Minimum Stimulus Strategy in the Diagnosis of BPPV

Presenter: Andrea Castellucci, MD

- [Anna] Hello, and welcome to today's class, Minimum Stimulus Strategy in the Diagnosis of BPPV. Before I turn this over to our presenter, I would like to go through our learner outcomes for today. After this course, participants will be able to describe horizontal canal BPPV, both geotropic and apogeotropic variants from the upright position. After this course course participants will be able to describe posterior canal BPPV from the upright position. And after this course participants will be able to describe multicanal BPPV from the upright position. Thank you so much. And now I'm going to turn this over to our presenter.

- Thank you very much, Anna. Thank you very much, and good morning to all of you. Good evening actually, or good afternoon depending where you are. And first of all I would like to thank Inventis for inviting me in such webinar, and second, I would like to thank Anna Scala for her excellent job in this Inventis Academia, for all her efforts in recruiting speakers and organizing webinars like this. And of course I would like to welcome the new entry, Rebecca, for joining this group. So my talk today will be about the minimum stimulus strategy in the diagnosis of BPPV. We will speak about the aim of the minimum stimulus strategy. That is basically the aim is to predict the diagnose of BPPV basically in the upright position.

So we will see when this kind of strategy will be used in particular, and we will see all the steps to diagnose BPPV basically from the upright position. First of all, before starting with this talk, I have to thank Professor Giacinto Asprella Libonati who most of you already know. He's an excellent scientist from Italy, and minimum stimulus strategy has been always among one of his workhorses, let's say. So he spent a lot of time in the study of nystagmus in patients with BPPV from the upright position, slightly bending the head backward and upward and trying to understand which are the signs that might help clinicians to understand which kind of BPPV they have in front of them.

So first of all I have to thank him and also because he included me and my other friends, Salvatore Martellucci and Pasquale Malara, he involved us in this kind of project, in this kind of studies, and he promoted these studies. And so this is the group that I would like to thank when speaking about minimum stimulus strategy because we work together actually. So most of the videos that I will show will be videos that have been recorded by Professor Asprella or Dr. Salvo Martellucci and Dr. Pasquale Malara. So BPPV, all of you know that BPPV is the most common vestibular disorder, and it's characterized by brief vertical spells triggered by high position changes with abrupt onset and rapid decrease.

This is the typical canal diesis, and BPP is ascribed to otoconia that dislodge from the utricular macula and go to the canal. And go to the canal, and let's say, make some perturbation in the dynamic of the semicircular canal. So we know that if we have canalolithiasis, we have otoconia that are free to float within the canal, and otoconia are free to float back and forth in membranous duct of the semicircular canal that is involved, leading to paroxysmal nystagmus that will be direction changing depending on the position of the head with respect to gravity. And we also know that we might have cupulolithiasis. And cupulolithiasis is something slightly different from canalolithiasis, because in this condition, otoconia adhere to the cupula of the canal involved or the involved canals.

So otoconia go to overload the cupula, and this overload cupula will lead to persistent endolymphatic flows that will be direction changing according to the position of the head with respect to the gravity vector. And we also know that there might be some atypical forms, like complete or incomplete canalith jam where otoconia are partially or totally entrapped in a narrow portion of the membrane, death leading to spontaneous nystagmus or a persistent direction fixed positional nystagmus. Depending on the position they have and depending on the canal, of course, they are settling. So as you can see, BPPV, of course, is a common disorder, but it does not mean that it's an easy

disorder because we might have atypical forms, atypical places where otoconia might settle.

And if we have this condition, it's nice to know from the beginning what we are going to expect when we put the patient in the positional maneuver, in the positioning test. So, of course we might have a typical posterior canal BPPV, where otoconia are here in the ampullary arm of the posterior canal. This is the geotropic variant because when we put the patient in the recumbent position, we will have an upbeat nystagmus that is typically due to a strong excitation of the posterior canal because there's an ampullofugal flow in the posterior canal. So there is a strong excitation of the canal. But otoconia might be in the ampullary arm of the horizontal canal leading to the apogeotropic variant.

Or there might be in the non-ampullary arm of the horizontal canal leading to the geotropic variant of the horizontal canal. Otoconia might also be in a close contact with the cupula, adhere to the cupula, or in the utricular side of the cupula, or in the canal side of the cupula, leading to cupulolithiasis. So we will have horizontal direction changing nystagmus that would be persistent, but we might have also atypical variants. We might have posterior canalolithiasis that not so common. I would say it's not that rare, but it's not that common. I'd say it's much more common to have horizontal cupulolithiasis horizontal canalolithiasis. But we might also have the BPPV variants that are associated to positional downbeat nystagmus, like anterior canal BPPV.

That is one of the most rare variant of BPPV due to the position, the position of the otoconia that are supposed to be, and this position, the canal should be self cleaning. So it's quite rare to have otoliths there, but it might happen. Or the most common, apogeotropic variant of posterior canal BPPV leading to positional down beating diagnosis. But we might have the so called sitting up vertical due to probably otoconia

here in the short arm of the posterior canal, or close to the ampulla here in the ampullary arm of the canal leading to a typical nystagmus, not when the patient is brought from the upright to the supine position, but when the patient is brought from the supine position to the sitting position.

And we might have of course canalith jam and a multicanal BPPV. So as you can see, there are a lot of variants of BPPV. So why do we have to use the minimum stimulus strategy in this patient, in a patient with BPPV? Let's try to see what is the minimum stimulus strategy and why we have to use this. So the diagnostic strategies for BPPV includes the detection of the diagnostic strategies need to aim to detect the affected ear. The first thing to understand. The involved canal and the involved arm of the canal. Of course, every canal has an ampullary arm and non-ampullary arm. Okay, and how can we detect this important information? Of course it's important because we have to treat the patient.

So if we do not detect the precise location of the otoconia, we will not be able to perform the proper diagnostic maneuver. So we have the traditional approach. Traditional approach is based on the typical, the classical diagnostic maneuver, Semont maneuver and Dix-Hallpike maneuver for the posterior canal and basically the supine head roll test, also called the Pagnini-McClure maneuver for the horizontal canal. And this maneuver test, each semicircular canal performing movements along the plane of the canal, imparting acceleration and inertial forces. And we will see, but we might be able to use the minimum stimulus strategies that it's based on a diagnosis and treatment with the least possible amount of maneuvers, mainly with the patient in the upright position.

So it's basically a strategy that is based on an nystagmus-guided approach with minimally invasive tests. And the key point of course is the upright protocol for BPPV. So with the patient in the upright position, just slightly bending the head along the

plane of the head, along the special plane, let's say. So let's have a look, a quick look to the traditional approach. Traditional approach is based on positional tests, also known as diagnostic maneuvers, and diagnostic maneuvers move free floating debris which band affected cupula of the synopsis core canal by using gravity and by using inertial forces and centrifugal forces. And several maneuvers have been performed, have been proposed to properly diagnose each kind of BPPV, moving the patient's head along the plane of the examined semicircular canal.

So let's have a look. This is the typical Dix-Hallpike maneuver for the right posterior canal. You can see that the patient, the head of the patient is rotated toward the right side to align the posterior canal, the posterior canal along the pitch plane. Along the plane of the movement of the whole trunk of the head in order to perform a maneuver that maximally move the otoconia inside the canal. So it exploits rapid movements of the whole trunk from the sitting position to the supine position with the head aligned with the involved posterior canal to impart otoconia, maximal inertial forces. So achieving maximal flow velocity of the endolymph. So it exploits not just gravity but inertial forces and centrifugal forces.

And of course this is the treatment, Epley treatment, Epley maneuver. But we also have, and this is of course the maneuver that we have to impart to the whole trunk of the patient. We also have the supine head roll test for the horizontal canal. So you can see here with the quick movement from the center to the right side, we'll have, depending on the position of debris, we'll have geotropic or upper geotropic nystagmus. In this case is geotropic, you can see that the patient went with the head toward the right side, and there's a right beating nystagmus that is peroxisomal. And also in this case, we had rapid movements of the head, with the head aligned with the plane of both canals from one side to the other side, and we're imparting otoconia maximal forces, maximal inertial forces, so achieving maximal flow velocity of the end of it.

