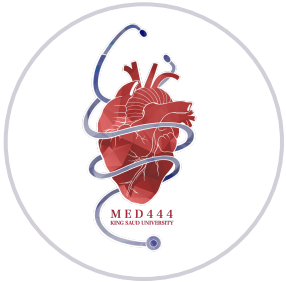
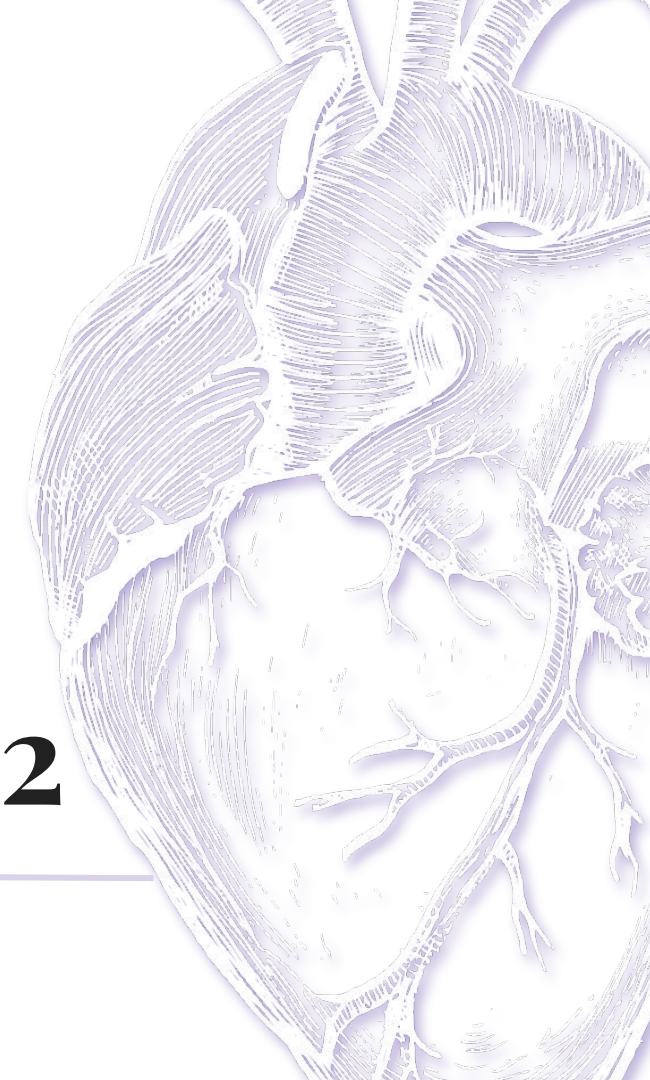




Cardiac cycle 1&2

Editing File

Main text Female's slide Male's slide Important text Doctor's note Extra

Objectives:

Dr.Nagy

Dr.najeeb

- Enumerate the phases of cardiac cycle.
- Explain the effect of heart rate on duration of systole and diastole.
- Recognize the pressure, electrical, sound and volume changes during cardiac cycle .
- Correlate different phases of cardiac cycle with various changes in events.
- Compare and contrast left and right ventricular pressures and volumes during the normal cardiac cycle.
- Describe atrial pressure waves & their relationship to cardiac cycle.
- Describe the use of the pressure-volume loop in describing the phases of the cardiac cycle
- Understand the general principle of the cardiac cycle and the various phases of the cardiac cycle
- Identify events occurring during cardiac cycle: mechanical, electrical, volume & pressure changes, heart sounds.

Cardiac cycle

فَلْيَنْظُرِ الإِنسانُ مِمَّ خُلِق

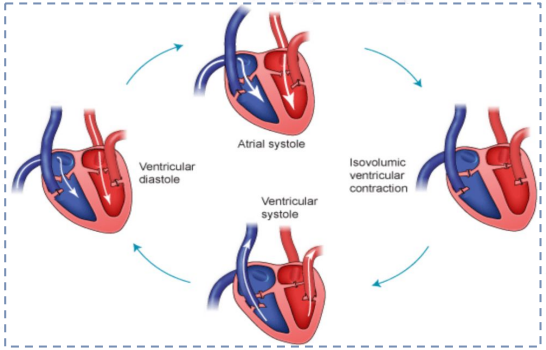
ECG demonstration from female Dr

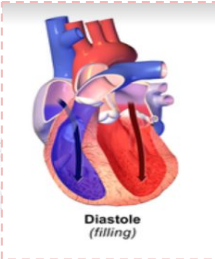
The cardiac (mechanical and electrical) events that occur from the beginning of one heartbeat to the beginning of the next is called the cardiac cycle, A single cardiac cycle is a complete beat of the heart.

1. Mechanical events: Pressure changes, Volume changes, Heart sounds during the cardiac cycle
2. Electrical events: Electrocardiogram (ECG)

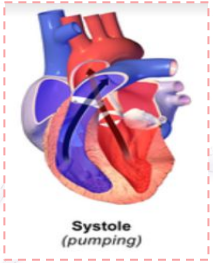
How does it start ? Each cycle is initiated by spontaneous generation of an action potential in the sinus node.

