Glaucoma Chats

Glaucoma Explained: Types, Risk Factors, and Treatments
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Transcript of teleconference with Dr. Jaehong Han, Kaiser Permanente Ontario Medical Center, California

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Please note: This Chat has been edited for clarity and brevity.

MS. SARAH DISANDRO: Hello, and welcome to today's Glaucoma Chat, "Glaucoma Explained: Types, Risk Factors, and Treatments." My name is Sarah DiSandro, and on behalf of BrightFocus Foundation, I am pleased to be here with you today, during Glaucoma Awareness Month, as we talk about the different types of glaucoma, including open angle, angle closure, normal tension, and more. We'll also be discussing who is most affected by each type and how treatments vary.

Our Glaucoma Chats are a monthly program, in partnership with the American Glaucoma Society, designed to provide people living with glaucoma and the family and friends who support them with information straight from the experts. All Glaucoma Chats presented by BrightFocus Foundation are also available to listen to as podcasts on the go on YouTube, Spotify, iHeartRadio, Amazon Music, Apple Podcasts, and Pandora.

BrightFocus Foundation's National Glaucoma Research Program is one of the world's leading nonprofit funders of glaucoma research and has supported nearly $51 million in scientific grants exploring the root causes, prevention strategies, and treatments to end this sight-stealing disease. National Glaucoma Research is currently supporting 38 active research projects across the globe.

Now, I would like to introduce today's guest speaker. Dr. Jaehong Han is a glaucoma specialist at Kaiser Permanente Medical Center in Ontario, California. As a member of the Patient Engagement Committee in the American Glaucoma Society, he is passionate about empowering patients through education and clear communication. Welcome, Dr. Han.

DR. JAEHONG HAN: Hello. I'm happy to be here today.

MS. SARAH DISANDRO: Great. Well, we're very happy to have you. Okay, so in order to set the stage for our deep dive into the various types of glaucoma, could you begin by explaining the parts and inner workings of the eye and how these areas are affected by glaucoma?

DR. JAEHONG HAN: Sure. First of all, I want to say that, clearly, today's topic is talking about how something doesn't work properly. But today, I want to emphasize how something works in the first place and, hopefully, help develop some intuition and make it interesting for patients to know and, you know, these are things that are difficult to do in the clinic with the time constraints that we have. So, first of all, I want to talk about what the optic nerve is and how that's involved in glaucoma. I want to get started by saying that our eyeballs are size like a cherry or like a quarter, a coin. And inside the eyeball is actually mostly filled with water-based jelly, and it's not even a living tissue. And its job is just to let the light in. And the light sensors in the eyes ... it's not like a little dot that just sees everything. Imagine that you're inside the room of the eyeball and you're looking at the wall inside. And light sensors are like the wallpaper that essentially is all the way around the room of the eyeball, kind of like a very thin wallpaper. And there are actually, like, 100 million light sensors in the eye, each of them giving you that pixel of your vision. And then hundreds of light sensors work together to form a connection that connects to the brain. And each of those connections is called axon. We have 1 million

axons that form together in a bundle that comes out of the eyeball and goes all the way to the back of the brain, and we call that optic nerve. And that's of interest to us because glaucoma is essentially a condition that specifically causes damage to this optic nerve.

And just to make it interesting, I want to share two interesting facts about the optic nerve. So, first, it's the fact that the optic nerve is actually only responsible for giving vision data. That means no pain, no touch. So, for example, inside the eyeball, as I mentioned before, is filled with this water-based jelly, and sometimes it can move around. And sometimes it can touch the light sensors inside. So, when that happens, people don't feel the jelly touching the light sensors, but that can activate the light sensors. Some people see these flashing lights. And that's, again, because of this phenomenon. But also, because of this, when we develop glaucoma and if there's any damage to the optic nerve, generally there's no damage. That's why we can lose vision but have this happen slowly and without any warning.

And another interesting fact—the second one—is that because there are 1 million connections inside the optic nerve, and it's not just one thing, a lot of the connections are redundant. What that means is that if you start with 1 million and you lose 100,000 of these connections, that might not actually cause you to lose any actual vision. And this is because our brain and the light sensors are pretty flexible, so even with fewer connections, it's able to adapt with the processing. So, it's stated that maybe it's even possible to lose 40 percent of your connections in your optic nerve but still might even have normal functioning vision.