So even in this case, we used gravity, inertial forces, and centrifugal forces, and how we can detect the side affected, thanks to the Ewald second law. Ewald second law says that ampullopetal endolymphatic flow generates stronger response than ampullofugal flow in the horizontal canal. So if we compare the amplitude and the intensity of nystagmus, when we bring the head of the patient on the right side, we compare it with the nystagmus induced on the other side, we'll see which is the strongest. And if it's geotropic, the strongest is the affected side. If it's upper geotropic, the weak is the strongest, is the affected side. So we can have the diagnosis with this maneuver. And the accurate identification of the affected side, we know that it's pivotal for an effective treatment strategies in BPPV.

But sometimes we might face some problems. We might face some problems because there are papers that say that, for instance, unilateral posterior counter BPPV might sometimes account for a bilaterally positive diagnostic test. So if we have a right posterior canal BPPV and we perform a diagnostic maneuver on both sides, we might have similar nystagmus on both sides. And if we're not skilled enough to understand which is the affected side, we might have problems in understanding which is the affected side. So we might have erroneous diagnosis and improper treatment strategies for the healthy sides. In case the clinicians only rely on positional nystagmus on the side randomly tested first. We need always to look at the nystagmus, our revoke nystagmus, on the direction of nystagmus.

We do not need just to perform a maneuver and only rely on the presence of nystagmus. We always need to understand which is the direction of the nystagmus that was evolved in this position. But sometimes we might be in front of cases like this. We might be in cases like this. For instance, this is a horizontal canal, BPPV, and sometimes it's not that easy to understand which is the strongest nystagmus, in which side is the strongest diagnosis. You see here there was a left beating nystagmus. So it

is a geotropic form. We can say that it's a horizontal canal BPPV in geotropic form. I'm performing a supine head roll test, and you can see that on the right side there's nystagmus that is not that different.

It's pretty similar to the nystagmus that I just evoked on the left side. Look again. Again, 180 degrees on the other side, look, there is no great difference among the two sides. So sometimes it might be difficult to understand the affected side. For instance, in these cases, as more as we repeat, the positioning maneuver probably will generate a dispersion of canaliths along the canal. So we reduce the piston action on the ampullary cupula. And that's why sometimes repeating repositioning maneuver, typical repositioning maneuver might not be enough to understand which is the affected side. Again, we always need to be sure about the type of nystagmus that we are generating, that we are evoking in a particular position.

You can see here the patient has a horizontal canal BPPV, but we evoked a typical nystagmus for horizontal canal BPPV through the Dix-Hallpike test. So we always need to understand which is the direction of the eyes of that diagnosis. So the diagnosis should always be based on the low nystagmus, rather than on the positional test that has been performed. You can see here another case, this is a patient with a right posterior canal BPPV. But you can see here that the typical Dix-Hallpike test does not give us any clues, it's negative. And if you put the patient in the supine head roll test, like in this case, this is on the right side with the head tilted on 30 degrees.

Now we have the typical nystagmus for posterior canal BPPV, for right posterior canal BPPV. So we always need to be careful on the nystagmus. That's why the importance of a nystagmus based approach is of pivotal importance. Another thing that is important is that if we have a patient in the acute stage of the disease, typically within the first 24 hours, 44, 48 hours, the first days, a patient might have, might have nausea, might have vomiting, might be vomiting, might have significant discomfort with this

continuous positioning maneuver, diagnostic maneuver from seated to supine position. And if we are not able to detect immediately, immediately, or with the less amount of maneuver, the affected canal, as in this case, you can see there's a right posterior canal BPPV.

Probably will not be able to complete the diagnostic and the repositioning maneuver because the patient, as in this case will need to stop, will ask us to stop and to vomit because it's very discomfort, this kind of maneuver from the sitting position to the supine position and again supine to sit, sit to supine, to change maneuver. And this might be true also for patients with anxious feelings, patients with anxiety related symptoms, patients with relapsing BPPV forms, relapsing variants. They immediately know that as soon as they will go down, they will start to be vomiting and nauseous. So they will ask us, "Please doctor, do the least as you can, because I don't want to suffer again.

" So for all this reason, all these factors might potentially prevent the clinician to achieve a correct diagnosis and complete the kind of repositioning maneuver in case the side of the canal affected are not correctly predicted before starting the kind of positioning maneuver. So in all these cases, we might be, for all these cases, we might be happy if we can use, if we can use minimal stimulus strategies, that is nystagmus guided approach for the diagnosis of BPPV, which aims to minimize the patient discomfort, imparting slight head rotation, just enough to move free floating particles, mainly exploiting gravity. So from the upright position we can understand which is the canal involved, which is the site, the canal and the arm involved in posterior canal BPPV and in horizontal canal BPPV.

So it has been developed in response to the need for a better tolerating and noninvasive diagnostic approach to BPPV, in particular for those patients who have a recent onset BPPV and so active symptoms and anxious subjects. So like in this video,

we just need to move a little bit the surface, let's say the inclination, we just need to slightly bend the head with respect to gravity. And we will probably, especially in the first days from this beginning of symptoms, will probably lead to a slight movement of otoconia that will lead to slight endolymphatic flows and they will lead to the slight eye moments that will allow us to understand which is the canal effect. And so we'll immediately proceed with the treatment.

So, according to the pathophysiology of the vestibulo-ocular reflex, each cupular deflection, either exciting or inhibiting the corresponding and ampullary afferents, generates the contraction of specific extraocular muscles that are coupled, leading to typical nystagmus. So we know that if we excite or inhibit a horizontal canal, we will have a horizontal nystagmus. If we excite right posterior canal, we will have an up beating nystagmus with right torsional nystagmus. That's basically the same nystagmus that we have if we inhibit the contralateral anterior canal and so on. So if we have in mind this kind of scheme, we will understand what's going on in a patient with BPPV from the upright position. But we have to recall which are the axis of the spatial axis and the planes that are described around each axis that we can exploit to move otoconia within the canal.

Okay? So we have the pitch plane. The pitch plane is basically the sagittal plane, and it's a plane that is described around an axis that goes from one ear to the other ear. So a horizontal axis called Y axis. And around this Y axis, we have the pitch plane. So if we bend the head backward and forward along the sagittal plane, we will be able to perform movements along the pitch plane. Okay. This is the first plane that we have to keep in mind. The second plane is the yaw plane. The yaw plane is a plane, is basically the actual plane, is the actual plane that is described around an axis that goes from our chin to the top of the head.

So a vertical axis called Z axis, and this plane is called the yaw plane. So each movement from the right to the left side and horizontal movement like this will be movements along the yaw plane. And then we have the roll plane. The roll plane is basically the coronal plane, and it's a plane described around an axis that goes from my nose to the back of the head. So, sagittal axis, let's say. And this axis is called X axis. And the plane described around this axis is the roll plane. So, moment like this, with my right ear that goes toward the right shoulder and the left ear that goes toward the left shoulder will be movements along the roll plane.

So these are basically the three main axes and three main planes of the space. But we know the anatomy of the inner ear. We know that the posterior canals and anterior canals align with a plane that is tilted, that is rotated 45 degrees from this special plane. So how we can move our hands to perform movements of the head that might align with the plane of our posterior and superior canal. We can see here, for instance, if we want to make movements of the head that align maximally with the right anterior and the left posterior canal, we need to rotate our head toward the left side 45 degrees. So we will have the left posterior canal that aligns with the pitch plane and the right anterior canal that aligns with the pitch plane.

So if we will bend the head forward and backward along this new plane, this new pitch plane. That's why it's a wide, it's a new plane. We can call it a RALP plane, right anterior and left posterior plane. Okay. Because in this position, we will only make endolymphatic movements along these two canals. And if there are otoliths inside one of these two canals, we'll probably be able to detect some movements, some nystagmus. And of course, we can do the same also in the other side for the other two canals. So for the right posterior and the left anterior canal, we can slightly bend, rotate the head toward the right side, and we will align the plane of the right posterior canal and of the left anterior canal with the pitch plane with the new pitch plane.