The cardiac cycle consists of (phases of the cardiac cycle):





A period of relaxation (filling) called Diastole during which the heart fills with blood (atrial and ventricular Diastole)



Followed by a period of contraction called systole (atrial and ventricular Systole)

Pressures changes in the cardiac chambers/cycle

Chambers	Normal range (mmhg)	Normal Range (mmhg)
Right atrium	Maximum pressure = 6-8 Minimal pressure = 0-2	Average= 2-8
Left atrium	Maximum pressure = 6-9 Minimal pressure = 0-2	Average= 2-10
Right ventricle	Maximum pressure = 25 Minimal pressure = 0-2	Systolic= 25-30 diastolic=2-8
Left ventricle	—	Systolic= 100-120 diastolic=3-12
Aorta	Maximum pressure (during systole) = 120 Minimal pressure (during diastole)= 80	
Pulmonary arteries	Systolic=25-30 diastolic=4/8-12	

Numbers are important

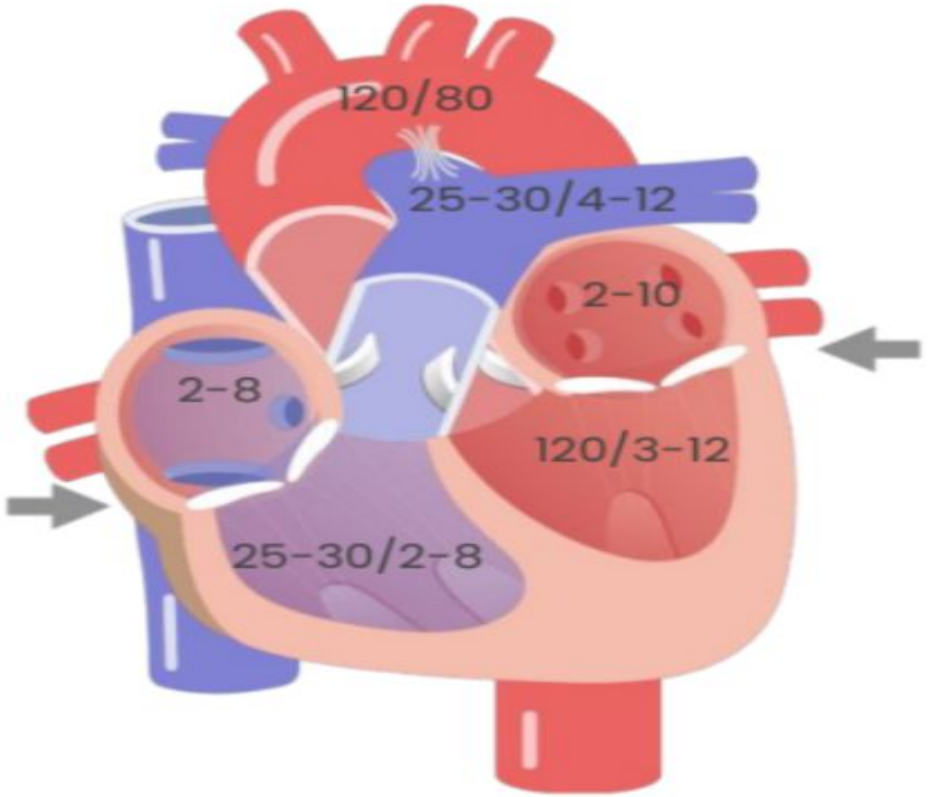
Events are the same in the right & left sides of the heart, but with lower pressures in the right side. Why? Because in the right side we have less muscle size and less distance to move the blood.

Note that Fluids, flow according to pressure gradients that is, they move from regions that are higher in pressure to regions that are lower in pressure.

→ Pulse pressure (difference between systolic and diastolic): 120-80 = 40 mmHg.

Extra slide

Summary of numbers

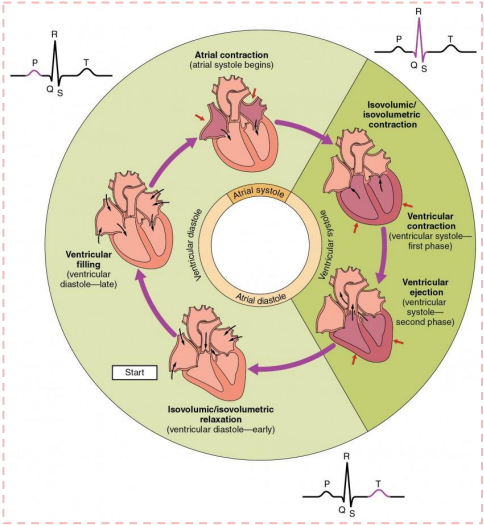


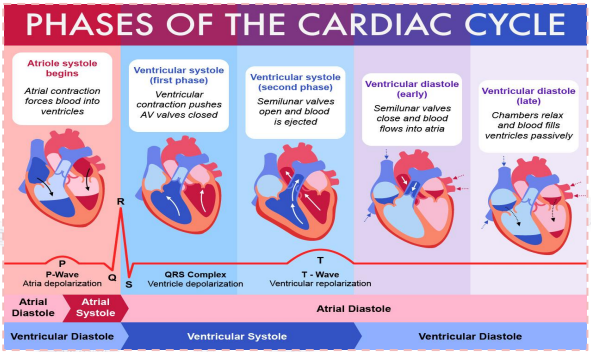
Female's slide

Events of cardiac cycle for left ventricle

Ninja nerd

A. Atrial Systole
B. Isovolumetric Ventricular Contraction
C. Rapid Ventricular Ejection
D. Reduced Ventricular Ejection
E. Isovolumetric Ventricular Relaxation
F. Rapid Ventricular Filling
G. Reduced Ventricular Filling (Diastasis)





Female's slide

A. Atrial Systole (atrial contraction)

SA node fires
AP ↠ P wave
(electrical activity)

→

Atrial Contraction
↑Pressure
↓volume

→

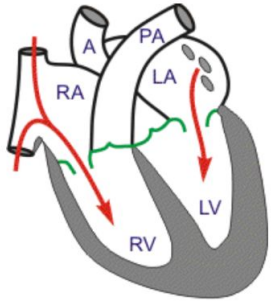
increase Atrial pressure

→

Tricuspid & bicuspid (mitral) valves open

↓

Left (and right) Ventricle filling (20%)



Heart sound: S4 is not audible in normal adults ↠ If heard it is caused by stiffness in ventricles (ex; ventricular hypertrophy), atria needs to contract strongly to fill (Pathological sound)

Which valve is open?

