**Course: Electrophysiology of Heart**

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**Lecture 20: Autonomic Function Tests-2**

Hello everyone. So, today we will start our next lecture that is autonomic function test. That is lecture number 2. Already we had discussed in the previous lecture the various types of autonomic functions test starting from valsalva monovore deep breathing test and hand grip test then cold pressure test. So, now we will see what are the available methods are there for autonomic scoring or how this scoring is done. So, we have done the test.

Now we need to score or we have to quantify to see check for the degree or the severity of the autonomic dysfunction. So, why there is a need for reporting of autonomic function test? As I had already told you to recognize the presence of autonomic dysfunctions with the help of test you would be able to recognize where the dysfunction is. Then you want to check whether the sympathetic loop has got any problem or the parasympathetic loop has got any problem. So, which the site of problem needs to get detected then the severity the degree of the severity of the dysfunctions autonomic dysfunctions needs to get elucidated and the therapeutic implications like if you are giving any cholinergic drugs or anticholinergic drugs, adrenergic drugs nor adrenergic drugs you are giving.

So, or beta blockers alpha blockers. So, what are the implications of those drugs which could modulate the functions of autonomic nervous system and predict the mortality risk in the subjects. So, initially this autonomic function test has been a very daunting task because there is not only one test you are supposed to do which could finally, give rise to the autonomic dysfunctions or relate to the autonomic dysfunctions you have to run a battery of test. So, in 1981 Ewing's method has or the scientist Ewing has usually done this battery of five test or this test are finally, named after the scientist Ewing. So, there are five phenomenon or five parameters that means, valsalva ratio during three valsalva monover we are supposed to do three valsalva monovers.

Then mean we have to go for six deep breathing then we have to check for the mean of the maximum and the minimum heart rate differences in the deep breathing that means, delta heart rate we have to check. In the three valsalva monover we have to check for the valsalva ratio and then we have to check for the delta heart rate in the deep breaths. Then 30 is to 15 ratio after standing systolic blood pressure fall the fall of the systolic blood pressure after standing when you when we stand up there is a fall in the systolic blood pressure how much is the fall we have to see. And diastolic blood pressure rise during hand grip whenever we do a sustained hand grip isometric exercise what is the rise in the blood diastolic blood pressure we have to see. So, these are the five battery of five test which is been considered one of the symptomatic for important for by Ewings.

So, the cut off values for autonomic function test using this five test we would we would see the deep breathing test delta heart rate more than 15 more than equal to 15 beats per minute is usually considered to be normal. Now, all the test are usually considered to be either normal or borderline or abnormal. So, this three entities are there either the test should conclude one as normal then borderline or abnormal. So, deep breathing test 15 more than 15 you have to remember this cut off values more than 15 equal to 15 is normal 10 to 15 is borderline less than 10 is abnormal. Similarly, the valsalva ratio valsalva ratio is very important more than 1.

21 is the normal value of the valsalva ratio within 1.2 that is borderline and less than 1.1 is abnormal. Then we have change in the diastolic blood pressure whenever there is a rise in the diastolic blood pressure of more than 16 millimeter of mercury it is normal less than 16 millimeter of mercury again whether it is 11 to 15 it is borderline less than 10 it is abnormal. When the systolic blood pressure generally usually falls within 10 millimeter of mercury.

So, this is normal, but if the difference is more than 10 suppose 10 to 19 it is borderline more than equal to 20 it is abnormal. And 30 is to 15 ratio again 1.04 is the cut off value more than equal to 1.04 is normal 1.

01 to 1.03 is borderline and less than 1.01 is abnormal. So, based on this category and criteria we usually classify whether the person is having normal borderline or abnormal autonomic dysfunctions. Now, Ewing's method based on this autonomic scoring we will classify this scan or cardiac autonomic neuropathy as normal, early, definite or severe. So, normal means all tests are normal or one test is borderline.

Early impairment means one of the three heart rate test is abnormal or two borderline. Now, heart rate means we are talking about the delta heart rate in case of valsalva ratio

and in case of the valsalva ratio 30 is to 15 ratio. So, other we have the blood pressure that means change in the diastolic blood pressure and the fall in the systolic blood pressure. So, and in the valsalva ratio also. So, the one of the three heart rate test which is abnormal and then definite two heart rate test heart rate and blood pressure both we have in case of valsalva actually.

So, two heart rate test is abnormal in case of definite in severe two heart rate and one or both blood pressure test is abnormal. So, normal, early, definite, severe all are normal all test are normal or one test is borderline that is normal. Early impairment early impairment or earlier cardiac autonomic neuropathy means one of the three heart rate test should be abnormal or should lie in the borderline. Definite means two heart rate has to be abnormal heart rate test up to be abnormal. Severe means either two heart rate has to be abnormal and one blood pressure has to be abnormal or both blood pressure test can be abnormal also.