So we will do like this. So we will bend forward and backward the head along this new plane and we will be able to detect probably posterior canal BPPV from that right position. And this is of course the LARP plane. So the minimum stimulus strategy has the key point in the upright protocol. The upright protocol is the crucial part of the minimum signal strategies. And basically it includes the head pitch test. So the patient upright position will go forward and backward along the pitch plane. Okay, we will have the role plane. We will have the upright head roll test. So slightly bending the head toward one shoulder and to the other shoulder. And we will have finally the upright RALP test and upright LARP test.

So bending the head forward and backward, well with the head tilted, rotated 45 degrees left or 45 degrees right to maximally stimulate some movements of otoliths within a posterior canal or even an anterior canal. So this is the basic algorithm that we have. And the algorithm for a minimum stimulus strategy starts with the evaluation of pseudo-spontaneous nystagmus. We know that mainly horizontal canal BPPV might lead to pseudo-spontaneous nystagmus. That looks like a spontaneous nystagmus. But as soon as the head is bent forward or backward, it will start to reverse. So first step is evaluation of cell do spontaneous nystagmus. If we have a horizontal pseudo-spontaneous nystagmus, we already know that probably there's a horizontal canal BPPV going on.

There are also some cases of posterior canal BPPV where a slight downbeat nystagmus might be detected. There are quite rare cases. There are a few records in literature. And of course this will immediately address us toward a diagnosis of a posterior canal. The second step is the head pitch test. So we'll bend the head forward and backward, and we will see what if we have a horizontal nystagmus that is direction changing. Okay, we will understand that there's a horizontal canal BPPV, but which is the side, which is the arm? Geotropic, apogeotropic? We will need to perform the

upright head roll test to understand if it's geotropic or if it's apogeotropic. And if we have the diagnosis, we'll start with the treatment.

If we do not have a diagnosis, of course we'll need to perform other maneuver, other maneuver to detect other signs that will help us to understand which the site affected. There's a supine positioning test, so slightly bringing the patient from the sitting position to the supine position, and we'll see if a slight tiny nystagmus, horizontal nystagmus will appear. If it appears, okay, we will know which is the canal affected, and we will immediately proceed with the repositioning maneuver. Or if we do not have anything, we will need to perform the supine head roll test or supine head roll test because basically it's a movement, the Pagnini-McClure maneuver, also known as supine head roll test, basically is a test made in the role plane because, okay, we are supine, but we are moving the head along the yaw plane, not along the roll plane, along the yaw plane.

Okay, so it's a supine head roll test. It should be correctly named. Anyway, in literature, it's called supine head roll test. So we'll call it supine head roll test. But you can see how many steps we have in our hands to achieve a diagnosis of horizontal canal BPPV before going to the spine head roll test, probably we do not need to arrive to the supine head roll test because probably from the upright position, we might have all our, in our hands all the key signs for this kind of diagnosis. Or let's go to the other arm of this algorithm, we might have, with the head pitch test, we might have a vertical torsional nystagmus. And if it's a vertical torsional nystagmus, probably we are in front of posterior canal BPPV.

And if we have vertical torsional nystagmus with the head pitch test, probably we'll be able to recognize to achieve a correct diagnosis. So we go directly with the treatment. If we do not have any nystagmus in the head pitch test for posterior canal BPPV, we might enhance the sensitivity of the head pitch test. Just rotating the head 45 degrees

toward one side and go again with the upright RALP test. And if nothing happens, we'll rotate the head toward 45 degrees toward the other side to perform the LARP test. Okay, so we will probably have the diagnosis with this kind of tiny maneuver. And if we do not have the diagnosis, of course we will need to perform the typical Dix-Hallpike test or Semont maneuver to achieve the diagnosis.

Of course, if we do not have any nystagmus with the head pitch test and with the upright test, of course we will need to bring the patient from the sitting to the supine position. Of course we need to perform all the classical maneuver, all the traditional maneuver. If we do not detect any sign or if we detect signs that are slightly mismatching. Okay, we will see, we will see a lot of cases. So let's have a look to the minimum stimulus strategies for horizontal canal BPPV. Horizontal canal might be due to canalolithiasis, geotropic or apogeotropic, geotropic if otoliths are in the non-ampullary arm of the horizontal canal, apogeotropic if the otoconia settle in the ampullary arm of the horizontal canal or horizontal canal cupulolithiasis if otoconia adhere to the cupula, either in the utricular side of the cupula or in the canal side of the cupula.

So which is the first step of the horizontal canal BPPV in the minimal stimulus strategy? The first step is, we said the upright protocol. The first step of the upright protocol is the detection of a pseudo-spontaneous nystagmus. There have been a lot of papers about the detection of pseudo-spontaneous nystagmus, and it's true. We will find patients, I would say half patients do have slight spontaneous nystagmus if they have horizontal canal BPPV. Why? Why do they have? Because pseudo-spontaneous can be observed in patient with horizontal canal BPPV. Basically because the plane of the horizontal canal is not horizontal, is 30 degrees tilted upward from the horizontal plane. So in this position, if we put the patient in this position, there will be a slight movement otoconia with gravity and it will lead to an nystagmus that will go over one side or toward the other side depending on the position of the otoliths.

And of course due to its gravity dependency, this pseudo-spontaneous nystagmus usually changes direction with the head pitch test. So changes the position of the head, the angle of the head with respect to gravity, and of course with a supine head roll test. So first step, pseudo-spontaneous nystagmus. Second step, the head pitch test. The head pitch test has been named a bow and lean test, has been named forward line, backward line. There are a lot of papers, this is just a small part of the literature on the head pitch test and on the bow and lean test. A lot of scientists had dedicated papers and cases in trying to understand which is the diagnostic role of this head pitch test or bow and lean test.

And actually, there are a lot of features that can be described. We can describe the direction of nystagmus with the head pitch test. We can also describe the intensity of nystagmus, comparing the intensity of nystagmus, bending the head forward and bending the head backward. So if we are able to detect a discrepancy, a difference in the intensity in one nystagmus from the other nystagmus, we'll probably be able to understand if it's a geotropic form or an apogeotropic form, but not always. It's easy to perform similar movements from one side to the other side. Because if we want to compare the intensity, we must be sure that the movement that we make in one direction should be the same in time, intensity, and angular movements of the movement that we perform on the other side.

Because if you want to compare the intensity and the amplitude, we need to be strict with these features of the movements. And it might be difficult. It might be difficult if we do not have a videonystagmographic recording. It might be difficult if we are not skilled enough to do the proper movements. So we might need to add some other positional test. For instance, this is a patient that has left beating nystagmus when we bring the head along the pitch plane forward. Okay. And this movement, you can see here, this

left beating movement, reverse when we put the patient in backward, sorry, we put the patient in backward, head bending, so backward, head pitch test in reverse.

And it goes toward the right. And this might be due to left horizontal canal, BPPV in geotropic form. If otoconia settle in the non-ampullary arm of BPPV, of the horizontal canal, because if we bring the patient forward, this otoconia will go through gravity toward the ampulla. So it will be an excitation for the horizontal canal of the left side. So we will have a left beating nystagmus. And if we do the opposite movements, otoconia will float opposite, so they will lead to ampullofugal flows, inhibitory for the horizontal canal, for the left horizontal canal. So we will have a right beating or horizontal nystagmus. But if you look at here, the same nystagmus in forward head bending and in backward head bending at the head pitch test can be generated from an BPPV of the opposite side in the apogeotropic form.

In the apogeotropic variant, you can see here, if we have otoconia close to the cupula, not attached, just close to the cupula, they might be also attached, but they might be also close to the cupula. And if we forward them the head, we will have an endolymphatic flow that goes away from the ampulla of the right side, and it will be inhibitory for the right horizontal canals. So we will have a left beating horizontal nystagmus. And if we bring the patient head backward, we will have a reversal of this nystagmus because otoconia will go toward the ampulla so it'd be excitation of the right horizontal canal. So we'll have a right beating horizontal nystagmus. So as you can see, those two type of nystagmus are the same at the head pitch test.

So how we can understand if it's a geotropic horizontal BPPV or an apogeotropic horizontal BPPV? We need another test, and it will be probably enough. Which is the other test is the upright head roll test. The upright head roll test has been introduced in a few years, a few years ago by our group, by Pasquale Malara, our colleague, friend. And we first published this paper in 2018. And we, actually, Pasquale thought that

probably just slightly bend the head 45 degrees, 30 degrees toward the shoulder, one shoulder, and then going on the opposite direction, probably. It might be of extreme help to detect the geotropism if it's a geotropic or apogeotropic. Let's have a look. Actually, this kind of maneuver was not introduced by Pasquale himself.

