure (carotic pulse) curve.

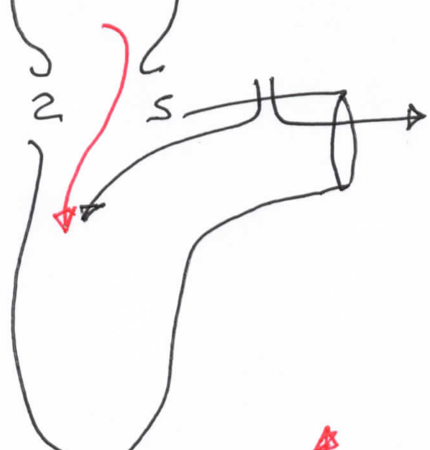


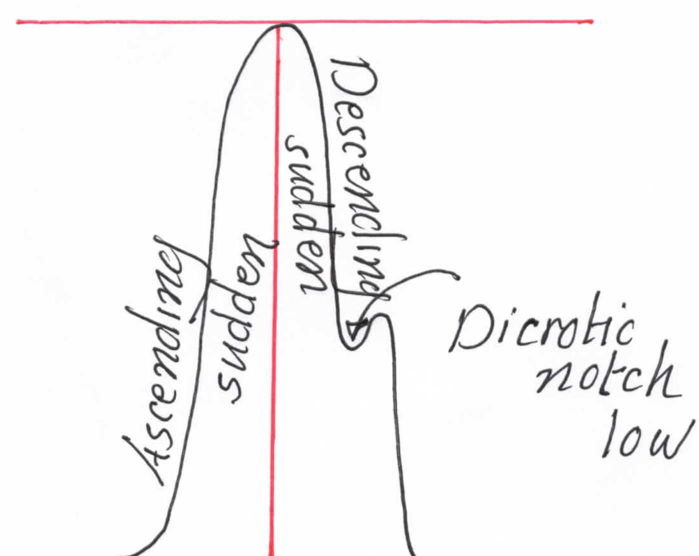
Clinical importance

1 Aortic stenosis

2 Aortic regurgitation Water Hammer pulse







$PP = S - D$

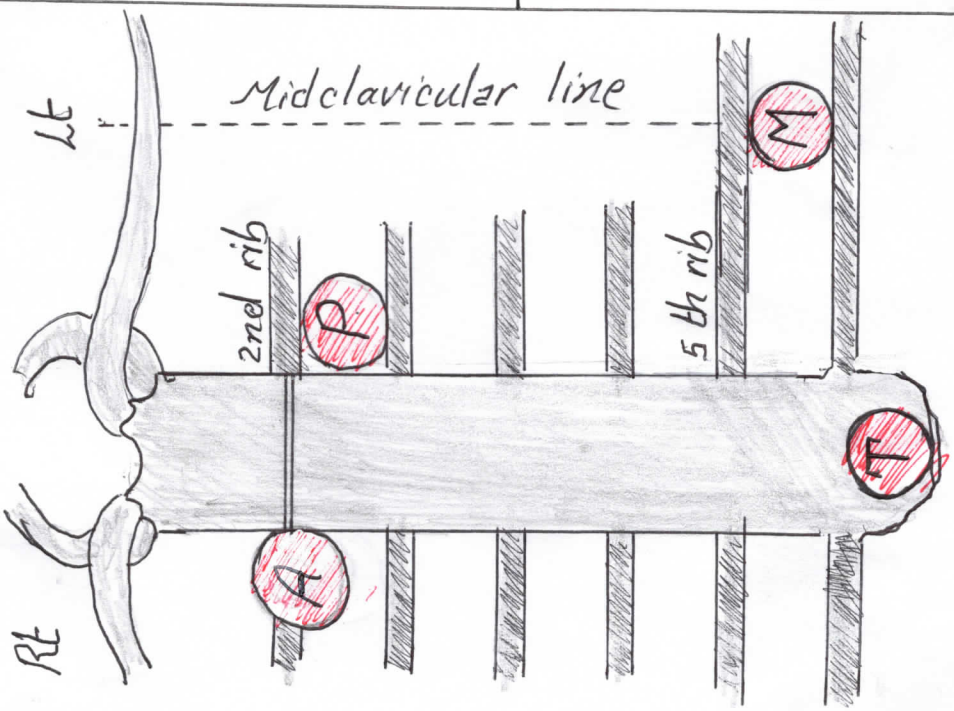
Heart sounds

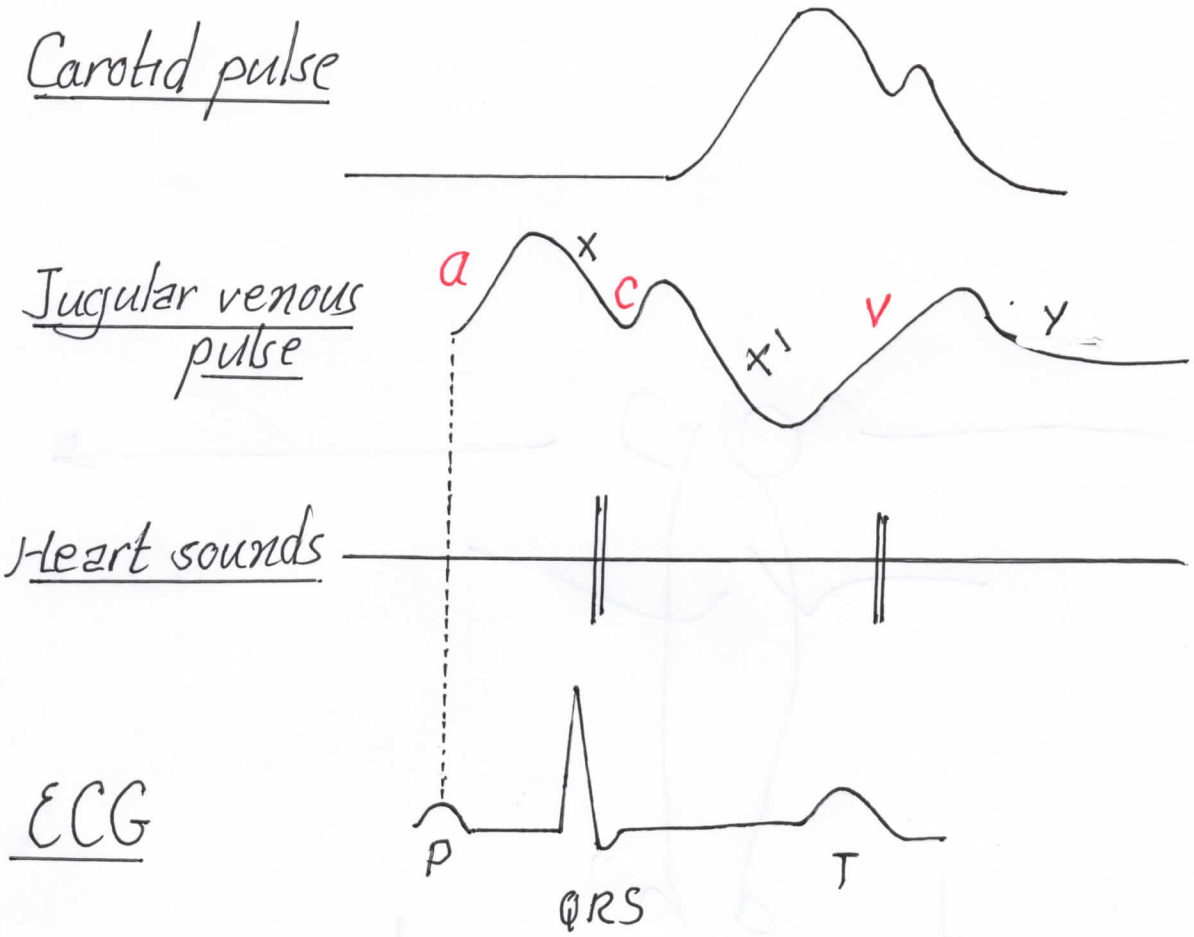
Stetho scope

Phono cardio gram

First heart sound (S_1)	Second heart sound (S_2)
A-V valves	Semilunar valves
Diastole end (Start of systole)	Systole end (beginning of diastole)
Apex of heart (mitral)	Second intercostal
lower end of sternum (tricuspid)	Aortic (Rt) Pulm (Lt)
Long isovol. cont rapid eject 0.15 s	Short isovol. relax. 0.12 s
Low pitch 30 Hz	High pitch 50 Hz
uB	Dup (dub)

S_3	S_4
Rapid flow of blood from atria to ventricle	
Rapid filling phase	Atrial systole phase
Normally Audible in children, athletes or may in pregnancy	Non audible.
Abnormal CHF	Failing of Hypertrophic Lt vent.