But if you go see the doctor about glaucoma, we generally just focus on the eye pressure and not the optic nerve. And that's for two reasons. First reason is because eye pressure seems to be the cause, meaning that if you have high eye pressure, that seems to cause more optic nerve damage, and so, of course, it's good to focus on stopping the cause, if possible. But the second reason is that with current science, there's nothing we can really do to heal any optic nerve damage or to strengthen the optic nerve directly. So, that was, kind of, the background I wanted to give before we focus on the eye pressure itself.

MS. SARAH DISANDRO: Great. Fantastic. Thank you so much. I had no idea there were actually 1 million different connections in the eye that can have an effect on glaucoma. Well, next, can you please give us an overview of, really, what goes wrong in the eye that causes that glaucoma? Can you start to talk to us about the different types of glaucoma and what causes each of these types?

DR. JAEHONG HAN: Yeah. So, as I mentioned before, I want to talk more about exactly how things work and then how they stopped working well.

MS. SARAH DISANDRO: Right. Okay.

DR. JAEHONG HAN: And in this instance, really, we need to understand about exactly how eye pressure works, so I want to take a moment to talk about exactly what this is because it's actually pretty complicated in some ways, so I want to spend some time explaining it.

MS. SARAH DISANDRO: Wonderful.

DR. JAEHONG HAN: Eye pressure is essentially talking about a plumbing problem. So, inside our eyeball, there's a water tank filled with water. And it's not like a pond or lake where old water just sits there, this is like a river, meaning that new water comes in and old water goes out. And it's important that this flows well and there's no backup of the water flow, which can cause too much water to be left inside the water tank. But before that, I want to share two interesting facts about this issue, just to make it, again, more intuitive and interesting. First interesting fact: I mentioned before that our eyeballs usually are sized like a cherry or quarter, but this water tank that we're talking about is actually really tiny. It's only the size like a raisin. It's at the front of the eyeball, but this small space is all it takes to create this eye pressure problem and cause glaucoma.

And the second interesting fact is that the water that's filling up the water tank isn't actually like normal water. It's actually filtered blood. So, to understand this, it's helpful to know why we have filtered blood in this water tank. And this is mostly because our eyeball in its job at the front is to let the light in and focus the light. That means all the windows have

to be clear, meaning that there's no actual blood vessels to supply the nutrients. We're talking about cornea, which is like the windshield of our eyeball that we can touch with our finger, and then the lens, which is actually inside the room of the eyeball. Its job is also to let the light in, but also to focus the light so that the right light can be focused to the light sensors inside. And these clear structures need nutrients, but also the waste has to be removed. And they're constantly working, so they constantly need this to happen. But imagine if your eyeball was filled with red blood, then we wouldn't be able to see at all, so that's why this system exists.

Also, the reason why this room is so tiny is, again, because the rest of the eyeball is filled with this clear, water-based jelly called vitreous. And that part is made of, pretty much, nonliving tissue, so that part of the eyeball doesn't have much of any circulation. And what's cool about this filtered blood is that our eyeball, this water tank called "anterior chamber" is not the only place that has this phenomenon. Another place in our body is actually surrounding our brain and our spinal cord. These parts of our body are also surrounded by filtered blood, so clear fluid there, just like our eyes. And it's thought that maybe in that space, it just helps with making an optimal condition for the electrical signaling. But also, what's interesting is this space around the brain and the spinal cord can also have the same pressure problem, kind of like glaucoma around the brain. So, these things can happen in different parts of our bodies.

That said, I want to talk about exactly how this water tank works in our eyes. So to understand this situation, it's helpful to know how this room inside the eye, the size of a raisin, is structured. So, imagine that there is the dome ceiling, so it's like a dome, like an upside-down bowl. And again, this is the cornea; this is where the light comes in. And imagine that the floor of this room is also clear, but this is the lens, the clear window that focuses the light. So, what's really important to understand is that in this room, in the middle of the room, there is what's called lens shutter. We call that iris. So, this lens shutter is really important to understand, and this is what causes a lot of problems, so this is important to try to have some intuition. The lens shutter is what opens and closes to adjust the light coming in. For instance, if it's really bright outside, then the hole in the

middle will become smaller so less light goes into the eyeball. And if it's kind of dark outside, the hole will open up. So, it adjusts the light coming in with the hole in the middle. And this structure is what gives the color to your eyes. You know, some people have brown eyes, green eyes, blue eyes, and so on. Imagine this room with the dome ceiling and the floor, and in the middle is a lens shutter.