There are maneuvers, these kind of maneuvers were called Bruning's maneuver. And this kind of maneuver had been used through years in the 50s and the 60s to understand what kind of, what kind of, let's say, activity might be, might be due to, let's say that they were used to understand the interaction between macular and canal activity. So it was used not for BPPV, even because in the 50s and 60s BPPV was not very known. And so they used this kind of maneuver just to understand how utricular and saccular macula could have an effect on canal activity or after canal irrigation, or in other condition. If we go back to the two scenario of the beginning and we add the head roll, the upright head roll test, we will understand if the patient has a geotropic horizontal BPPV or an apogeotropic horizontal BPPV.

Okay, so we will immediately have a look to some examples. So this is a patient with right horizontal canal BPPV. This is Pasquale. So there was no pseudo-spontaneous nystagmus. So look forward, head bending. Look, there's a tiny right beating nystagmus. Tiny right beating nystagmus might be due to a right geotropic horizontal canal BPPV, or also to a left apogeotropic horizontal canal BPPV. And backward head bending, nystagmus reverses, yes. And it's okay. But with the upright head roll test, we'll understand if it's a geotropic form or an apogeotropic form. Look, right head bending. You can see that there is a right beating nystagmus and leftward head bending. There's a left beating nystagmus. So this is right geotropic horizontal canal BPPV, full stop.

We can immediately proceed with the diagnostic maneuver, with the reposition maneuver. Of course, we always put the patient in the supine position and we perform

the supine head roll test, at least this at the beginning, but in years we started to stop and proceed immediately to the repositioning maneuver because there was a close association between these signs and the signs that we met with the spine head roll test. Look at this patient. There was a slight left beating nystagmus in forward head bending. So it might be due to a right apogeotropic horizontal canal BPPV, but also to a left geotropic horizontal canal BPPV. So how we can tell the difference between these two types of BPPV?

Of course we put the patient in the opposite position with backward head bending. And of course the nystagmus reverses. Now it's right beating nystagmus. But as we said, it might be due also to a left geotropic BPPV. Even if otoconia were here, they would give the same type of a nystagmus. So even in this case, we can go on with the applied head roll test, an applied head roll test, so slightly bending the head toward the left side, sorry, toward the right side. We immediately understand that there is an apogeotropic form, because in this position we have left beating nystagmus. So it should be a right apogeotropic horizontal canal BPPV. There are no other choices. And if we want to be sure that this is the correct diagnosis, we can bend ahead toward the other side and we will be sure that there's a direction changing nystagmus and the horizontal plane.

And of course this is a horizontal canal BPPV. We cannot know if it's canalolithiasis or a cupulolithiasis. This is the only limitation of this test. We will not be sure that it's a cupulolithiasis so persistent nystagmus, or canalolithiasis, so paroxysmal nystagmus. For this kind of information, we'll need to perform supine head roll test. Another case, left horizontal canal and BPPV in apogeotropic form. So otoconia are here in the left horizontal canal. You can see here that there's a tiny, several spontaneous nystagmus that goes toward the left side. Okay. And then Professor Asprella now is putting the head of the patient forward. And you will see here that there's a right beating

nystagmus and it might be due to a left apogeotropic BPPV, but also to a right geotropic BPPV.

We cannot know just with the head bending test. With this kind of test, we cannot be sure that this geotropic or apogeotropic form. Professor Asprella now is bending the head backward to be sure that there's a direction change in is diagnosis. And it's direction changing because the direction now is left beating. And this is due to an excitation of the left horizontal canal. But it might be due also to an inhibition of the horizontal canal if it was horizontal geotropic nystagmus. But if we bend the head on the role plane toward the right side, we can see a left beating nystagmus. So this is an apogeotropic form. And if we put the patient opposite on the left side, we can see that after a small latency, there is a direction changing nystagmus.

So you can see here that there is no need for 90 degrees, but just 30, 30 degrees, 45 degrees toward one side and toward the other side. Last case for the horizontal canal, this is a left horizontal canal BPPV in geotropic form. So with the otoconia sampling then on ampullary arm of the left horizontal canal. So there was a slight right beating nystagmus, pseudo-spontaneous nystagmus. So in forward head bending you can see that there's a tiny left beating nystagmus. And if it's tiny left beating nystagmus, it means that probably there is a left horizontal canal BPPV in geotropic form, but it might be also due to a right horizontal canal BPPV in apogeotropic form because it might be due to an excitation of the left ampullary afferents or an inhibition of the right horizontal afferents.

So now Salvo will perform a backward head bending. And backward head bending will tell us that it's a direction changing nystagmus, so it's typical of BPPV, sure. And you can see here that now nystagmus reverses, is going toward the right side, because now otoconia are inhibiting the left afferents. I will rapidly go to the head roll test, but as you can see, we just need slight head bending and slight movements. We do not need

big angles. We just need tiny angles. You can see 30 degrees toward one side, 30 degrees toward the other side, 30 degrees forward, 60 degrees backward. And we can have a lot of details and we have data analysis, basically. So now Salvo is testing the geotropism.

So bending the head toward the right, there was a right beating nystagmus. Bending the head on the roll plane toward the right, the left side. In this case, there was no great nystagmus, no detecting nystagmus, no problem. We already have three signs, so we do not need this additional sign. It's okay, probably now otoconia are a little bit dispersed. There were dispersal along the canal. So if the history, as I was saying, if the history of the patient is consistent with BPPV and we have all the key signs, the upright head roll test, like in this case, the upright protocol, I would say, so, the head pitch test, the upright head roll test, and also the detection of the nystagmus.

It might not be essential to perform even the supine head roll test. We usually, at the beginning, we usually perform every time the supine head roll test to be sure that it was typical for these kind of things. But as more as we started to use this kind of test, we saw that there was no need to perform the typical supine head roll test. The only exception is to understand if it's an apogeotropic form, if it's a cupulolithiasis or a canalolithiasis. You can see here it was clear that it was a horizontal canal BPPV of the left side in geotropic form. So we started immediately with the Gufoni maneuver for the left horizontal canal. This is another case of Salvo.

You can see here that the tiny pseudo-spontaneous nystagmus was going toward the left side, so slightly bending the head toward the ground. So forward head bending, there was a reversal of nystagmus. And it might be due either to an inhibition of the left horizontal canal afferents or an excitation of the right horizontal afferents, right horizontal canal afferents. He now goes backward, and we have a reversal of nystagmus. A reversal of nystagmus that gave us the clue that it's a direction changing

form, of course. And head roll test, 30 degrees toward the right side, there's a left beating nystagmus. Okay, this is an apogeotropic form, an apogeotropic form of the left side. Okay, I do not need to perform the supine head roll test, in particular if the patient is anxious, if the patient is nauseous, if the patient is in the first days of the onset of symptoms.

So we do not need the patient to vomit to understand which is the side, even, because it will not allow us to complete the treatment. So immediately, let's go to the repositioning maneuver. In this case, Salvo use a Zuma maneuver to convert this apogeotropic form in a geotropic form and to treat the patient accordingly. So I will rapidly go toward the end of this video. So as you can see, nystagmus is always going toward the right side, because nystagmus needs to go away from the ampulla of the left horizontal canal. So there are continuous ampullofugal flows. And after a few times, just to understand if everything was okay, he just check if the nystagmus now is geotropic.

So he, so he achieved a switch from an apogeotropic form to a geotropic form. So there is a residual otoliths in the non-ampullary arm. And now he performs a typical Gufoni maneuver for the left horizontal plane. As I mentioned before, to achieve a correct diagnosis, we might only need two nystagmus. There is not always a need to have all the four nystagmus. Look, this patient has a right beating nystagmus in backward head bending. So it might be due to a left horizontal canal BPPV in geotropic form, or a right horizontal canal BPPV in apogeotropic form. So no need to go forward. Let's go on the roll plane. So in the roll plane, on the left side, there is a geotropic fall.