So, in this way we classify this cardiac autonomic neuropathy or CAN. Later on in 1983 another criteria has come had come up that is Bellaveri criteria. Bellaveri criteria consisted of deep breathing test valsalva monomer and hand grip test. It omitted the standing lying position and 30 is to 15 ratio. So, delta heart rate valsalva ratio and change in the diastolic blood pressure this we have to see.

Usually the criteria remains the same only we have given the score of 0, 1 or 2 which means the highest score in case of abnormal is 2, in case of valsalva ratio is 2, in case of hand grip test is also 2. That means the highest score has to be 6. If the person is having score as 6 that means the cardiac autonomic neuropathy is severe in that person. So, in that way we will see the scores when added the cardiac autonomic neuropathy can is classified as 0 to 1 in that is no cardiac autonomic neuropathy, 2 to 3 early cardiac autonomic neuropathy and 4 to 6 that is severe cardiac autonomic neuropathy. Later on O'Brien in 1986 has classified another battery of test which is almost similar to Ewing's test, but only difference is only one valsalva monomer is done instead of 3, only one deep breath is taken instead of 6.

So, this actually reduces the time consumption or time taken to perform all the battery of test. So, that is more comfortable of the patient and much quicker. This systolic fall is already taken, diastolic change during hand grip is also taken and deviations of the RR interval during quiet breathing that is the delta RR during the quiet breathing that is also taken. So, this is usually the classification done by O'Brien. So, generally we follow the Ewing's method or the 5 battery of test.

So, this test are again further divided based on the sympathetic component and the

parasympathetic component. So, we will see whether valsalva checks for the parasympathetic component or not or with the hand grip checks for the sympathetic component or not. So, deep breathing test and valsalva usually check for the parasympathetic component. Hand grip test and cold pressure test this usually check for the sympathetic component. Standing to lying test or we have the head up tilt test when we have a automated tilt table.

So, we can go for the head up tilt test they usually check for the parasympathetic component as well as sympathetic component. Now, in case of parasympathetic component that is usually 30 is to 50 ratio we check for in case of standing lying to standing or head up tilt. In case of sympathetic component in lying to standing or head up tilt we usually check for the blood pressure that is change in the systolic blood pressure. Here we will go for the heart rate usually in case of parasympathetic component in sympathetic we check for the blood pressure in parasympathetic we check for the heart rate. So, these are the 6 test which are divided as per the sympathetic domain and the parasympathetic domain.

Deep breathing valsalva for sure parasympathetic cold pressure test and hand grip is for sympathetic. Standing to lying, lying to standing or head up tilt goes both for parasympathetic as well as sympathetic only heart rate 30 is to 15 ratio is checked in case of parasympathetic component. And the blood pressure fall is checked in case of sympathetic component. Now, disadvantages while performing this autonomic function test as I had told you that the sympathetic component Ewing's criteria has used the sympathetic component for diagnosis of the severity of the cardiac autonomic neuropathy. And sympathetic dysfunctions need to get assessed independently not in combination with parasympathetic there is overlapping of the test.

And sympathetic abnormality is more common than the parasympathetic component. And one abnormality may not follow the other that means not necessarily the parasympathetic dysfunction is followed by sympathetic dysfunction. So, to compensate this we have the CAS score that is composite autonomic severity scores. This is usually developed by the Mayo Clinic this composite autonomic severity score or in short form we tell as CAS. This considers the three domains mainly based on the sub scores that is cardiovagal, adrenergic and pseudomotor.

So, cardiovagal is mainly the heart rate of deep breathing and valsalva monover. Adrenergic is mainly the blood pressure of valsalva monover and tilt test whatever the changes in the blood pressure. And we get to check the pseudomotor test that is the QSAT or quantitative sweat axon reflex test. In general we call it as QSAT quantitative sweat axon reflex test. So, sub scores we have cardiovagal, adrenergic and pseudomotor.

So, in case of pseudomotor or how quantitative sweat axon reflex test usually we see this ionotophoric drug delivery system is there via electrodes that is usually placed in the proximal part of the wrist. And also in the three sides of the right leg at the region of distal region, proximal region of the leg and the foot region along with the ground electrode. And then we check for the sweat response. So, quantitative how this QSAT or quantitative pseudomotor axon reflex test is done is usually check for the latency and the sweat volume or the volume of sweat. Now, this electrode this usually consist of 10 percent acetylcholine solutions.