Ventricular pressure < Arterial pressure → Semilunar valves remain closed
Atrial pressure>Ventricular pressure → Av valves open (tricuspid & mitral)

B. Isovolumetric Ventricular Contraction

QRS
(electrical event)
Depolarization of the ventricles)

→ LV contracts with no significant shortening of fibers (increase tension) (ventricles contract with no emptying)

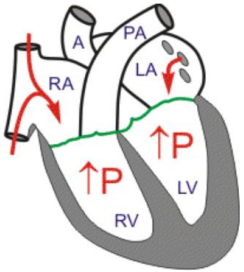
→ LVP increase
(slightly above 0-2 mmHg)
LVP > LAP

→ IVP (intraventricular pressure) pushes the cusps of the AV valve up & AV orifices are closed
MV closes (S1) "lub"

Dr: Why? It happens due to closure of AV valves

→ IVP < pressure of large arteries, (so the semilunar valves also remain closed)

→ All valves are closed, No blood enter or leave the ventricles



additional 0.02 to 0.03 second is required for the ventricle to build up sufficient pressure to push the semilunar (aortic and pulmonary) valves open against the pressures in the aorta and pulmonary artery

Which valve is open?

None, they are all closed.
Due to blood building up in the ventricles the AV valves close down, and at this point the pressure in the atria has dropped to between 0-10.
The pressure in the pulmonary artery and aorta is still higher than the ventricles so the semilunar valves remain closed.

Iso = the same
Volumetric = volume measurement
-Why is it called isovolumetric? no change in blood volume → because all valves are closed

C. Rapid Ventricular Ejection

(Maximum ejection phase)

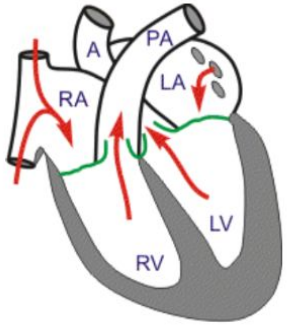
Atria has the least pressure in this phase.

Left Ventricle

LV contracts with shortening of the fibers → increase LVP, rises up to 80-120 mmHg→ LVP > Aortic pressure → Aortic valve opens→ 70% of blood is ejected from the LV to aorta → End of the ST segment or the beginning of the T wave on the ECG

Right Ventricle

RV contracts with shortening of the fibers → RVP > 25 mmHg → Pulmonary valve opens so blood leaves the ventricles rapidly to the aorta and pulmonary artery



Which valve is open?

Semilunar valves (aortic+pulmonar).
Once the left ventricular pressure has reached 80, the aortic valve will open and these two chambers will be considered as a single one.. So pressure will be increasing in both of them until it reaches the peak which is 120.

What part of the cardiac cycle ejects most of the stroke volume?
-Rapid ventricular ejection (70% is ejected)

At the end of this phase:
intraventricular pressure reaches its peak level with the aorta as they are opened to each other.

D. Reduced Ventricular Ejection

(Reduced Ejection Phase)

Ventricles begin to repolarize (T wave) (LV contraction is weaker) (Electrical event)

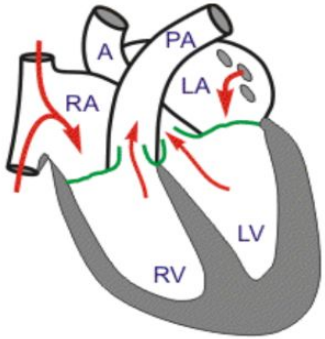
LVP falls but is still higher than aorta so ventricular emptying continues

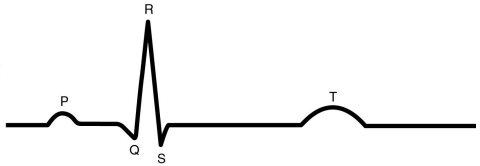
Aortic valve is still open

Blood continues to be ejected into aorta. Less volume of blood (30% of stroke volume) flows into aorta & pulmonary artery

weaker than the maximum ejection phase.

Marked by the beginning of the T wave on the ECG.





Which valve is open?

Ventricular pressure > Arterial pressure → Semilunar valves remain open
Atrial pressure < Ventricular pressure → Av valves stay closed

E. Isovolumetric Ventricular Relaxation

(Onset diastole)

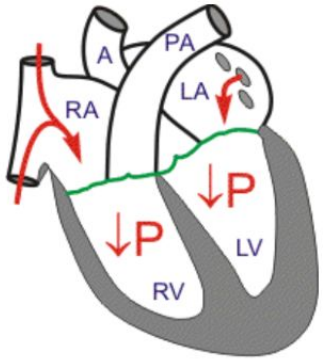
VENTRICULAR DIASTOLE [PROTO DIASTOLE] Before isovolumetric Ventricular Relaxation

- In this stage, the ventricles relax and the intraventricular pressure decreases, becoming less than the aortic and pulmonary artery pressures.
- Blood present in the aorta and pulmonary artery tends to move back into the ventricles.
- At this stage the semilunar valves (aortic and pulmonary) are closed and do not allow entry of blood into the ventricles

Left Ventricle

Full repolarization of ventricles, End of T wave → LV relaxes → Intraventricular pressure falls → LVP < aortic & pulmonary pressure → closure of SML (aortic) Valves

S2 "Dub"



Ventricular pressure > atrial pressure ↠ AV valves remain closed
The blood does not enter or leave the ventricles.

Remember: Isovolumetric (either contraction or relaxation) → all valves are closed

Dr: Why? Due to closure of SLV to prevent blood from flowing back into the aorta "Blood Never goes back"

Which valve is open?