Okay, it is a left horizontal canal BPPV in geotropic form. So let's go with the Gufoni maneuver. And in fact, it gives right horizontal beating nystagmus. And after a few minutes, Salvo will complete the Gufoni maneuver, and will check again, the nystagmus receded. Look here again. Look, nystagmus is almost receded completely.

So just with two steps of the upright protocol, we understood, which was the type, the canal, and the type of nystagmus. And we performed directly the reposition maneuver. Of course, there are other steps in the minimum stimulus strategies, the sit and supine positioning test. So only bringing the patient from the upright position to the supine position to see which nystagmus appears. And of course, if it's a geotropic form, nystagmus will go on the opposite side.

If it's an apogeotropic form, nystagmus will go toward the fixed side. These are the so called secondary signs of lateralization, as Dr. Califano used to name this kind of signs. But actually, if we had a chance to perform the upright protocol with the head pitch test, and with the upright head roll test, usually we do not need to go to the sitting supine positioning test. Of course, sometimes we do not have all the key signs in the upright position, so we need to go with the supine positioning test. There are other secondary sign of lateralization, like the neutral point in the vertical plane, the neutral point, the horizontal plane. The latency test that has been introduced recently.

But usually we do not need to rely on this test if we perform comfortably the applied head roll test. So this was our first paper in 2019 only with it was a prospective preliminary study with 12 patients. And we want to compare the upright protocol with the three step complete battery, with the upright protocol, with the sitting supine positioning test, and finally the supine head roll test, that is the supine head roll test, the Pagnini-McClure maneuver. And these are the results. The results. I will rapidly go to the results that the applied protocol was effective as the complete protocol in all the patients. So there was 100% of diagnostic accuracy. We can see that pseudo-spontaneous nystagmus was detected in half of patients, while the head pitch test could be detected not in all the patients, but the applied head roll test was detected almost in all patients.

So it was highly effective. In 2020, so basically, three years ago, we concluded a multicentric study with the upright protocol. We collected 134 patients with horizontal canal BPPV. There are a lot of colleagues that you for sure know, like the group of Florence, like Dr. Pecci, Beatrice Giannoni, Vincenzo Marcelli from Naples, Scarpa from Naples, and other friends, Eric Armato. So we collected a lot of patients. And in all these patients, we divided the patients according to the onset time. So the extremely acute patients, those patients who had symptoms since a few days, patients with symptoms from two days and seven days, and patients, let's say chronic patients, patients who started to have symptoms more than seven days before.

And we perform the upright protocol. So pseudo-spontaneous nystagmus, head pitch test, upright head roll test we perform in all this patient, we also measure the supine protocol, let's say just the sit and supine position, the sit and supine positioning test, and the supine head roll test. So we collected also the data coming only from this supine protocol. And of course, we compared all these two types protocol with a three step battery. So the complete diagnostic protocol with the upright protocol and the supine protocol together. And we found that the color diagnosis with the upright protocol was very, very high, almost 96%, and almost complete concordance between the upright protocol and the complete diagnostic protocol, including upright and supine tests.

So there was no difference according to onset time. So even patients with symptoms that occurred more than seven days before were positive, this protocol. So their protocol was effective even if either had the head pitch test or the upright head roll test, or both gave incomplete results. And this is quite interesting, because if we do not have on both positioning signs, or if we do not have signs in both backward and backward and forward head pitch test, we can achieve the diagnosis as well. So just to conclude, the minimum stimulus strategy for the horizontal canal BPPV, we can say

that there's a minimum discomfort for the patient because we do not need to rely on the supine head roll test.

That leads to strong nystagmus with usually stronger autonomic symptoms. Only one nystagmus on both planes. So only one nystagmus on the wall plane, only one nystagmus on the pitch plane are enough for the diagnosis. Of course, it does not allow to clearly recognize the paroxysm of an nystagmus. So if we have an apogeotropic form, we'll not be sure that it's a cupulolithiasis or canalolithiasis. Of course we cannot know if it's a heavy cupula. Of course, there are some patients who do not have lithiasis, but who have heavy cupula for other kind of disease. Some patients with Meniere's disease develop heavy cupula. Some patients with migraine develop direction changing nystagmus that can be ascribed to the heavy cupula of the horizontal canal.

Of course, with this kind of algorithm, we cannot know if it's heavy cupula, cupulolithiasis or canalolithiasis. We can just know if it's geotropic or apogeotropic form. And we will see. A few comments on a minimum stimulus strategy for the posture canal BPPV. There is very few literature about this topic, at least until last year. I think in the last year probably there have been published a paper from a Spanish group of professor Eduardo and Martin Sans about the head pitch test for the vertical canal BPPV. But there are a few papers about this, and actually they say that the head pitch test might be useful also for the posterior canal BPPV, because if we have vertical torsion on the nystagmus, usually if we upward, then the head will have an up beating nystagmus, and if we bend the head forward, we will have a downbeat nystagmus because it's basically excitation of the posterior canal when we backward head bend the head.

And if we bend the head forward, we will have an inhibition of nystagmus because an inhibition of the posterior canal because otoliths go toward the ampulla of the posterior

canal. But they both say that a head pitch test could be suited to remove debris in the factory canal. So modifying the discharge activity of the posterior canal reference depending on ampular bending. But both posterior canal lie in a plane that is approximately 45 degrees to the mid sagittal plane. So head rotation along the pitch plane seem not to represent the most appropriate movements to shift debris longitudinally through the lumen of the posterior canal. So the use of gravitational, of the slow gravitational force with bendings along a plane, that it's an offset plane with respect to the posterior canal plane, probably explain why some patients do not have a positive head pitch test.

So why the sole head pitch test only achieve a correct diagnosis in nearly 75% of patients. I just mentioned these papers from colleagues from South America who use actually an abbreviated Dix-Hallpike maneuver. But actually it was not conceived for otoneurologists. It was just conceived for a general practitioner who want to perform some diagnostic maneuver in patients with vertigo. And to understand if it's a posterior canal, they suggest to use an abbreviated diagnostic maneuver in the seated position with a chair. And they also design a kind of repositioning maneuver, a kind of abbreviated Epley maneuver from the sitting position. But actually it was not conceived for patients, for skilled clinicians in otoneurology. So it's not an nystagmus based approach.

It was just maneuvers for general practitioners. Let's have a look. Let's have a look. This is a patient with the right posterior canal BPPV. Here is Salvo. Salvo performing forward head bending. And in forward head bending, you can see otoconia here. In forward head bending, nothing happens. You can see here that eyes are still, eyes are not moving. But if he performs a diagonal head bending, after a few latency, you can see that slide upbeat nystagmus, actually not that slide. A clear torsional nystagmus with right torsional component, up beating right torsional component appears, so this

is of course a right beating, right posterior canal BPPV. Of course he needs to perform a diagnostic Dix-Hallpike maneuver to perform consequently Epley maneuver.

Of course, it might be due also to an inhibition of left anterior canal afferents. But of course we know that anterior canal BPPV is actually anecdotal, is rare, much more rare. So we know that if we have this kind of nystagmus and the head pitch test in the upright protocol, we will have the chance to detect a posterior canal BPPV. It will be more likely to have posterior canal BPPV than an anterior canal BPPV. Another case of left posterior canal BPPV. Look left posterior canal BPPV. There is a slight down beat nystagmus with right torsional component. Why? Because now otoconia are going toward, otoconia are going toward the ampullas where they are inhibiting the afferents of the posterior canal.

So we have a downbeat right torsional nystagmus. But if we put the patient in the head pitch test backward, we are still in the pitch plane. Now we have a left torsional component with upbeat nystagmus. Upbeat nystagmus with the left torsional component. So we have the confirmation that it's a left posterior canal BPPV. And then we can proceed. If you want to keep the patient in the sitting position, we can directly proceed with the Semont maneuver that confirms the posterior canal BPPV on the left side and we can directly proceed with Semont maneuver. With the Semont repositioning maneuver. But sometimes we cannot have. We might not have nystagmus in head pitch test. Look at this patient.

