Course: Electrophysiology of Heart

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Lecture 15: ECG and Hypertension

Hello everyone. So, we will start our next topic that is electrocardiogram. So, the concepts will cover what are the ECG features related to hypertension. We are talking about systemic hypertension over here. So, first and foremost the blood pressure definition is very important. So, what do we understand by arterial blood pressure? It is the lateral pressure which is exerted by the column of blood on the vessel wall.

This is the arterial blood pressure and we know we have various entities of blood pressure like systolic blood pressure, diastolic blood pressure, mean arterial pressure and pulse pressure we had already discussed. Now, systolic blood pressure means the maximum pressure which is occurring during the beating of the heart and diastolic blood pressure means the minimum pressure which is present when the heart is resting. So, that is why these two entities are very important when we talk about hypertension. Now, the various classifications of various stages of hypertension usually come and go.

The recent hypertension classification is the normal if it is if the systolic blood pressure is less than 120 millimeter of mercury, the diastolic is less than 80 millimeter of mercury. So, this is the normal blood pressure as of now. The elevated is 120 to 129 and less than 80. So, elevated blood pressure is 120 to 129 millimeter of mercury and less than 80 is the diastolic blood pressure. So, the borderline will come under this.

After this anything beyond this will come as hypertension stage 1. 130 to 139 millimeter of mercury and diastolic blood pressure between 80 to 89. Stage 2 is 140 or higher, then diastolic is more than 90. Then we have hypertensive crisis when we it is a very emergency conditions when the blood pressure goes more than 180 millimeter of mercury the systolic blood pressure and the diastolic blood pressure goes more than 120 millimeter of mercury. Now, based on the different stages of blood pressure we get to see various changes on the ECG because of the compensatory mechanisms and what are the compensatory mechanisms.

Now, because of the hypertension there is a pressure or systolic overload. Pressure or systolic overload means there is an increased afterload. Now, there is there are two terms which we supposed to remember that is preload and afterload and contractility. Because these three are the important factors on which the stroke volume of our heart depends. Now, contractility means how fast the heart is contracting.

Preload means when the ventricle is filled. So, that is the end diastolic volume. So, preload is nothing but the end diastolic volume. When the atria contracts fully and there is filling of the ventricles that filling of the ventricles that that is known as end diastolic volume. So, this is nothing but the stretch.

The more the volume is present in the ventricles the more will be the stretching of the ventricles, the more will be the pumping of the blood out of the ventricles. So, that is as per the Frank's Stirling's law. Now, afterload is the resistance it is mainly the systemic vascular resistance. Afterload is the resistance which is usually offered by the systemic blood vessels mainly here it is the ota to the ventricles to pump the blood out of the ventricles. So, whenever there is increased afterload, this increased afterload means there is increased systemic vascular resistance.

So, because of this increased systemic vascular resistance the heart particularly the left ventricle will face difficulty to pump the blood out towards the ota because of this resistance. Because pumping of the blood from the ventricles to the ota mainly depends on the ventricular pressure and the otic pressure. Here ota is the systemic blood vessel we are talking about. So, this should be more, but whenever the reverse happens that means the systemic vascular resistance is more the otic pressure is more at that time their pumping will be difficult. So, this increased afterload causes compensatory hypertrophy of the ventricles and dilatation of the heart.

So, because of this compensatory hypertrophy that means there is increased in the muscle mass. So, the left ventricle muscle mass is basically denoted by the whether it is left ventricle or right ventricle the ventricular muscle mass will give a strong vector, strong vector that will denote the QRS complexes mainly the R wave. So, there will be morphological changes in the QRS complexes. Second because of the strong vector which is generated because of the increased muscle mass there can be axis deviation. There can be QRS durations also can be changed usually it is changed there can be secondary STT changes because the depolarization is getting affected and so the repolarization will also get affected the repolarization will also be abnormal.

So, there will be secondary STT changes it is secondary STT changes because it is not the changes or related to the myocardial infarction which we get. There will be increased QT interval the corrected QT interval which usually denotes the action potential duration that will get increased because of the increased depolarization of the ventricles. And of course, there will be change in the P wave morphology with simultaneously the with the left ventricular what we see in hypertension left ventricular hypertrophy there is left atrial enlargement also. So, that is why the atrial enlargement is usually depicted by the P wave morphological changes. So, now we will see what are the changes we are getting this is the normal ECG where this is the direction of the vector during normal depolarization.

The same direction of the vector will also happen in the left ventricular hypertrophy only the vector will be very very strong. So, whenever this vector will be very strong and as we see as I had told you usually the ventricular mass we see in the leads V 1 or V 2 or V 5 V 6 mainly based on the horizontal view mainly from the horizontal view. So, we can see this is the normal the QRS complexes which is inverted S wave we get in case of V 1 and V 2 and in case of V 5 and V 6 this is the R wave which we get this is the T wave this is the T wave and there is a slight sloping of the T wave. So, this is the normal ECG changes which we get in normal conditions, but in case of left ventricular hypertrophy we can see deep S wave as well as we can see very very long or tall R waves. We also see the secondary S T changes we can see T wave inversion and also down sloping of S T segment.