There's a lower part of the room and upper part of the room divided by the lens shutter. In the lower part of the room, all the way around the wall in a circular fashion like a ring, is where the water comes in. So this is where the blood becomes, you know, clear fluid. Then, it's important to know how the water flows in the first place. So again, in the lower part of the room, all the way around the wall, so it's not like there's one faucet that just brings the fluid in. It's all the way around the walls. It's like a ring. That's where clear fluid comes into the lower room. And then this water—clear fluid—has to go through the central opening through the lens shutter and then go to the upper part of the room. Now in the upper part of the room, all the way around the wall, again, in a ring fashion, is where the drain is located—essentially, like a gutter. And so, that's where the clear fluid has to leave, accessing this drain. And this is how the flow of the water works inside this room. And so, in a normal fashion, water comes in, water goes out through this room, constantly supplying nutrients to the lens and the cornea, and nothing bad happens. That's our normal anatomy and physiology.

Now glaucoma, with eye pressure, we're essentially talking about something bad happening plumbing-wise, where the water has problems flowing out of this system. So, this is where the whole classification of glaucoma comes into place. You know, is it open? Is it closed? And we say open angle, closed angle. So, let's talk about this word "angle" for a moment. Why even use the word angle? Let's go back to this room. And I mentioned that the ceiling, which is cornea, is like a dome, so imagine looking at the angle between that lens shutter and the dome. It's not like our typical box-shaped room where everything is 90 degrees. It's a dome, so there's an angle, like 30 degrees, 45 degrees. But essentially, this angle is looking at how tight this space is. So, to go back to the classification, open angle means that when that water comes out from the lower room

and goes through the middle hole through the lens shutter and goes to the drain all the way around, that whole journey has no problem. Water has no problem getting to the drain, but somehow the drain is not draining well.

That's what open-angle glaucoma means: Water has no problem getting to the drain, and there's plenty of space for the water to get to the drain—so open angle—but it's not draining. And there can be many, many causes for this. Typically, we call it primary open angle, which means that everything looks okay. Just looking with the microscope and everything, the drain looks good, but eye pressure is high, so it must not be draining well. Primary means we think it's just normal wear and tear. You're getting older, drain is not working—this is the typical 60 year old, 70 year old, 80 year old, who's developing this problem. Secondary means that we think that there might be some other causes that's causing this drain to not work well. And that there can be so many reasons. You could be taking certain medications, like steroids, that can make the drain not work as well. You could have history of trauma so that you potentially break it, so it doesn't work well. You could have infection, or you can have a situation where there's something, some residue that's being created from inside the eyeball, such as pigment dispersion or pseudoexfoliation, where something is clogging up that drain. That's the idea behind the open angle, but it's relatively straightforward.

But the closed angle is very hard to explain and very hard to understand. But essentially, the easy idea to think about is that instead of the drain being the problem, the problem is that that journey that I talked about, where the water comes from the lower room wall, then going through the hole through the lens shutter and getting to the drain, that journey is somehow compromised. And largely, we have to really think about the lens shutter in the middle that's causing a problem in this situation. And just to make things complicated, there are actually two ways that this problem can happen—not just one. So, let me explain. One way that there can be a problem is … okay. Think about this lens shutter, and there's a hole the middle. So, there's the inner circle of the lens shutter. So, in some cases, this inner circle can become stuck to the floor of the room. The floor is the lens, and somehow this can happen. And this is weird,

but it can happen because this lens shutter, think of it like very floppy, floppy tissue and sometimes, for some reason, this happens. And when that happens, usually it's a big problem because all of a sudden, the water coming from the lower wall of the eyeball cannot come through the middle hole because that middle hole is no longer available because the inner lens shutter got stuck onto the lens. So, that's called acute angle closure, and sometimes people use the word pupillary block because that middle hole is called pupil, so that middle hole is blocked. So, that's one way that this, kind of, problem can happen. But there's another way that angle can be closed. And again, this is why this is kind of confusing, and I want to try to make it as intuitive as possible. But another way the angle can be closed is that I mentioned that there's an inner circle of that lens shutter, but think about the outer circle of the lens shutter. So, what I'm trying to say is that the outer part of the lens shutter can actually, over time, block the drain in front of it, so that's a second way that the angle can close because of the structures in the eye. So, those are the two main ways.