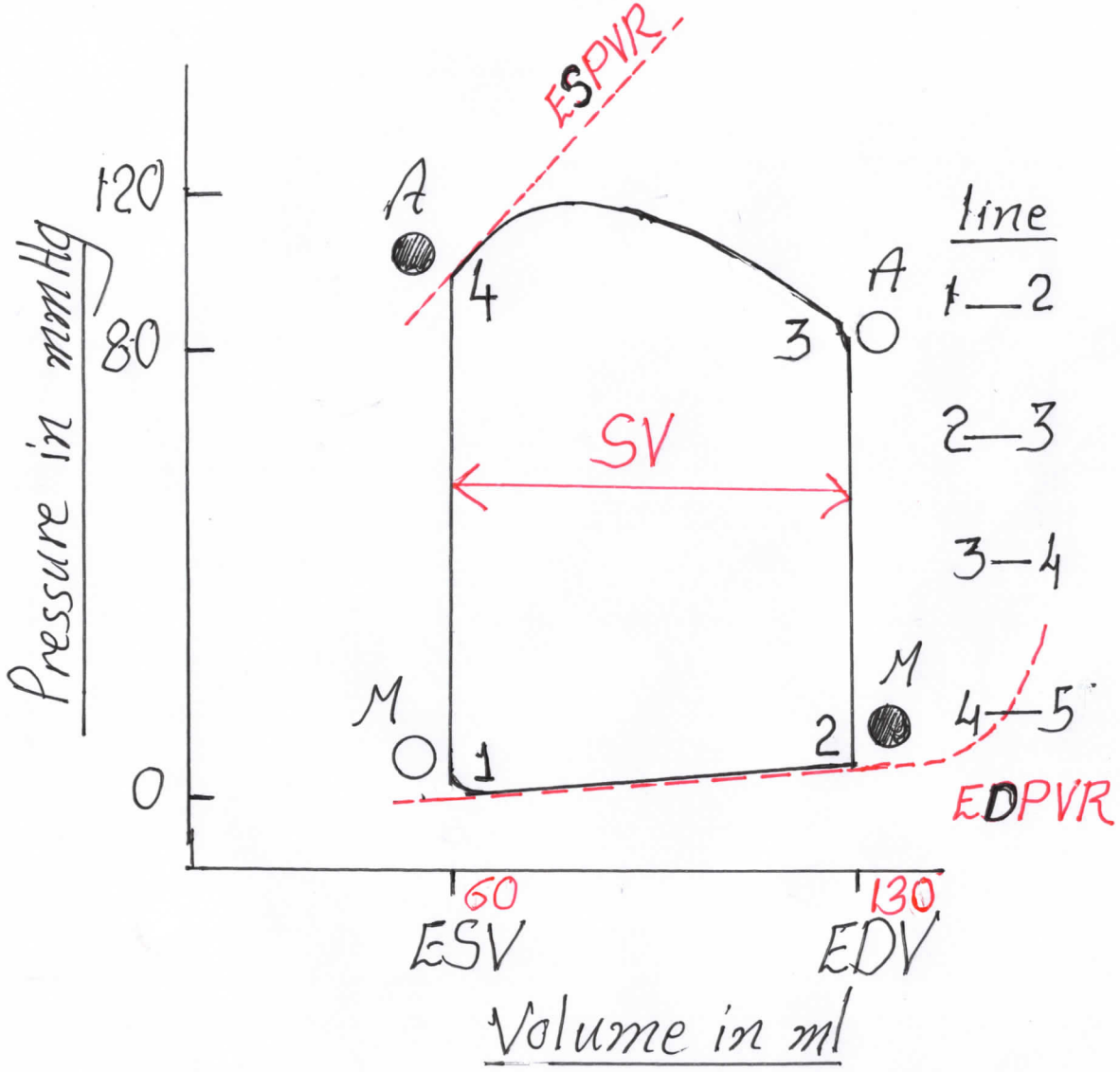




- a wave — atrial cont. follows P wave of ECG
- c wave — vent. cont. follows QRS complex of ECG

- x` wave occurs with carotid pulse.
  i.e normally jugular vein collapses with carotid pulsation
- v wave occurs with descending limb of carotid pulse.
  i.e with collapsing of carotid pulse