All valves are closed
Ventricular pressure < Arterial pressure → Semilunar valves close
Atrial pressure < Ventricular pressure → Av valves stay closed

F. Rapid Ventricular Filling

(Rapid inflow)

Left Ventricle

Due to the ventricular volume increase.
LVP falls (2-4 mmHg) < LAP (6-9 mmHg)

→ Mitral / bicuspid valve opens & ventricle begins to fill with blood

→ Blood: left atrium ↠ LV. LV volume increase rapidly (70-80% of ventricular volume)

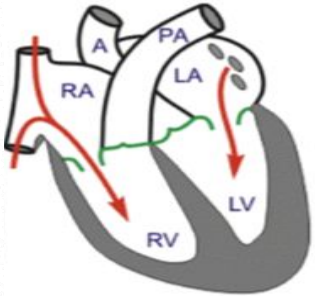
No contraction, blood moves because of gravity
Passive filling

Right Ventricle

RVP falls (0-2 mmHg) < RAP (6-8 mmHg)

→ Tricuspid valve opens & ventricle begins to fill with blood

→ Blood: Right atrium ↠ Right ventricle.
RV volume ↕↕ rapidly (70-80% of ventricular volume)



Rapid flow of blood from atria to ventricles ↠ S3, which is normal in children (also pregnant women, fit athletes) but is not heard in normal adults.
S3, is known as the "ventricular gallop." or ventricular dysfunction.

G. Reduced Ventricular Filling (Diastasis)

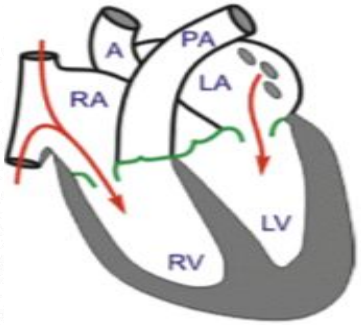
(Reduced inflow)

It is the final portion, of ventricular filling which occurs at a slower rate than in the previous phase

At the beginning of this phase most of the blood has already entered the ventricles (70-80% filled). Remaining blood (5%) in the atria also flows into the ventricles. then the atrial systole occurs to fill the last (20%).

Heart rate alters the time available for diastasis

Then the atrial will contract and will begin a new cycle (atrial systole)



Which valve is open?

AV valves (tricuspid+mitral)

Reduced inflow is the longest phase in the cardiac cycle

Diastasis is the longest phase of the ventricular diastole, and it occurs after the rapid filling phase and before the atrial contraction phase. During diastasis, the ventricular pressure remains low and constant, allowing for a slow and steady flow of blood into the ventricles.

Summary of cardiac cycle

Important slide

Extra slide

	Electrical event	Mechanical event	valves + heart sounds	Pressure
A. Atrial Systole (atrial contraction)	P wave	Atrial contraction	AV valves open (S4)	Atrial pressure increases
B. Isovolumetric Ventricular Contraction	QRS	LV contracts with no significant shortening of fibers	AV closes (S1)"lub" Now all valves are closed	LVP increases LVP > LAP
C. Rapid Ventricular Ejection (MAXIMUM EJECTION PHASE)	End of ST segment	LV contracts. Blood is ejected from the LV into aorta	Semilunar valves open	Increasing LVP LVP > aortic pressure
D. Reduced Ventricular Ejection (REDUCED EJECTION PHASE)	T wave	LV contraction is weaker. Blood continues to be ejected into aorta	Semilunar valves is still open	LVP falls but is still higher than aorta
E. Isovolumetric Ventricular Relaxation (diastole)	End of T wave	LV relaxes	Semilunar valves close (S2)"dub" Now all valves are closed	LVP < aortic pressure
F. Rapid Ventricular Filling		Ventricle begins to fill with blood. LV volume increases rapidly	AV (mitral valve) opens (S3)	LVP falls < LA pressure
G. Reduced Ventricular Filling (Diastasis)		it's the final portion of ventricular filling, which occurs at a slower rate than in the previous phase		

Summary of cardiac cycle

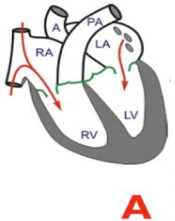
Important slide

Male's slide

	AV valves	Semilunar valves	Status of ventricles and atria
Early diastole	Open	Closed	• Whole heart is relaxed • Ventricles are expanding and filling
Atrial systole	Open	Closed	• Atria contract and pump blood • Additional 10-40% filling of ventricles
Isovolumetric ventricular contraction	Closed	Closed	• Ventricular myocytes begin to contract • Ventricle volume unchanged
Ventricular ejection	Closed	Open	• Ventricles fully contract • Pump blood to rest of body
Isovolumetric ventricular relaxation	Closed	Closed	• Ventricles relax • Ventricles volume unchanged • Atria expand & are filling

Extra slide

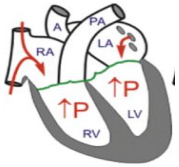
Event of cardiac cycle



A

Atrial Systole

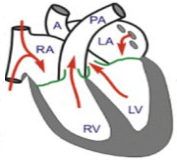
تنقبض atria وراح يقل volume of atria ويزيد pressure of atria وتنفتح AV valves وينتقل الدم من منطقة الضغط المرتفع إلى منطقة الضغط المنخفض (ventricle)



B

Isovolumetric Ventricular Contraction

هي المرحلة ما قبل ان الفنتركل تنقبض (يكون انقباض بسيط جدا) وفيها يزيد الضغط بشكل بسيط داخل الفنتركل مما يضغط على semilunar valves لكن كمية الضغط غير كافية انها تفتح الصمام

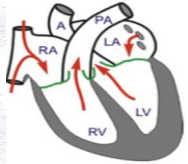


C

Rapid Ventricular Ejection

المرحلة الفعلية لانقباض الفنتركل وفيها يزيد الضغط داخل الفنتركل بشكل كبير مما يضغط على semilunar valves ويفتحها وراح ينتقل الدم من الفنتركل إلى large arteries

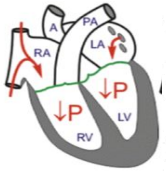
(اقوى مرحله ينتقل فيها الدم واقوى ضغط داخل الفنتركل)