Now with the angle closure, it tends to happen to patients that have smaller eyeballs with smaller room in the water tank to begin with, so these tend to be more women, Asian women, or certain ethnicities, or just patients that need high, like +3, +5—that's called hyperopia—but basically magnifying glass. These patients tend to have smaller water tanks in the eye, the room, in the first place, which makes these kinds of blockages happen more likely. But also, just to add another layer of complexity, this room is not, like, a static thing. It's a very dynamic situation. What I mean by dynamic is that, as I mentioned before, the lens shutter can open and close, so throughout the day, it can open, it can close. And depending on its configuration, that can make the blockage happen more likely. This is why when patients have close-angle glaucoma or they, at least, have risk of developing it, often we tell patients not to take any medication that might make them drowsy, like taking allergy medications, because those medications tend to open up the lens shutter, and sometimes that can make it more likely for the inner ring of the lens shutter to get stuck onto the lens. And the other dynamic thing is that, I mentioned that the floor of this room is the lens, and lens is where we can develop cataract as we all get older. When we develop cataract in the lens, not only does the lens

become cloudier like our hair color turning more gray as we get older, but this lens gets physically bigger and bigger. When that happens, that makes the room that I'm talking about smaller and smaller. So, these dynamic changes also contribute to this angle-closure glaucoma happening.

And one last thing, I understand even as I'm explaining it, I'm, kind of, thinking in the back of my mind, "It's a pretty confusing topic," but I want to talk about one thing, one interesting fact about angle closure. I mentioned earlier that, typically, when you get optic nerve damage, there's no pain. But when you have angle-closure glaucoma, especially if the eye pressure goes up suddenly and really high, then it's actually normal and expected that the patients have pain. And that's because in this situation, when the water from the lower wall of the eyeball cannot go through the middle hole of the lens shutter and is completely blocked, then because all of a sudden you went from normal drain to no drain at all, the eye pressure shoots up very high. And when the eye pressure's so high in this room, it actually causes a problem with the blood flow to the rest of the eyeball, like the lens shutter itself. And the lens shutter has a lot of blood flow in it, and it has a lot of pain receptors, a lot of nerves that actually give pain signals. So, when the lens shutter itself starts to have a problem with blood flow, then that causes severe pain. So, even though damaging the optic nerve itself doesn't cause pain, when you have very high eye pressure that happens suddenly, that can cause pain because that can cause pain in the iris, in the lens shutter, where the pain nerves are located. So, that's a nuance, but I just wanted to bring that up to the listeners.

MS. SARAH DISANDRO: Great. Thank you for explaining the different types of glaucoma in such detail. And also, as a note to our listeners, BrightFocus Foundation has discussed in detail these different types of glaucoma on previous Chats, including juvenile glaucoma, so you can definitely check out our archive for more of that information. Okay, great. So, on to our next question: How do treatments differ for each of these different types of glaucoma?

DR. JAEHONG HAN: So, typically, we think of the situation with glaucoma as having causes that we cannot really improve. If you have wear and

tear, you're getting older, and that's only something that will get worse with time, and that's not reversible. But we do focus on lowering the eye pressure. But, actually, knowing the causes can help tailor the treatment. For example, again, aging is not something we can fix right now, but if we know that the cause of the drain not working well in the open angle is, for example, using steroids, then obviously, the treatment will be to stop using steroids. In those kinds of situations, just stopping using steroids and letting them clear out of the system might be able to fix the main cause in that situation.

Now, another potential thing to think about is, again, especially with closed angle. So, in the closed angle situation, we know that there's a problem with the water flowing to the drain in the first place, so then if we think that's the main cause, then we focus on improving that situation. Usually, that's done with two approaches. One is to use the laser. This is called laser peripheral iridotomy, just basically just using the laser in the clinic to make a hole through the lens shutter. So, I mentioned that in the middle of the lens shutter is the hole, but if you make another hole through the lens shutter from the side, then what happens is even if the central hole gets all the way stuck onto the lens, because there's another hole that we made artificially with the laser, the fluid can still flow. So, that's one way to improve the situation.