Look at this patient with the forward head bending, no nystagmus. Probably otoconia are here. But this kind of movements that is in an offset plane with respect to the posterior canal is not enough to move otoconia. I do not have details of this lady. I do not have details on the time from the beginning of the symptoms. Probably it was not new. It was a late onset BPPV. So I am performing an upright head roll test along the right anterior left posterior plane. So RALP plane. Nothing happens. RALP test, upright

RALP test negative. But if I turn the head toward the right side and I perform the LARP test. Upright LARP test. You can see now a tiny nystagmus going down.

Down beating nystagmus over the left with torsional component. And if you go back, oh, we can finally detect an up beating nystagmus with a right torsional component due to an excitation of the posterior canal afferents, because otoconia were going away from the ampulla, like here. And now we have the confirmation with the Dix-Hallpike test. Another patient, similar. In forward head bending, nothing happens. In backward head bending, in a few minutes, in a few seconds, I perform the head bending, the backward head bending, and you can see no clear nystagmus is detected, probably otoconia. Actually, there's a slight up beating nystagmus but I cannot be sure to understand which is the torsional component. So I need to enhance the sensitivity of this test, rotating the head toward one side and over the other side.

So with the upright RALP test and upright LARP test. We are now testing right posterior canal and left anterior canal. And nothing happens. We are shifting the head along the right posterior and left anterior. Nothing happens. Now we are shifting the head along the right anterior and left posterior. And now you can see that there is a tiny down beat nystagmus with right torsional component. And now there's a torsional nystagmus. There is a up beating nystagmus with the left torsional component. Okay, now we have the diagnosis, so we can go with the repositioning maneuver for the left posterior canal BPPV. So if we have a history consistent with posterior canal BPPV, we can perform, as we said, a head pitch test.

If we are able to identify the affected side of posterior canal BPPV, we can directly proceed with the repositioning maneuver. If we do not detect the effective side with the head pitch test, we can perform movements along the plane of the posterior canal with the upright RALP and upright LARP test. So if we identify the affected canal, we can perform, we can directly go through the repositioning maneuver. If we do not identify,

of course, we need to perform both Dix-Hallpike tests, of course. And this is the upright protocol for the posterior canal BPPV. And this is our paper two years ago. It was a prospective, multicentric study. We included other colleagues from Italy. And also in this case, we divided patients, we divided the courts in three groups, the early stage BPPV, the acute BPPV, when the symptoms from two days to seven days, and let's say the chronic stage of BPPV, when the patients already had symptoms that begun more than seven days before.

And we saw that the head pitch test elicited nystagmus in 92 cases, in 40 cases in both headed bendings, while in 47 cases, only in backward position. Of course, in backward position, it's much more common to have this kind of nystagmus because it leads to an excitation of nystagmus. So nystagmus is stronger, so it's much more easy to detect, strong nystagmus due to an excitation of posterior canal. And the head pitch test alone predicted a correct diagnosis more or less in 75%. So we achieved the same percentage of the literature. But if we add the upright RALP and the upright LARP tests, we were able to identify the affected side in additional 13 cases. In additional 13 cases. So it was very interesting because the upright protocol with this additional upright RALP, upright LARP test allowed a correct diagnosis in 87% of cases.

The important thing is that the diagnostic sensitivity was 100% in patients presenting within seven days from the symptoms onset, while it reduced less than 79% of patients with the patient that were examined later than seven days. So in this case, time was important, time was an important factor. And we know that of course, the intensity of positional nystagmus in BPPV depends on several factors like the critical mass and the position of canaliths. And since the otoconia mass is thought to be larger and settled in the central part of the canal in the first stage of the disease, cupular deflection should be wider in this condition. So this accounts for stronger vertical spells and stronger nystagmus, okay. So accordingly, diagnostic tests based on otoconial gravitations along the canals, due to these slight head movements that only exploit gravity, are

likely more sensitive in the acute stage of the disease, mainly if head movements are closely aligned with the canal plane.

So in the first days of the disease, when we need, when the minimum stimulus strategy is very, very useful for us, right, in this period, we might have the chance to have higher. We have higher chance to detect signs of signs of the canal affected and spare the patients, use this spine positioning, and again supine to recumbent, recumbent to supine, seated to supine, and again, again, and disabling symptoms, let's say. So therefore, the impairment of the upright protocol sensitive over time may be related to reduced cupular bendings, and weak nystagmus was due to a progressive reduction of the otoconial mass and otoconial dispersion along the membraneous duct. Of course, this is much more easy to occur as time passes from the beginning of symptoms.

You can see here patient with a long lasting right posterior canal BPPV. Of course, we are doing all upright test to understand if there is something going on. But as you will see, there is no detectable nystagmus. And this is not because she does not have BPPV. This is not because I'm not performing the maneuver in the core plane, because as you can see here, I'm performing the maneuver along the left posterior right anterior, so the yaw plane and nothing happens. Nothing happens in both positions, in both backward and forward head bending. And you will see that also in the LARP, left anterior right posterior plane, nothing will happen. So it means that probably otoconia are a little bit dispersed along the canal and they do not achieve the critical mass to lead to endolymphatic flows that lead to detectable nystagmus.

And this is a matter of time, of course. So this kind of treatment in this kind of algorithm is highly sensitive in the first stage of the disease, in particular for the posterior canal. As I showed you, according to our data, there is no matter of time for horizontal canal, probably horizontal canal, in horizontal canal otoconia are more free to move than posterior canal, probably. But as you can see here, there is no nystagmus on a head

roll test. But if we perform a diagnostic maneuver, the traditional diagnostic maneuver, this is a Dix-Hallpike maneuver, we can see here that there's a typical right posterior canal BPPV. So this is important thing to remember, this applied head roll test, using just the, sorry, the applied protocol, using only gravity is highly effective in the first stage of the disease.

Another important thing to remember is that if we use this test, if we use this test, we might be in front of a typical case. Look, this girl with this lady with right posterior canal BPPV. There is nothing going on in head pitch test, with the head pitch test. Forward and backward head bending. Now we will go to with the upright RALP test. So nothing is going on on the forward bending. Nothing is going on in the backward bending along the plane of the left posterior canal. But if we go through the applied LARP test, we can see a tiny down beating nystagmus in forward head bending, like an inhibition of the right posterior afferents slides.

Actually it was very slight, but now it's very clear with backward head bending. You can see here a strong nystagmus due to an excitation of the posterior canal reference. So it's typical posterior canal BPPV. And sometimes if we directly proceed with the diagnostic maneuver, the Dix-Hallpike maneuver, when we had this strong nystagmus in the head pitch, in the head protocol, you can see here that the patient had a strong nystagmus. So in this case, she was nervous to vomit as well. But if we had this kind of strong nystagmus, we might not detect a typical paroxysmal nystagmus, and been paroxysmal nystagmus, probably because otoconia already went toward the utricular. Probably they are already in the non-ampullary arms.

So we had a tiny downbeat nystagmus. This is something that I will hate to tell you, because sometimes when we use this kind of protocol, we might not be able to detect with the typical diagnostic maneuver, the typical, a bit torsional nystagmus. So in posterior canal BPPV, minimal stimulus strategy leads to minimal discomfort for the

patient with a very high sensitivity, mainly in the acute stage. So a few words for the multicanal BPPV. Look at this patient. At this patient with trauma, post traumatic patient, look, backward head bending with LARP at the upright RALP test, Up beating nystagmus with the right torsional component. So there's for sure a right beating, right posterior canal BPPV. Look, now Pasquale goes with upright RALP test along the left posterior canal.

And look, there's also up beating nystagmus with left torsional components. So probably, actually, for sure this lady has a multicanal BPPV. And actually it's very useful to know from the beginning if we have just one canal affected or both canal affected, because we'll need to understand if we perform diagnostic maneuver and repositioning maneuver. We are happy to understand if there are more than one canal affected, because we will be able to better clarify the nystagmus that we will face when we perform a repositioning maneuver. Look, this is another lady with multicanal BPPV. Look, in upward head bending with the head pitch test, there's probably a tiny upbeat nystagmus with the left torsional component. Probably. It's not easy to understand.

But probably I understood that there's something going wrong here. Then we confirm that there's a left posterior canal BPPV with the upright RALP test. Okay, now tiny down beat nystagmus with the right torsional component because it's inhibiting the left posterior canal reference. Now there's up beat nystagmus with the left torsional component because now we are exciting. Now otoconia are going away from the posterior canal cupula. So they are exciting the posterior canal, the left posterior canal, so we confirm that there's a posterior canal BPPV. Okay. And we perform an upright RALP test. And then we want to check also the other side. Look there's a tiny downbeat, nystagmus with left torsional component. And now there's a stronger nystagmus with right torsional component.