D

Reduced Ventricular Ejection

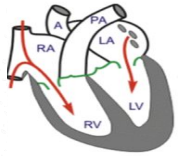
تضعف قوة الانقباض للفنتركل ويقل الضغط فيها لكن يبقى الضغط أعلى من large arteries ويكفي انه يخلي الصمامات مفتوحه ويستمر تدفق الدم



E

Isovolumetric Ventricular Relaxation

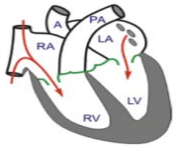
تبدأ الفنتركل يصير لها relaxation بشكل بسيط ويزيد volume of ventricle مما يقلل الضغط ويصير اقل من large arteries و بتقفل ال semilunar valves وفي هذه المرحلة ما يدخل دم ولا يطلع شي من الفنتركل



F

Rapid Ventricular Filling

بعد ما يصير full relaxation للفنتركل يقل الضغط فيها ويصير اقل من ال atria وتنفتح ال AV valves وينتقل الدم من atria إلى الفنتركل بشكل كبير (بدون م تنقبض ال atria)



G

Reduced Ventricular Filling (Diastasis)

يبدا يقل تدفق الدم من atria إلى الفنتركل و في هذه المرحلة تدفق الدم يكون اقل من المرحلة السابقة (in rapid) وف Rapid تكون الفنتركل ممتلئة بالدم بنسبة 70-80%

و عند انقباض atria اللي هي الخطوة الأولى تسبب بزيادة الدم الى الفنتركل بنسبة 20-30% وتكون الفنتركل ممتلئة بنسبة 100% وتتكرر الدورة

- AV valves are open in phase (A,F,G)
- SM valves are open in phase (C,D)
- All valves are closed in (B,E)
- Av and SM valves are never both open.

Special thank to : khalid alsobei

Important slide

Duration of cardiac cycle

Duration of cardiac cycle = reciprocal of heart rate = 1/HR
Example: heart rate is 75 beats/min,
Duration of cardiac cycle is= 1/75= 0.0133min x 60 (1 minute= 60 seconds)= 0.8 sec

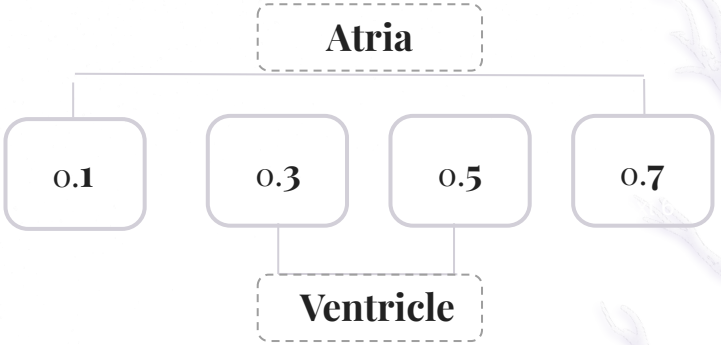
Notice how the diastole is longer, it's caused by blood filling

	systole	Diastole	Total
Atrial	0.1 sec	0.7 sec	0.8 sec
Ventricle	0.3 sec	0.5 sec	0.8 sec

Isovolumetric contraction of ventricles: 0.05 sec
Maximum ejection phase: 0.112 sec
Reduced ejection phase: 0.141 sec
TOTAL= 0.303 sec

Protodiastole: 0.033 sec
Isovolumetric (isovolumic) relaxation: 0.071 sec
Rapid inflow: 0.110 sec
Reduced inflow: 0.161 sec
Atrial systole: 0.12 sec
TOTAL= 0.495 sec.

Dr : Nagi wonderful method to memorize it



Duration of cardiac cycle

	Heart Rate 75/min	Heart Rate 200/min
Duration, each cardiac cycle	0.80	0.30
Duration of systole	0.27	0.16
Duration of diastole	0.53	0.14

Increase in heart rate leads to decrease cycle duration , The duration of the action potential and the period of contraction (systole) also decrease, but not by as great a percentage as does the relaxation phase (diastole).

Dr : Nagi wonderful summary

Important slide

EDV, ESV, and Stroke Volume Output

During diastole, filling of ventricles increases volume of ventricle to 110 - 120 ml. this is called the end-diastolic volume (EDV).

What could affect it?
1) total blood volume (ex. Anemic people ↠ will decrease)
2) active state (ex. Athletes ↠ increase)
3) heart diseases (ex. In hypertrophy heart, dilated cardiomyopathy)

During systole, the volume ejected is about 70 ml, this is called the stroke volume (SV) output.

The remaining volume in each ventricle after ejection, about 40 to 50 ml, is called the end-systolic volume (ESV).

Stroke Volume: The volume of blood ejected on one ventricular contraction, SV = (end-diastolic volume) – (end-systolic volume).

Note, by increasing the EDV and decreasing the ESV, the SV output can be increased.

Ejection Fraction, and Cardiac Output

Important slide

Female's slide

Cardiac output = Volume ejected per minute (mL/min) average of 5-7L
but it can pump up to 20L (from tissues and veins) physiologically.

Cardiac output = Stroke volume × Heart rate

Ejection fraction: the fraction (%) of the end-diastolic volume that is ejected in one stroke volume, (shows ventricular function).
What does ejection fraction tell us? It shows how well the cardiac muscles is contracting.
For example; if contraction is weak, ejection fraction will be low.

Ejection fraction= Stroke volume / End-diastolic volume X100

SV, Ejection Fraction, and Cardiac Output

Exercise to memorise: A man has an EDV of 110 mL, an ESV volume of 40 mL, and a heart rate of 75 beats/min. What is his stroke volume, his cardiac output, and his ejection fraction?