But sometimes, especially if the patients are older anyways and if they have some cataract, then we often just recommend doing cataract surgery because cataract surgery, just to go back, is essentially replacing that lens that we're born with, which is inside the eyeball that's getting cloudier and that's getting bigger. So, we remove it completely, so we just take it out. It's, kind of, like if you had a really bad tooth, you remove it, but you don't just leave it empty, you put in an implant. And in the case of our eyes, our lens serves a purpose, it focuses the light. So, when we remove the cataract, we have to replace it by putting in a plastic lens implant that's tailored to each person's eye so that we can put in the power to focus the light for that eyeball. By doing this, because the lens implant is much thinner than the original lens, especially with the cataract, that can create a lot of space inside the eye. So oftentimes, even if patients don't have really bad angle closure or narrow space, oftentimes even just doing

cataract surgery can improve the plumbing and make the eye pressure lower because this can create more room in this water tank, so to speak. So, that also can help direct the treatment.

Another thing is, even though most of glaucoma tends to happen in older patients, sometimes, for whatever reason, younger patients can also develop a problem with the drain and not draining well. So, in these cases, a lot of the times focusing on improving the drain using the laser, such as selective laser trabeculoplasty, this is essentially a laser that we use in the clinic to just apply a little bit of the energy. The drain in our eyes is essentially living tissues, and the thinking is that they're just not working as well in filtering out these fluids. And the intention behind doing the SLT laser is by applying a little bit of energy that you try to make them healthier again. Some patients respond better to it, and other patients don't as well. And there's some idea that younger patients tend to do better with these kinds of treatments where we try to make these living tissues healthier again. Maybe the thinking is , if you're a really older patient and these living tissues are really old and not as healthy, then maybe it's harder to make them healthy again. So, there's some idea there.

And another thing to keep in mind is that the most important part in some ways in trying to think of the cause is to really make sure that the cause isn't because of infection or inflammation. We group the infection and inflammation together to call it uveitis. But essentially, some patients—just like how we can have viral infection or bacterial infection or other problems, like autoimmune conditions in other parts of our body—these things can happen inside the eyes, as well. And these things can directly cause a problem with the drain, or this can make it so that that lens shutter I talked about can get stuck on the lens or can get stuck upwards and cover up the drain. So in these patients, what's important is that we really want to try to avoid doing the SLT laser that I talked about before because these kinds of lasers, when done to the eyes, can cause more inflammation, and so, clearly, if the problem is inflammation, then we want to really make sure that we don't cause more inflammation. Knowing the causes, knowing why something doesn't work does really help tailor what we should consider doing and tailor to each person and each person's situation.

MS. SARAH DISANDRO: Great. Thank you so much. So, can you actually have more than one type of glaucoma at the same time? Is that possible?

DR. JAEHONG HAN: Yes. Definitely. Essentially, just stepping back, talking about these classifications makes it seem a little bit difficult to approach—you have this or that. But, again, these classifications are just pointing to what the possible causes might be, and we intuitively understand that you can break things from multiple causes. For example, you might be getting older and the drain might have some wear and tear, but if you use steroid eye drops, then now you have two reasons that the eye pressure can go up. And then you might have been involved in a car accident last month, and that can also add another layer of the situation. And on top of that, maybe you're developing cataract, and even though you didn't have a problem with the angle being narrow before, maybe because the cataract is getting bigger, maybe that's making the space inside the water tank smaller over time. So, there can be a lot of different things that can happen. Some patients may be just unlucky and have multiple causes, and other patients might have one cause. But essentially, it's important to keep an open mind and try to understand exactly what's happening and exactly what's causing the situation so that one can tailor how to fix the situation.

MS. SARAH DISANDRO: Great. So, can glaucoma run in families? I mean, if you've been diagnosed with glaucoma or if you're a glaucoma suspect, how important is it to talk to your family about your diagnosis?

DR. JAEHONG HAN: Yeah, so I like to use the analogy of thinking about cars and car parts—for example, think about brake pads or tires. We intuitively know that these things generally don't break down the first day that you drive the car and over time—50,000 miles or 100,000 miles—these things wear down and can break. But some family of cars, for instance, might have certain problems happen faster. Maybe if you drive a Tesla and they have high acceleration, then maybe the tires might wear out faster even though not right away. So you know, it's important to know these things. And similarly, in some families, the thinking is that the wear and tear of life that affects our drain and so on might happen faster in some families. It's important to know that so that you can get checked for having glaucoma.

And as I mentioned before, most glaucoma happens with pretty much silent manner because the optic nerve can get damaged with no pain, and you can lose even half of your optic nerve and you might not even have any symptoms. It's really important to be screened early on, I think, especially because you can lose a lot of optic nerve without you knowing. Now, when a patient comes later and if I see that they still don't have much of vision loss but the optic nerve looks thinner, it's hard for me as a glaucoma specialist to know if the patient actually had some damage or if this is just what the patient's optic nerve looked like because I don't have any way to compare.