So we are in front of a bilateral posterior canal BPPV, and it's important to know if this lady has a bilateral posterior canal BPPV, because probably it's better to perform Semont maneuver. Semont maneuver only exploit the plane of the factory canal. So if we want to perform, if we want to treat the right posterior canal without moving otoconia on the left posterior canal, it's better to use Semont maneuver, because Semont maneuver is only through the plane of the right posterior canal. Of the posterior canal affected. If we used airplane maneuver, we probably move also the otoconia on the other side. And look, now there's a liberatory nystagmus. So we are moving only otoconia in the right posterior canal.

Nothing is going on on the left posterior canal. And it's good because she has both posterior canal affected. So the next time we will perform a Semont maneuver on the other side, we will check the right side, and we'll perform also Semont maneuver in the left side. So this is good because we are just moving otoconia in the posterior canal that we're testing. This is another lady with multicanal BPPV. Let's have a look. Downward, forward, head pitch test. Probably there is a tiny left beating nystagmus, probably. Head pitch test backward, there's a right beating nystagmus. So probably there's a horizontal canal BPPV in this lady. Probably it might be left horizontal canal BPPV or right horizontal canal BPPV.

Left in geotropic form or right in apogeotropic form. Okay, let's have a look in upright head roll test. Upright head roll test gives, along the role plane, gives. There was a tiny geotropic nystagmus. So probably there's a left geotropic BPPV. Left geotropic, horizontal canal BPPV. But I want to be sure that she does not have posterior canal BPPV. But actually she has. Look, there's a tiny downbeat, nystagmus with right torsional components. And here there's stronger, upbeat nystagmus with left beating torsional components. So probably she has horizontal canal and posterior canal BPPV on the same side. I will rapidly go with the diagnostic test. We said before that she likely had left beating horizontal canal BPPV in geotropic form.

In fact, she has a horizontal geotropic BPPV. And now I'm just performing some maneuver to be sure that it was a right, left horizontal BPPV. And actually she has both sides geotropic horizontal canal. But as you could see, there was not a great difference between the right and the left side. So the upright protocol was very important, was highly important to understand that there was a left horizontal canal BPPV. And now we also have the confirmation that she has also left posterior canal BPPV. The last case, it was an interesting case, because this man had a typical horizontal canal BPPV. Look, there's a strong horizontal nystagmus toward the left. So probably there's a right horizontal canal BPPV in geotropic form, or a left horizontal canal BPPV in apogeotropic form, we will see, we will see later.

Okay. So it reverses, so right geotropic or left apogeotropic. So we can perform upright head roll test, and you can see here, okay, it's geotropic, it's geotropic. We have the confirmation here that it's geotropic, great. So we do not need to perform supine head roll test, okay. So this person, this man has a geotropic horizontal canal BPPV of the right side. So this is the cartoon of what we made to understand which is the diagnosis. So we perform immediately the Gufoni maneuver. But look what happens. Look what happens. During Gufoni maneuver probably, I made some mistakes with the planes, and we can see here some torsional component, sudden torsional component. Look, the patient is, look, there is a torsional component over the right, so probably I made some mistakes during the maneuver.

This is what I imagine, during the maneuver, I made these mistakes, and probably otoconia fell here in the short arm of the posterior canal. And look, I use the upright head roll test to have a confirmation that otoconia went in the short arm of the right posterior canal. So probably they attached to the utricular side of the posterior canal ampulla, so they did not fell in the utricular macula, but they went away, they went toward the posterior canal cupula of the same side, of course. And later I confirmed

that it's a cupulolithiasis of the posterior canal, but it was not from the beginning. It was iatrogenic. It was due to my incorrect treatment strategy. And you can see here, persistent, a bit right torsional nystagmus, consistent with right posterior canal BPPV.

So I rapidly go to the ending of this talk. I would like to thank, of course, Professor Asprella, but in particular my friends Salvo Martellucci and Pasquale Malara, who made this kind of talk with me. I would say, and I would like to thank all of you for your kind attention, and I will immediately go to read the questions. Okay, so how to deal with multiple canal BPPV? Which can you treat first? How to decide? This is a question from Dr. Hitesh Patel from India. Well, probably I already answered your questions. Where there are multiple canal BPPV, I usually treat if there are both horizontal and posterior canal, usually horizontal canal gives much more stronger nystagmus and usually leads to stronger symptoms.

So I tend to prefer to treat first horizontal canal BPPV and then go with posterior canal BPPV. If there are both posterior canal BPPV, I usually ask the patient which is the more active side, the more symptomatic side. And I use these kind of questions to understand which is the most, let's say urgent side to treat. Will the slides be available to download for later reference? I think yes. This is a question I don't know from who but you can ask Inventis, and there is kind questions from my friend Kumar Vats from India, Brother Andrea reversal nystagmus on upright from posterior semicircle canalolithiasis occur in 75% of patients. What happens when patient with posterior cupulolithiasis is up-righted from Dix-Hallpike or half Dix-Hallpike position?

This is a very interesting questions, and usually in posterior canal cupulolithiasis, when you put the patient from Dix-Hallpike, in Dix-Hallpike position, you have a tiny upbeat torsional nystagmus that is persistent. This kind of nystagmus is usually much more evident when you put the patient in half Dix-Hallpike position, as you carefully said. Because in this position the cupula is perpendicular, sorry, is parallel, is perpendicular

to the gravity, is perpendicular to the gravity. So if there are otoconia tests, the cupula will be bent more. So nystagmus is stronger in half Dix-Hallpike position. Usually when you put the patient in the opposite side, especially with the nose down in the opposite side, this kind of nystagmus reverse.

When you put the patient upright, I do not see a lot of nystagmus in most patients, but I really would be happy to talk with you about this topic because I know that you published several papers on this posterior canal BPPV, and as you probably remember, I already told that I had similar cases. So I would be very happy to share my opinion with you and share my cases with you. So another question, how to deal with, okay. Have you studied the nystagmus strength difference between the minimum strategy and the traditional diagnostic maneuvers? This is a question from Ismail Aran Tapia. No, we didn't study this, but I thank you for this question because it's an important topic.

With the upright BPPV protocol, we do not need to study the difference. There is no need to study the difference between nystagmus from one side and nystagmus from the other side in terms of intensity. We just need to understand if nystagmus goes on one way or in the other way. So we just need to have information about the geotropism. So with the head pitch test and the upright head roll test, we just want to understand the direction of the nystagmus. We do not measure the intensity, because if we measure the intensity, if we wanted to measure the intensity, we have to be sure that every movements that we made, that we made should be the same because we cannot measure the difference in intensity of nystagmus.

If we perform just from this position, 35 degrees forward, and then we perform 75 degrees backward, because if we want to compare the intensity, we need to use comparable stimuli. With this protocol, we just want to understand the direction of nystagmus. So we never rely on the stronger nystagmus, let's say, to understand which

is the affected side or which is the other side. We always want to match the data from the head pitch test and the upright head roll test, matching the data irrespective to the amplitude of nystagmus. We almost always achieve a correct diagnosis. So another question. Upper protocol seems to be helpful. Thanks for the informative session. We don't have to worry about back problems and anxiety of the patient.

Isn't it easier and effective? So this is a question from Suvaresha Peldaria Yes, thank you for your comments. You mean back problems and anxiety of the patient, easier and effective? Yes. It's a protocol that is very useful for patient with anxiety. Patients who do not, are not very happy to perform a continuous seated and supine positioning. I'm not sure to understand well, but back problems. You mean problem for the back, from the back? No. You mean for the neck? No. Because if some person, especially old person, elderly patient, have neck stiffness, we do not need to flex the head or the neck. We can flex all the trunk a little bit more or less backward and forward to achieve a correct angle with the gravity vector.