Try to solve it by yourself:
Stroke volume =
Cardiac output=
Ejection fraction=

Normal ejection fraction is about 60 – 65 %. (might be 50-65%) Ejection fraction is good index of ventricular function.

EF between 60-65% is normal and it can be until 50% still normal but EF< 40% is heart failure

Answers :
Stroke volume = EDV – ESV = 110 - 40 = 70ml
Cardiac output= SV × HR = 70 X 75 = 5250 ml/min
Ejection fraction= SV / EDV X 100 = 70 /110 X 100 = 0.64 X 100 = 64%

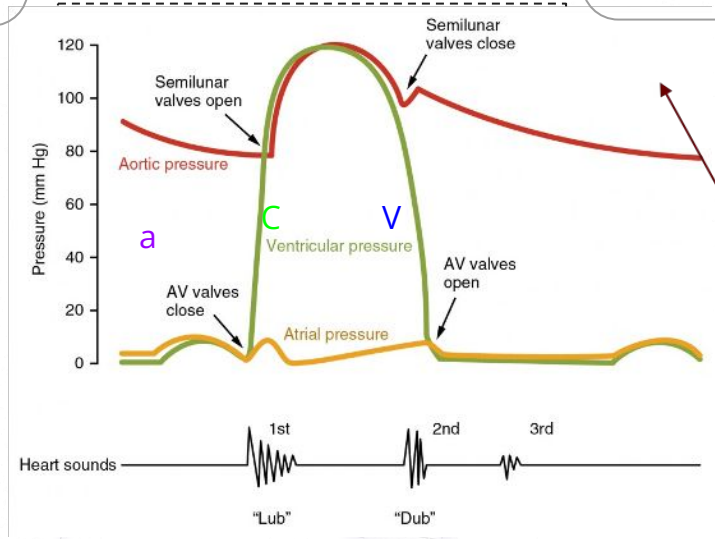
Important slide

Female's slide

Pressure changes (wiggers diagram)

The entry of blood into the arteries causes the walls of these arteries to stretch and the pressure to increase to about 120 mm Hg

Incisura (dicrotic notch)
caused by backward flow of blood immediately before closure of valve.



After Aortic valve has closed, pressure in the aorta decreases slowly throughout diastole to 80 mm Hg (diastolic pressure).

Wave a: atrial contraction (increases pressure)

Wave c : bulging of the A-V valves backwards (due to increase in pressure in ventricles), at beginning of ventricular contraction

Wave V: Results from slow flow of blood into atria at end of ventricular contraction.

وَفِي أَنْفُسِكُمْ أَفَلَا تُبْصِرُونَ

More explain next slide

EXPLAIN

Pressure changes (wiggers diagram)

From 51:48

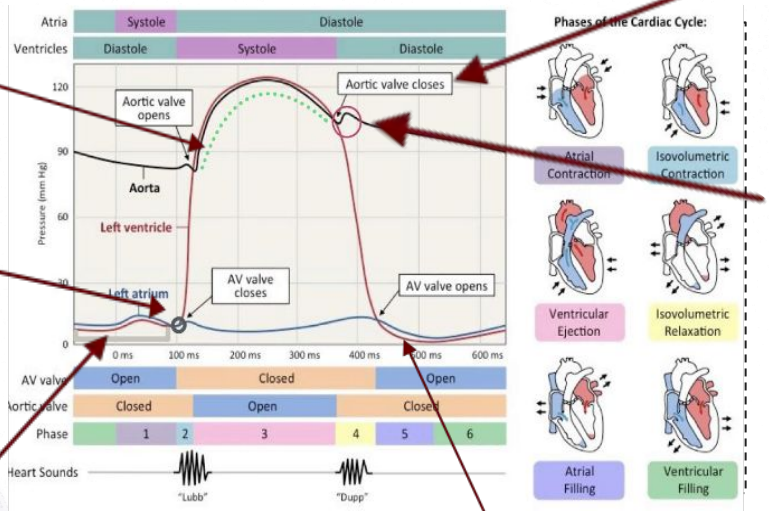
3

As ventricular pressure increases, aortic valve start opening cause ventricular pressure is higher than aortic pressure.

Why does aortic pressure follow ventricular pressure? Due to the movement of blood (SV)

4

When aortic pressure gets higher than ventricular pressure, the aortic valve closes.



2

Closure of AV valve because ventricular pressure became more than atrium

5

When the aortic valve closes, the flow of blood from the heart to the aorta momentarily stops. This causes a brief increase in pressure within the aorta. Once the valve closes, the rebounding blood flow creates a small pressure wave that travels back up the aorta, leading to a momentary increase in pressure, which we see as a bump in the arterial pressure waveform. This bump is the dicrotic notch.

1

The beginning of atrial contraction, AV valve is open because Atrial pressure is higher than ventricular pressure

6

Once the ventricular pressure is less than the atrial pressure, the AV valve will open and blood will flow passively and the cycle repeats.

Volume-Pressure Diagram (loop); Cardiac Work Output During the Cardiac Cycle

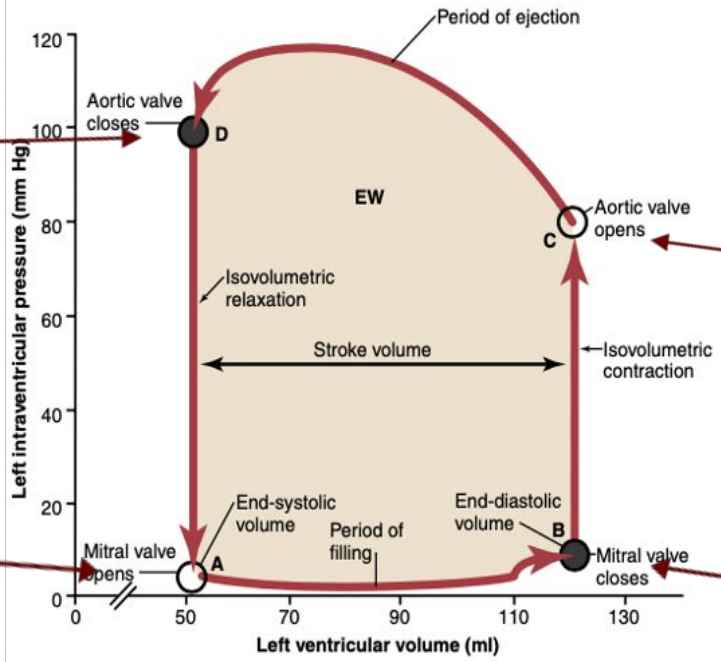
Important slide

Female's slide

important!!!