What I'm getting at is, nowadays, we have a technology, imaging technology, that we use a lot—we depend on a lot. It's called OCT, optical coherence tomography. It's basically a fancy way that we can use to measure the thickness of the light sensors around your optic nerve. And so, by measuring the thickness, the thinking is that if it gets thinner then that's showing some damage. And if you know what it used to be like before, then that gives you confidence that if it is thinner from before that some damage is happening and we should do something about that. But again, if we don't know what it used to look like and just looking at the patient, then that makes that difficult to figure out. That's why a lot of the times and early on, there's question about, "Hey, I'm not sure what to call this patient. Is it mild glaucoma?"—mild means the vision is still intact, but I, as a specialist, think that there is some actual damage happening—versus glaucoma suspect. Glaucoma suspect means I don't think there's any actual damage happening at all, but I think this patient has some risk of developing this issue in the future—let's say family history or high eye pressure or just the way things look inside.

So, again, by having this information ahead of time, such as how the optic nerve looks ahead of time, this really makes the glaucoma management much easier. But also, again, once you lose parts of your optic nerve, that living tissue is gone forever. With the current technology, we don't have any ways to strengthen the optic nerve or reverse any damage, so it's really important to get checked regularly because we only know how to prevent things from happening.

MS. SARAH DISANDRO: Exactly. And I loved your car analogy. I really think that's something so many people can relate to. Okay, so we have two questions from listeners about normal tension glaucoma. First question is, "How would you know if you have normal tension glaucoma?" And the second question we received is, "Is normal tension glaucoma harder to diagnose?"

DR. JAEHONG HAN: Yeah, so, glaucoma is, again, one of those conditions that is just very difficult for patients to really know. So, you wouldn't really know if you have glaucoma normal tension or other kinds of glaucoma as a patient. It's really difficult to know, and it's a very vulnerable situation to be in. Regardless of whether it's normal or not, I think you depend on the doctors and the testing to see what kind of glaucoma and how well it's doing. That said, normal tension glaucoma is a tricky one. Basically what normal tension glaucoma is hinting at is that everything about the situation seems to suggest glaucoma, but actually the eye pressure is not high. So, that's what normal tension glaucoma is hinting at. And just like how glaucoma is essentially including so many different causes all into one pile, this normal tension also can include many different kinds of situations. For instance, we check the eye pressure for each patient very episodically, meaning that we check maybe one time and then 3 months later check again. And at that time, the eye pressure may have been normal, but who knows what the eye pressure is like when they're at home, they're sleeping, and so on? One possible idea behind the normal tension is that maybe this person actually has high eye pressure, it's just not high when we check it.

Now, that said, there's also some theories about what normal tension glaucoma might be. And this is also talking about: How does eye pressure cause optic nerve damage anyways? I had mentioned that we focus on it because high eye pressure is the cause, but how? Why? Why does this cause the problem? And some of the science isn't at a point where we can say, "Oh, this is exactly why this happens." But we have some idea. And to explain it, so I mentioned that bundles of connections, the optic nerve, leaves the eyeball to go all the way to the back of the brain. And our eyeball is essentially covered by this wall on the outside, called sclera. But there's an exception, which is where the optic nerve comes out of

the eyeball. That's where we don't have a normal sclera. So, there's, like, an opening where the optic nerve can come out, and there's some theory that over time when you have high eye pressure where the optic nerve and all the fibers come out, that high pressure can cause a pressure where these little holes where the optic nerves come out of—again, called lamina cribrosa—there might be some problem where things are bending the wrong way and things can push down on the optic nerve, which can cause damage over time. And there's some theories that in some patients, maybe even just a little bit of eye pressure increase can cause this to happen.