So, these are the secondary S T T changes now this this down sloping of S T segment and T wave inversion this usually occurs because of the repolarization because there is increased prolonged depolarization and the prolonged depolarization abnormal depolarization will also cause abnormal repolarization. So, hence deep S waves and the QRS durations the tall R waves secondary S T changes and T wave changes are usually seen in left ventricular hypertrophy. So, the next we see is the atrial enlargement now I have been talking I have been talk about the right ventricular hypertrophy because right ventricular hypertrophy usually it is not related to systemic hypertension it is usually not related to systemic hypertension systemic hypertension will causes the compensatory change in the left ventricular. So, left ventricular hypertrophy is seen along with the left atrial enlargement right ventricular hypertrophy is usually related to the lung pathology where we get the lung vessels the resistance is increased the lung you get pulmonary hypertension. So, the left ventricular hypertrophy as well as left atrial enlargement this we see in case of systemic hypertension mainly.

So, this is the two waves these are the two waves which we see because of the depolarization of the two atria the left atria and the right atria generally we do not get to see this two waves separately because both atria usually depolarized synchronously. But we see this two hums separately whenever there will be abnormality in the conduction of the impulses in separately in this two atria which usually happens in case of left atrial enlargement. In case of left atrial enlargement we see this second hump enhanced second hump in case of lead two specifically and this is because of the left atrial enlargement the two atria are depolarizing separately because of the enlargement of the atria this is also known as p mitral because usually left atrial enlargement and this sort of waves are usually seen whenever there is mitral valve pathology like mitral valvular regurgitation. So, that is why the wave name is given p mitral the same we see in case of right atrial enlargement which is related to the pulmonary pathology we get p pulmonolive. So, these are the certain ECG features which we get in case of left ventricular hypertrophy.

Now, coming to this case discussion what we see in this twelve lead ECG the first thing which we have to see is we can see the very deep S waves in case of V 5, in case of V 5, V 6 actually we get very tall R waves and in case of V 2 and V 3 we get deep S waves. So, V 2, V 3 we are getting deep S waves, fine V 5 and V 6 we are getting tall R waves. Then what are the other changes we could see over here. So, there are secondary ST changes also we can see the secondary ST changes we can see in lead 1, AVL also we can see T wave inversion and also in case of V 5, V 6 also we can see the secondary ST changes. So, secondary STT changes we see in lead 1, AVL and in case of V 5, V 6 these are the secondary ST changes we can see.

Now, if we come to the axis. So, the very easy approach is the quadrant approach. So, if we take of AVF and 1. So, lead 1 and AVF lead. So, lead 1 is showing positive deflection and AVF is showing negative deflection.

So, positive and negative deflections if you just could remember the quadrant approach we have like discussed it is nothing but left axis deviation. So, with all this, this is very much conclusive of left ventricular hypertrophy. There are deep S waves in V 2 and V 3, there are tall R waves in V 5 and V 6, there are secondary ST and T changes and there is left axis deviation. So, this is left ventricular hypertrophy. Now, if we come to the second example.

In the second example, this we can see very much if we see V 2 and V 3, the S waves are so deep that it is the pages the ECG graph paper is falling short for the S waves. So, very deep S waves we are getting in V 2 and V 3, we are getting tall R waves in V 5 and V 6, again tall R waves in V 5 and V 6. We are seeing ST segment depression in V 5, V 6 lead to ST segment depressions and ST segment and T wave inversion lead 2, lead 3 and very much in AVL. So, ST secondary STT changes we see in 1, 2, 3, AVL, V 5 and V 6. And now, the axis if we take of 1, lead 1 is positive deflection and here we can see the lead AVF is also, we can see the lead AVF is also positive.

So, both are in positive directions. So, here we would not be getting the left axis deviations, but this though we do not get left axis deviation always, but yes we can because of the above changes V 2 and V 3, V 5, V 6 and ST changes also there is QRS wide QRS in case of V 5 and V 6. So, wide QRS in case of V 5 and V 6. So, this also tells of left ventricular hypertrophy. We had left axis deviation in case of the previous example, here we do not have the left axis deviation, but still we have the other features to denote it as left ventricular hypertrophy.

So, these are the two examples which is very important and in this way we see look for the ECGs. So, with this the summary of ECG criteria for left ventricular hypertrophy which is usually seen in case of hypertension, hypertensive changes. The mainly we use this Sokolov-Leon criteria, where the S wave depth in V 1 plus tallest R wave height in V 5 to V 6 should be more than 35 millimeter. The S wave in V 1 plus the tallest R wave in V 5 or V 6 should be more than 35 millimeter. This is a very sole criteria and important criteria we have used for left ventricular hypertrophy.

Along with that we have S 2 segment depression and T wave inversion usually in the left sided leads, left atrial enlargement, left axis deviation sometimes and increased QT C corrected QT interval which is because of mainly the increased action potential duration because of the increased depolarization of the ventricles. So, these are the summaries, these are the key features we have to remember for left ventricular hypertrophy. With this I would like to conclude today's topic and also one very important thing is whenever left ventricular hypertrophy is confirmed from the ECG, we should always go for echocardiography. Echocardiography is very much necessary to check the for the left ventricular hypertrophy. So, these are the criteria you should remember.

So, these are the references and thank you. .