Special thanks to Rayan Alshehri for his great explanation!

Phase IV (D) : Period of isovolumic relaxation. All valves are closed. Volume is constant but pressure is decreasing.



Phase III (C): Period of ejection. Volume is decreased.

Phase I(A) : Period of filling. Volume is increasing.

Phase II (B) : Period of isovolumic contraction. All valves are closed. Volume is constant but pressure is increased.

What is point A? End-systolic pressure +Mitral valve open
What is point B?End- diastolic volume + Mitral valve close
What is point C? Aortic-valve opens
What is point D? Aortic-valve close
Calculate stroke volume? End-diastolic v- end-systolic v=70ml

Concepts of Preload and Afterload of ventricle

Preload : the end-diastolic pressure when the ventricle has become filled.

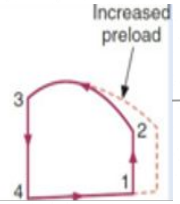
volume of blood after diastole that is directly proportional amount of stretch in ventricle

Afterload (Is bad): the pressure in the aorta leading from the ventricle.

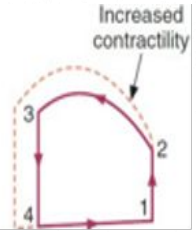
pressure that ventricle must overcome to pump blood through aorta

In many abnormal functional states of the heart or circulation, the preload and afterload, or **both** are severely altered from normal.. as shown :

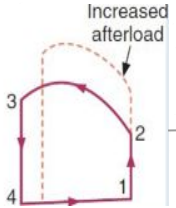
Why both also ? Due to long standing heart impairment



A. Increased preload: venous return ›› increase in SV based on the Frank–Starling relationship....reflected in increased width of the PV loop.



C. Increased contractility: ›› increased width & height of the PV loop. (Athletes)



B. Increased afterload: due to an increase in aortic pressure ›› decrease in stroke volume....is reflected in decreased width of the PV loop.

heart sounds and murmurs

Important slide

Female's slide

Function of valves

- Atrioventricular (A-V) valves (tricuspid and mitral) prevent backflow of blood from ventricles to atria during systole.
- Semilunar valves (aortic and pulmonary artery) prevent backflow from aorta and pulmonary arteries into ventricles during diastole.

→ These valves, close passively (pressure gradients). Don't need ATP

Closing of valves causes audible sounds

1. Listening with a stethoscope to a normal heart, one hears "lub, dub, lub, dub".
2. First heart sound (S_1): " The "lub" is associated with closure of A-V valves at beginning of ventricular systole.

   Second heart sound (S_2) "dub" is associated with closure of the semilunar (aortic and pulmonary) valves at the end of ventricular systole.

   No sounds occur when valves are open

Murmurs are abnormal sounds that occurs in:

- Valvular disease.
- Congenital heart disease.
- Hyperdynamic circulation

Summary

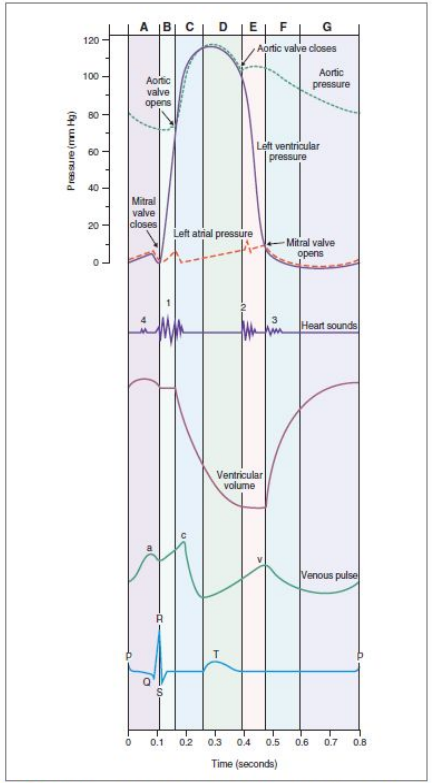


Figure 4–25 The cardiac cycle. The mechanical and electrical events that occur during one cycle are shown. Atrial systole (*A*); isovolumetric ventricular contraction (*B*); rapid ventricular ejection (*C*); reduced ventricular ejection (*D*); isovolumetric ventricular relaxation (*E*); rapid ventricular filling (*F*); reduced ventricular filling (diastasis) (*G*).