So in our opinion, this is very effective, especially for those patients who do not in the first stage of the disease and the patient who do not accept to perform several maneuvers to understand which is the diagnosis. Is heavy cupula an otoconia? Yes, exactly. Well, let's say heavy cupula. Okay, cupulolithiasis might be due to, sorry, cupulolithiasis might lead to heavy cupula of course. But in this case it's not called heavy cupula, it's called cupulolithiasis. In cases, in no otoconial cases, we might have symptoms and findings consistent with heavy cupula that it's not due to otoconia. Because if all heavy cupula are otoconia, we always should transform a heavy cupula to a canalolithiasis, because at least in those patients with otoconia that are settled, that are attached in the canal side of the canal cupula.

So a lot of patients do develop, in particular, I would say migraine patients, some Meniere's patients, at least from my opinion, from my experience, develops not

necessarily in acute phase, but also in intercritical phases. Some signs that are very, very, very consistent with the increased weight of the cupula, respective to the end lift. And after a few days of treatment, I would say with steroids, with Mannitol, or with other drugs, in some cases also with drugs for migraine. This kind of finding received, or rather reverse some cases from a heavy cupula, some patients develop a light cupula, that is a geotropic nystagmus with persistent course. So there are a lot of cases, but this is something that goes beyond the aim of this webinar.

Another question from my friend Maxim Situco. I'm happy to hear you. Deandre, thank you for your lecture. Thank you very much for your comments. What criteria do you use to differentiate horizontal canal cupulolithiasis and horizontal canal short term canalolithiasis? Regards, Maxim. Well, it's a tricky question. It's a tricky question because usually cupulolithiasis of the horizontal canal leads to persistent direction changing apogeotropic nystagmus. Horizontal canal, short term canalolithiasis, I think you mean short term. If you mean ampullary arm, it leads to paroxysmal positional nystagmus. That's usually with reverse Gufoni maneuver or the Pagnini maneuver or with the Zuma maneuver. Switch immediately, switch to geotropic form. But if you mean with short arm, the retract of the canal that goes from the cupula to the utricle in this case is very, very, very hard.

It's very hard. Probably you need maneuver, impulsive maneuver to transform in a way to see what happens. If you transform that cupulolithiasis in a canalolithiasis, it means that otoconia were settled in the canal part of the horizontal canal. If you achieve receding nystagmus, probably otoconia were settled in the other part, in the other side of the cupula of the horizontal canal. So probably it was a short term canalolithiasis. Probably we transformed in a short term canalolithiasis. But actually, I'm not sure I have an answer for your question. Another question from Ricardo Marte. Do you also recommend to perform the protocol without visual fixation? Well, it's better to perform

it without, with visual fixation because as you saw, most of these nystagmus are tiny nystagmus.

And if the patients do not have a video Frenzel at least, or you can also use typical Frenzel goggles, but you need to eliminate fixation, because if the patient fixates, probably some tiny nystagmus will be suppressed. Another question from our friend Kumar Vats. I'm remembering. Okay, I will still come up with an interesting case on this topic. I'm very happy that you will discuss about this topic. Another paper. Very nice use of a presentation. Dr. Ramesh Rawiwal from India. Thank you very much for your nice comments. Another question from Sudhir Kotari. Professor Kotari is very happy to have you in this kind of webinar. I'm honored. Is Semont a better option to treat bilateral posterior canal BPPV in one setting?

We know that while doing Epley, the particle from the other ear might fall back. Exactly. This is a very important key point that Professor Kotari said. When we have bilateral BPPV of the posterior canal, if we perform an Epley maneuver for the right posterior canal, when we are treating, when we put the patient in the second position of the Epley maneuver, it's actually a Dix-Hallpike maneuver for the contralateral side. So we will move back and forth, especially doing the third position and bringing the patient again in the seated position, let's say the fourth position of the Epley maneuver, we will bring otoliths back and forth along the canal that we are not treating. And there are two problems.

This will complicate the treatment of the other canal because we are dispersing otoconia, or we might put otoconia in some not easy part to treat in the part that we are not treating. And the other problem is that we are not very confident to understand what's going on in the canal that we are treating. In the posterior canal that we are treating, because we are confident to understand what's going on there when we are able to interpret the eye movements. We know that if we bring the patient from the first

position of the ampulla to the second position, nystagmus usually is on the same direction because otoconia needs to go still away from the afferents from the ampulla.

And then when we are in nose down position, sometime we have a downbeat nystagmus with ipsilesional torsional component because probably we are exciting the back with the anterior canal. So we have a lot of signs that are giving us information that we are treating properly the right posterior canal, the canal that we are treating. But if we have a concomitant posterior canal BPPV on the other side, there will be a mess. So in this kind of patient, I usually perform Semont maneuver that we are only exploiting the plane of the canal. So it's a very important topic and I thank Professor Katari for reminding this. Does this protocol have limitation in cervical problems? This is another nice question.

No, it does not have limitation in the cervical problem because we might have the chance. I would say we must slightly bend the whole trunk of the patient backward and forward during the head pitch test or toward on one side or the other side during the upright head roll test. So if the patient, elderly patients, patients with a recent head trauma or neck trauma, slightly bending the whole trunk from one side to the other side and we will have the same sensitivity. If, another question from Suresh Thontadarya, if patient already has back problem and neck problems, still this protocol but can be done easily? Yes, exactly. This is exactly the question, the answer to your question.

Thanks for the clarification. Thank you. Thank you doctor for your nice comments. Is there a reason for reversal of nystagmus when we place patient in Dix-Hallpike position after Epley maneuver treatment? Yes, the reason is that, this is a question from Jana Kubesova Yes, Jana, the reason is that, you mean when we treat a patient with Epley, a typical right posterior canal BPPV, we treat the patient for a right posterior canal BPPV? When we perform a Dix-Hallpike again to check. I think you mean this. When we check the Dix-Hallpike, we do not see a typical upbeat nystagmus with a right

torsional component if we are treating the right side, but we usually detect a downbeat nystagmus, with the slight left torsional component.

This is because with that Epley maneuver we made otoconia going from the ampulla. So we removed otoconia until the non-ampullary arm of the posterior canal. But usually with the Epley maneuver we should be able to replace otoconia in the utricle. But sometimes it's not possible just with one maneuver. So if we check, and it's very, very common. If we check, I usually do this. If we check in the same session, in the same examination, the patient again after performing an Epley maneuver, we check again with a Dix-Hallpike maneuver, we usually have the chance to see that some otoconia are still in the posterior canal, but in the non-ampullary arm of the canal. And so we will have a downbeat nystagmus.

And this is, I would say, the confirmation that most of the BPPV with positional downbeat nystagmus are due to apogeotropic, so posterior canal BPPV. It means that most of these cases are due to otoconia that are slightly entrapped in the narrow portion, probably of the non-ampullary arm of the posterior canal before falling in the utricle eventually. So this is quite common. And I would suggest you to perform again an Epley maneuver with slight vibration, with impulsive maneuver like Semont maneuver, or with a quick liberatory repositioning maneuver, rotation maneuver made by Professor Califano. There are a lot of maneuver that use impulsive, rather than Epley, they use mainly gravity. And most of these cases, at the third time you check, you do not see anything more.

So this time we'll see it. So I think I answered all the questions. I'm not sure if Anna is still online.

- Never moved, absolutely. Andrea, very inspiring presentation. So thank you so much for delivering such an engaging presentation, and I'm pretty sure that we all relish this

learning experience. Thank you so much. So quick note for the audience. If you are intrigued by today's topic, I'd like to mention that on Audiology Online, Inventis partner page, you can find an interview with Dr. Castellucci in which Andrea discusses the minimum stimulus strategies for the diagnosis of BPPV. Then we will be seeing more of Andrea soon as he takes the spotlight in an exciting upcoming webinar I have organized for the fall. Complete and incomplete canalith jam diagnosis of a typical variance of BPPV and the key rules of video head impulse test.

One more thing, don't forget, please mark your calendars for March 6. Dr. Vishal Pawar from Dubai takes the stage to lead the seminar Fundamentals of Videonystagmography. This is just the kickoff to a series of three sessions that Dr. Pawar will be managed for academia. So thank you so much, Andrea, one more time. See you soon.

- Thank you very much, Anna.

- Thank you. Thank you so much for your participation. Have a wonderful rest of the day. And until next time, bye bye.

- Thank you very much. Bye everyone.