Often a common question is about blood pressure. Is blood pressure related to eye pressure? If I have high blood pressure, does that mean my glaucoma is going to get worse? And generally, our answer is, "You know, they're not that related." Eye pressure is a local issue with the drain or the way things flow in the eye, like I talked about earlier. But there is an exception to this idea, which is that, especially when you're sleeping, if your blood pressure to the eyes are actually low, like lower than what's considered normal. So, normal blood pressure is 120/80. But let's say if the blood pressure when you check it before you go to sleep is, let's say, 100/60 or less than that, there's some thinking that that's actually not good for glaucoma. And the thinking is that, essentially, part of the damage to the optic nerve could be because the blood flow to your optic nerve is compromised, meaning that if you have high eye pressure then that can interfere with the blood pressure going to your optic nerve. And what matters is the difference between the eye pressure and the blood pressure. So, even if your eye pressure is not necessarily very high, but if your blood pressure is low, then when you're sleeping, it's possible that your optic nerve might not be getting as much blood pressure going to the optic nerve, and that can cause the optic nerve to slowly die. So, that's another theory for some of these patients that have normal eye pressure that's somehow getting worse. And that's why in these patients we talk about making sure you don't take any blood pressure medication before going to sleep and making sure you have some salt in your diets, because we don't want the blood pressure to be too high, but we don't want it to be too low either. We want it to be just right, if possible.

But going back to normal tension, generally, we suspect glaucoma in some patients because even though there are so many ways that you can damage the optic nerve—you can have infection, inflammation, and you can have a stroke to the optic nerve or you can have some tumor in your brain that's pushing on the optic nerve. So, there are many ways to have optic nerve damage and not just glaucoma. But usually, glaucoma optic nerve damage, there are certain patterns to it that makes the specialists suspect it, because, again, we think that it's because of how the optic nerve is exiting the eyeball, and that tends to cause a certain pattern, like the top and the bottom of the optic nerve gets thinner and so on. This is technical, but essentially, that kind of pattern is what makes the glaucoma specialist think about glaucoma in a patient that has normal eye pressure, even if the eye pressure is not high. But that said, obviously, since it's not as obvious in lower-risk patients—like younger patients, no family history, eye pressure's normal, but optic nerve is getting worse—then it's important to think outside the box and think about maybe this isn't glaucoma. Maybe this is something else. Maybe we should get an MRI of the brain or around the eyes to make sure that there isn't a big tumor growing or something like that.

MS. SARAH DISANDRO: I see. Well, thank you for that. We are starting to run a little low on time, but we do have one more listener question that came in: "Is there any way to decrease the exfoliate in pseudoexfoliation syndrome?"

DR. JAEHONG HAN: Yeah. That's a good question. Pseudoexfoliation is a very difficult topic. It's thought to be this genetic condition. But at the same time, if you have the gene, it doesn't mean you will for sure have pseudoexfoliation. It seems to be also related to the environment and getting older. And just because your father or mother had pseudoexfoliation doesn't mean you're likely to have pseudoexfoliation. It's complicated. But basically, the idea is that when we look at the eye with the microscope, we can see these parts of the lens and around the lens shutter where things are, kind of, peeling off, and that's called the exfoliation. And the thinking is that these extra tissues that are being peeled off somehow contribute to the eye pressure being high. But generally, I kind of think of it as if I see it then it just means that I still treat

everything the same, meaning I focus on making the eye pressure lower, but it's just that these patients—not all of them but a lot of them—don't do as well, meaning that they're more likely to get worse and more severely.

Now, to answer directly the question, as far as I know, there isn't something that I think of to, let's say, make it so that exfoliation happens less. I still treat it the same with eye pressure, but the only thing is that with exfoliation glaucoma, sometimes I think about possibly doing cataract surgery sooner. Only because with pseudoexfoliation glaucoma, there's also another thing where the supporting structure around the lens is thought to be weaker. So, if you wait until the lens is really dense and the patients are older, then it's more likely to have complications from cataract surgery. So, that's one factor that I think about. But as far as I know, I don't know of any way to reduce the exfoliation from the pseudoexfoliation glaucoma.

MS. SARAH DISANDRO: Thank you, Dr. Han, for the invaluable insights you shared with us today. To our listeners, thank you so much for joining our Glaucoma Chat. I sincerely hope you found it helpful. Our next Glaucoma Chat will be on Wednesday, February 12. To our audience listening, thank you again for joining us, and this concludes today's Glaucoma Chat.

Useful Resources and Key Terms

BrightFocus Foundation: (800) 437-2423 or visit us at BrightFocus.org. Available resources include—

- Glaucoma Chats Archive
- Research funded by National Glaucoma Research
- Overview of Glaucoma
- Treatments for Glaucoma
- Resources for Glaucoma
- Expert Advice for Glaucoma

Helpful treatment options or resources mentioned during the Chat include—

- laser peripheral iridotomy
- selective laser trabeculoplasty (SLT)
- optical coherence tomography (OCT)