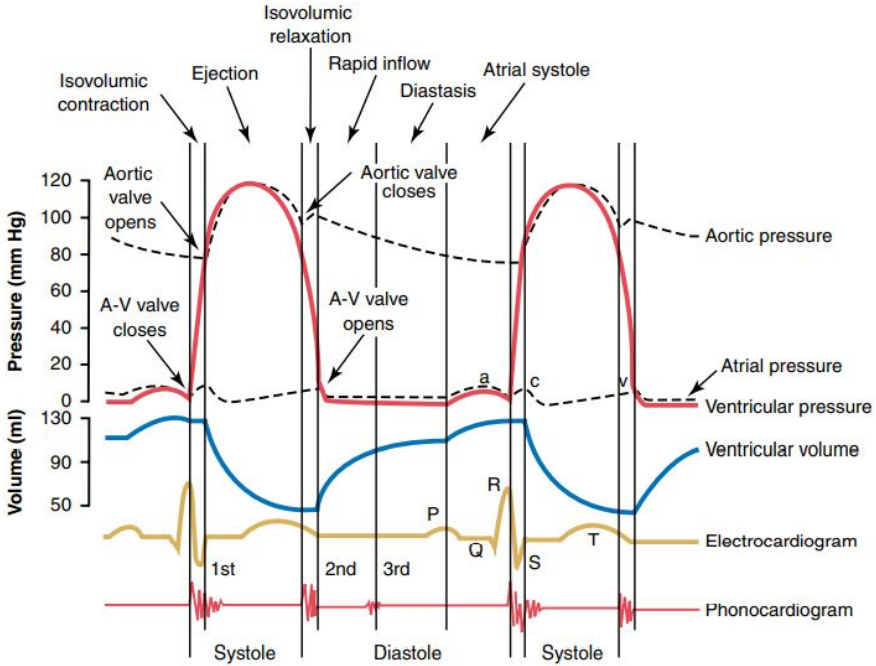


Figure 9-6 Events of the cardiac cycle for left ventricular function, showing changes in left atrial pressure, left ventricular pressure, aortic pressure, ventricular volume, the electrocardiogram, and the phonocardiogram.

Causes of heart sounds

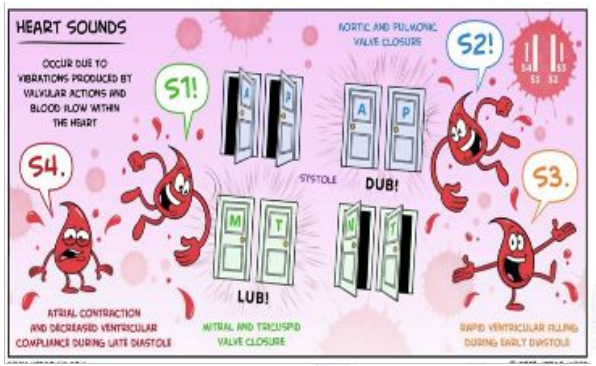
وَسُبْحَانَ اللَّهِ رَبِّ الْعَالَمِينَ

The cause is vibration of the taut valves immediately after closure, along with vibration of the adjacent walls of the heart and major vessels around the heart.

Heart sound	Occurs	Associated with
S1	during Isovolumetric contraction	Closure of mitral and tricuspid valves
S2	Isovolumetric relaxation	Closure of aortic and pulmonary valves
S3	Early ventricular filling	It is normal in children, But in adults is associated with ventricular dilation (e.g. ventricular systolic failure), anemia
S4	Atrial contraction	Associated with stiff, low compliant ventricle (e.g.ventricular hypertrophy, ischemic ventricle)

S1, S2 are the normal **"lub" "dub"**

S3, S4 are associated with abnormality in adults



Check here for our summary
Highly recommended !!!!!

Sorry but if you will not check it راحت عليك المليون

MCQs:

Answers

For more question check our summary file!

1/C
2/B
3/D

1 **What is the reason behind S1 sound?**

A	Closing of SM valve	B	Opening of SM valve	C	Closing of AV valve	D	Opening of AV valve

2 **Which phase of the cardiac cycle is responsible for 70% of blood ejection?**

A	Reduced Ventricular Ejection	B	Rapid Ventricular Ejection	C	Atrial systole	D	Reduced Ventricular filling

3 **During isovolumetric ventricular contraction, which of the following is true?**

A	Volume increases	B	Ventricular pressure falls	C	MV valve is open And Av is closed	D	Volume remains the same while LVP increases

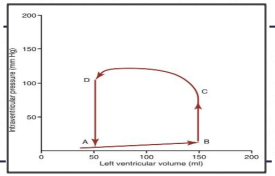
MCQs:

Answers

For more question check our summary file!

4/B
5/B
6/C

4 What is the ventricular ejection fraction ? Use the pressure-volume diagram



A	70%	B	66.66%	C	62.62%	D	76.1%

5 A 60-year-old woman comes to the emergency with 4.7L cardiac output, a ejection fraction 0.7, a EDV 110 ml. What is her heart rate ?

A	73	B	61	C	82	D	77

6 Which event is associated with the second heart sound?

A	Closing of the A-V valves valve	B	Opening of the A-V valves	C	Closing of the Aortic valve	D	Closing of the Aortic

SAQ

Which phase has the highest and lowest Ventricular pressure and what is its value ?

Highest pressure = rapid ejection phase (around 120)
Lowest pressure = rapid ventricular filling around 0-2 (mmhg)

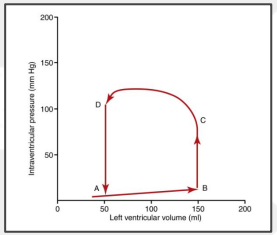
The ECG waves (P , QRS, T) correlate with which phases of the cardiac cycle ?

P wave indicates atrial depolarization before atrial systole.
QRS indicates ventricular depolarization before isovolumetric ventricular contraction .
T wave indicates ventricular repolarization at reduced ejection and isovolumetric ventricular relaxation

A patient has a resting heart rate of 82 beats/min , What is the cardiac output of this patient?

CO = SV x HR —> 100 x 82 = 8200 ml/min

What is the extent of diastole in the ventricular pressure-volume relationship?



From point D and point B

SAQ

Write the cardiac cycle

Phase							
Electrical event							
Mechanical event							
Pressure							
valves + heart sounds							

Finally you have arrived , we have been waiting for you !!

Meet our team !

Team leaders

Rimaz Alhammad

Noreen Almaraba

Rayan Alshehri

Omar Albaqami

Aljoharah Alyahya

Heroes of the lecture :

Abdulrahman almalki

Norah Albahily

leena Shagrani

Did you like the lecture ? we mean our work :)

Contact with us! physiology.444ksu@gmail.com