



CARDIOVASCULAR SYSTEM

SUBJECT : Physiology
LEC NO. : 17
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وَقُلْ رَبِّ زِدْنِي عِلْمًا



SCAN ME!

▲ TABLE 10-5

Cardiovascular Changes during Exercise

Cardiovascular Variable	Change	Comment
Heart Rate	Increases	Occurs as a result of increased sympathetic and decreased parasympathetic activity to the SA node
Venous Return	Increases	Occurs as a result of sympathetically induced venous vasoconstriction and increased activity of the skeletal muscle pump and respiratory pump
Stroke Volume	Increases	Occurs both as a result of increased venous return by means of the Frank–Starling mechanism (unless diastolic filling time is significantly reduced by a high heart rate) and as a result of a sympathetically induced increase in myocardial contractility
Cardiac Output	Increases	Occurs as a result of increases in both heart rate and stroke volume
Blood Flow to Active Skeletal Muscles and Heart Muscle	Increases	Occurs as a result of locally controlled arteriolar vasodilation, which is reinforced by the vasodilatory effects of epinephrine and overpowers the weaker sympathetic vasoconstrictor effect
Blood Flow to the Brain	Unchanged	Occurs because sympathetic stimulation has no effect on brain arterioles; local control mechanisms maintain constant cerebral blood flow whatever the circumstances
Blood Flow to the Skin	Increases	Occurs because the hypothalamic temperature control center induces vasodilation of skin arterioles; increased skin blood flow brings heat produced by exercising muscles to the body surface where the heat can be lost to the external environment
Blood Flow to the Digestive System, Kidneys, and Other Organs	Decreases	Occurs as a result of generalized sympathetically induced arteriolar vasoconstriction
Total Peripheral Resistance	Decreases	Occurs because resistance in the skeletal muscles, heart, and skin decreases to a greater extent than resistance in the other organs increases
Mean Arterial Blood Pressure	Increases (modest)	Occurs because cardiac output increases more than total peripheral resistance decreases

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Cardiovascular Changes during Exercise

Cardiovascular Variable	Change	Comment
Heart Rate	Increases	Occurs as a result of increased sympathetic and decreased parasympathetic activity to the SA node

We have a basic tone in the autonomic nervous system (symp,para) if the symp increases the para decreases HR ↑

The pacemaker potential of the SA node with symp activity become sharper and fast
وال para بعمل العكس

Venous Return

Increases

Occurs as a result of sympathetically induced venous vasoconstriction and increased activity of the skeletal muscle pump and respiratory pump

The CO will increase, and we need more blood to the muscle doing exercises, How can we increase blood flow to the muscle? by increasing CO, How can we increase the CO? by increasing venous return (most important factor)

لو زدنا ال HR اكثر من 100-110 هل ال VR ممكن يزد؟ لأ طبعاً لانه ال filling time رح يقل وتكون فترته قصيرة ف ال VR رح يقل وال SV رح تقل وال CO رح تقل

[Increasing the heart rate at certain levels will increase venous return]

باختصار، هناك تأثير إيجابي لزيادة HR على العائد الوريدي ضمن نطاقات محددة. ولكن عندما يصبح HR مرتفعاً جداً (أكثر من 100 ضربة في الدقيقة بشكل عام)، تتفوق التأثيرات السلبية المتمثلة في انخفاض وقت الامتلاء البطيئي وزيادة مقاومة الأوعية الدموية، مما يحد من الزيادة في العائد الوريدي أو يقللها.

لما تركض بصير عندك ، vasoconstriction بس هل بصير vasoconstriction ؟
هسا ال arterioles control the blood flow to the organ فلشو بدك تضيقها وانت بتركض؟ انت اصلاً بحاجة لO2 زيادة
فلازم تتوسع مش تتضيق فشو اللي بصير بال skeletal muscle ؟ vasodilatation لل arterioles
اما ال veins بصيرلها venoconstriction عشان تزيد كمية ال Venous return عشان يصير عندك
shift blood to go back to the heart

هسا كمان بصير عندك deep breathing وانت بتركض ، ف ال chest cavity رح يصير الضغط فيها more negative وكمان
ال right atrium بصير اقل من الصفر negative ف بزيد عندك ال VR

كمان شغلة ، هسا شو اللي بخلي الدم يرجع للقلب ؟ ال pressure gradient
زي ال mean systemic pressure وهو متوسط الضغط في جميع الاوعية الدموية وقيمته 8mmHG
وكمان ال central venous of pressure خلال ال exercies رح يقل بال RA ويصير اقل من صفر (-1)
فوقت ال exercies اجبت تحسب فرق الضغط بيناتهم (٨--١=٩) وهيك ال pressure gradient زاد ، فكمية الدم الراجعة للقلب
رح تزيد

خلال ال exercies شو صار بالضغط ؟

- 1- ↑ negativity of central venous pressure
- 2- ↑ the different between the Main systemic and the central pressure
- 3- ↑ VR