Left ventricle Pressure Volume loop



4 phases

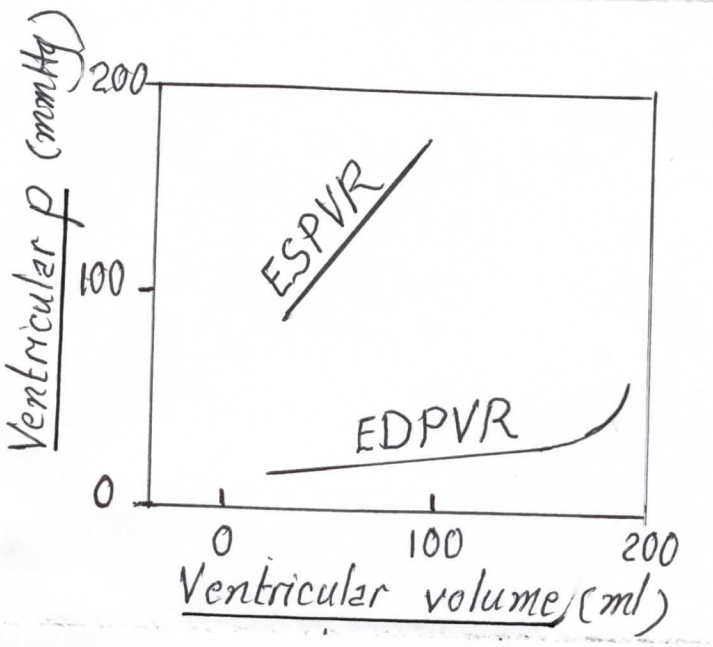
Line	Represents	Vent volume	Vent P
1—2	V filling phases	++ from ESV to EDV	slightly
2—3	Isovol. cont. phase ±		++ to 8
3—4	Ejection phases	-- from EDV to ESV	++ to 12 then-
4—5	Isovol relax phase ±		-- to 0

Point	
1	Mitral valve opens
2	" " closes
3	Aortic valve open
4	" " closes

Ventricular Pressure Volume Relationship

Modified length-tension relation.

Volume represents length. Pressure represents tension.



EDPVR

++ EDV ⟶ ++ vent. p.

= passive length tension relation.

ESPVR

++ EDV ⟶ ++ ESP (aortic clamp)

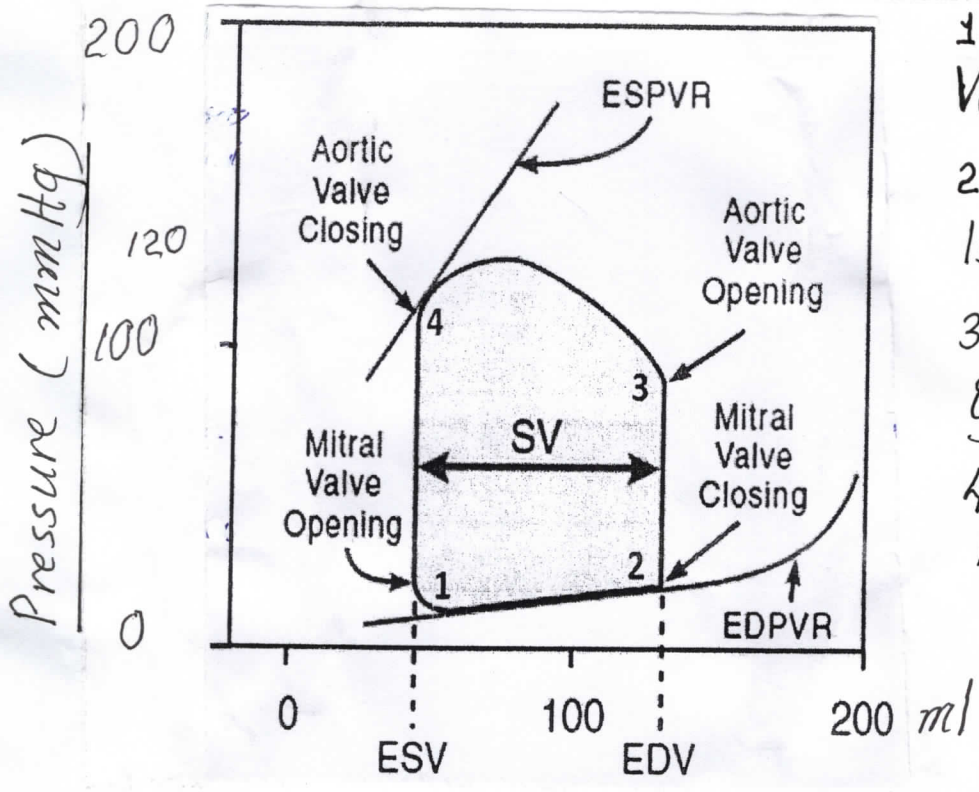
= active length tension relation.

its slope depends on inotropic state.

Pressure - Volume loop (Lt vent. pressure - volume loop)

Area ∝ Vent. work

4 phases



1 ——— 2
Vent. filling phase

2 ——— 3
Isometric cont. phase

3 ——— 4
Ejection phases

4 ——— 5
Isometric relax. phase

1 Mitral opens
2 Mitral closes
3 Aortic opens