And this is mainly because we have to pass on 2 milli ampere current. So, for that reason usually this acetylcholine solutions for the conductivity this is usually present in the electrode. So, the volume of sweat how much it is generated and the latency that is usually calculated or measured in case of quantitative pseudomotor axon reflex test. Now, you in the diagram which we see this is the time and the sweat rate. So, this is where the stimulus is given this is the stimulus and this is where the sweating has start that means onset of sweating.

So, this period is latency and from here till here we get the sweat volume or volume of sweat. So, in this way we can calculate the latency and the volume of sweat in the QSAT. So, based on this sub scores the composite autonomic severity score CAS. So, cardiovascular sub score 0 1 2 3 the normal value is 0, 1 is the heart rate due to deep breathing or the valsalva ratio which is reduced in case of this reduction has to be more than or equal to 50 percent of the minimum minimal normal value. In case of deep breathing heart rate or if the valsalva ratio is reduced to less than 50 percent then it is second.

And when both are reduced to less than 50 percent of the minimum normal value then it is considered to be third point. In similar case the adrenergic score 0 is the normal value, 1 depends on the early phase 2 reduction then latent the late phase 2 if it does not return to the base line what is the pulse pressure reductions and what is the systolic blood pressure recovery. If it is not done if the recovery is not set between 4 to 5 seconds then it is 1, if the recovery is not done within 6 to 9 before 6 to 9 seconds then it is 2, if the recovery is taking more than 10 seconds then it is 3 and 4. Now in generally adrenergic sub score 3 and 4 steps about your orthostatic hypotension where the systolic blood pressure reduction is 30 millimeter of mercury and mean blood pressure is reduced by 20 millimeter of mercury. So, this usually give the scores of 0, 1, 2, 3, 4.

So, here in adrenergic the highest score abnormal score is 4, the highest abnormal score in cardiovascular sub score is 3. So, this gives the total score of 7 also we have now the

pseudo motor sub score. So, pseudo motor sub score 0 is the normal value in one point we have single site abnormal and more than 50 percent of the lower limit in two we have single site less than 50 percent of the lower limit or two or more sites reduced or more than 50 percent of the lower limit when two or more sites are more than less than 50 percent of the lower limit that is 3. So, third point or 3 point is the pseudo motor sub score.

So, that means 7 and 3 10. So, 10 is the highest score in case of the case. So, that is why now autonomic failure here when we are talking about autonomic failure we are talking about generalized autonomic failure. We are not talking only about cardiac autonomic neuropathy we are talking about generalized autonomic failure say in generalized autonomic failure we have 0 as normal 1 to 3 as mild 4 to 6 as moderate and 7 to 10 as severe. Generally, if you get score 1 or more than 1 that means the autonomic neuropathy is significant in that person. So, you that is the score higher than 1 is clinically significant and indicates presence of autonomic neuropathy usually.

So, this is mainly of the generalized autonomic failure that means along with the cardiac autonomic dysfunction the other systems of our body are also affected which are usually vaguely mediated and the sympathetic nerves are also mediating them. So, in the summary this is an extra edge the autonomic symptom profile ASP is an well established questionnaire which was designed to evaluate the severity and distribution of symptoms and the autonomic functional capacity of the patients with autonomic disorders. But it used to take huge number of time like the time it has used to take much time because this usually comprises of 169 questions they used to assess various domains generally 11 domains used to get assessed. Because when we talk about generalized autonomic failure we are not only concerned about cardiac autonomic neuropathy we are concerned about whether the oculomotor reflexes are oculo reflexes are normal that means the pupillary light reflexes are normal or not whether my secretory functions is normal or not the secretion of the glands whether my gastrointestinal functions is normal or not whether the erectile function is there or not. So, there are various domains which are assessed, but since it used to take large lots of time.

So, new scale has been developed again by myoclinic that is compass 31 that is composite autonomic scoring score. So, this compass 31 consists has reduced the 169 questions to 31 questions and this 31 questions consist of various domains. So, these domains are whether orthostatic intolerance the questions are asked to assess this whether orthostatic intolerance are present or not usually 4 questions are there vasomotor function is checked with 3 questions secretomotor functions 4 questions gastrointestinal functions with 12 questions bladder motility 3 questions and pupillary reflexes or pupillary motor actions with 5 questions. So, totally we have 31 questions and usually

the Cronbach alpha we can see except in pupillary motor all are pupillary motor and secretomotor all are usually of more than 0.

8. So, it has got a good validity the validity the internal validity of this scale is good enough. So, that is why along with compass 31 and CAS score the autonomic dysfunctions are usually calculated or measured and correlated. So, in this way we can check for the autonomic dysfunction which is present in a body with the help of CAS score as well as compass 31 which is a well established questionnaire. So, these are the references of today's lecture. Thank you.