ف بس يصير عندك change بال pressure gradient ال VR رح يزيد عندك

Stroke Volume	Increases	Occurs both as a result of increased venous return by means of the Frank–Starling mechanism (unless diastolic filling time is significantly reduced by a high heart rate) and as a result of a sympathetically induced increase in myocardial contractility
Cardiac Output	Increases	Occurs as a result of increases in both heart rate and stroke volume

بنرجع نأكد زيادة ال HR لمستوى معين بتزيد ال CO

Blood Flow to Active Skeletal Muscles and Heart Muscle	Increases	Occurs as a result of locally controlled arteriolar vasodilation, which is reinforced by the vasodilatory effects of epinephrine and overpowers the weaker sympathetic vasoconstrictor effect
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During exercise, we have sympathetic activity. The **local metabolites** can overcome the sympathetic activity ... O₂ ↓ , CO₂ ↑ , Acidity ↑ , Lactic acid leading to VD

In skeletal muscles, we have $\beta 2$ receptors. During exercise, the effect of sympathetic activity with adrenaline and noradrenaline **will affect and stimulate $\beta 2$** , leads to vasodilation

The effect of sympathetic activity and hormones on arterioles is vasodilation , not vasoconstriction (in skeletal muscle)

اثناء ال resting تأثير ال symp يكون على ال alpha 2 receptore وبالتالي بتعمل VC، هسا نيحي نحكي عن القلب

the heart has the property of autoregulation of coronary arteries, and the sympathetic activity causes vasodilation (VD) of the coronary arteries.

The local metabolic effects (adrenaline and noradrenaline) are more powerful in producing vasodilation (VD) than the sympathetic activity.

ال BF يزيد مش بسبب ال symp بل بسبب ال metabolites بشكل رئيسي ، اكثر metabolite بعمل VD بال coronary وهو اقوى واحد Adenosine ، اكثر metabolite بعمل VD ببقية ال tissue هو ال NO

Blood Flow to the Brain

Unchanged

Occurs because sympathetic stimulation has no effect on brain arterioles; local control mechanisms maintain constant cerebral blood flow whatever the circumstances

Blood flow to the brain is regulated by a process called autoregulation, which is significantly supported by the Circle of Willis. This ensures that the brain receives a consistent blood supply regardless of fluctuations in systemic blood pressure

When systemic blood pressure increases, the blood vessels within the Circle of Willis constrict to reduce the blood flow, preventing excessive blood flow to the brain. Conversely, if systemic blood pressure decreases, these vessels dilate to increase blood flow, ensuring the brain receives adequate blood supply

Blood Flow to the Skin

Increases

Occurs because the hypothalamic temperature control center induces vasodilation of skin arterioles; increased skin blood flow brings heat produced by exercising muscles to the body surface where the heat can be lost to the external environment

During exercise, increased metabolic activity leads to increased heat production. This causes vasodilation (VD) in the skin, increasing the temperature of the skin. The higher skin temperature leads to increased blood flow, which in turn increases heat loss from the body

Blood Flow to the Digestive System, ~~Kidneys~~, and Other Organs

Decreases

Occurs as a result of generalized sympathetically induced arteriolar vasoconstriction

هسا الدكتور حكا انه ال kidneys عندها autoregulation ف ال blood flow يكون زي ال brain ما بقل ، وبالنسبة للجهاز الهضمي حكينا هالمعلومة من قبل (بس توكل لا تلعب رياضة) ، ال symp رح يعمل VC ويقلل ال digestive system Blood flow ال

Total Peripheral Resistance

Decreases

Occurs because resistance in the skeletal muscles, heart, and skin decreases to a greater extent than resistance in the other organs increases

During exercise, all the skeletal muscles in your body will be active, and vasodilation (VD) of the arterioles will occur in all of them. As a result, total peripheral resistance (TPR) will decrease.

The washout of metabolites that accumulate in the skeletal muscles will be slow after you stop exercising, so the recovery of TPR will be slow.

Conversely, diastolic pressure is connected to TPR. If TPR increases, diastolic pressure will increase as well.

زيادة ال TPR وين بتصير ؟ بال GI لانه صار فيه تضيق

طيب ال systolic pressure شو بصير عليه وقت ال exercies ؟ بزيد
Systolic pressure mainly affected by cardiac output , by the volume of blood ejected during the heart beat

during exercies , CO  so SB 

حكينا كيف بنقيسه

Mean Arterial Blood Pressure

Increases
(modest)

Occurs because cardiac output increases more than total peripheral resistance decreases

small increase

$$MBP = DP + \frac{1}{3} (SP - DP)$$

ليش الزيادة بتكون قليلة ؟ لانه ال Diastolic بقل وال systolic بزيد (لانه ال CO بزيد)

هيك انهينا الحمد لله ، لاتنسوا اهلنا بغزة من دعائكم + تنسوش تحلوا اسئلة التكنو