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Dr. Alyssa Smith:

Hello, everyone. Welcome to another episode of ENT in a Nutshell. My name is Alyssa Smith and today we're joined by Pediatric Otolaryngologist Dr. Frank Virgin. Today we'll be discussing pediatric chronic sinusitis. Thanks for being here Dr. Virgin.

Dr. Frank Virgin:

Yeah, thanks for having me.

Dr. Alyssa Smith:

So let's first start with presentation. How does a patient with chronic sinusitis typically present?

Dr. Frank Virgin:

So typically a child with chronic sinusitis that presents to an otolaryngologist is going to present with probably a pretty substantial history of recurrent upper airway infections, multiple courses of antibiotics and parents that are just kind of at the end of their rope in terms of dealing with the constant symptoms. And the symptoms that they typically will have are persistent nasal congestion, a thick to colored drainage, they frequently will have postnasal drip and a common thing that you'll hear parents say is that they just seem to clear their throat constantly sometimes to the point where it gives them trouble at school where they'll get in trouble or people will make fun of them for the constant throat clearing and nose blowing.

They can have headaches, but in kids it's pretty difficult sometimes for them to articulate exactly what they're feeling. And they'll have frequently cough, especially the patients that have some underlying pulmonary issues, facial pain. And then one of the more common symptoms of acute sinusitis is fever. The kids with chronic sinusitis frequently don't have fever, but could potentially have frequent exacerbations of their symptoms that include fever. And then frequently the ones that have significant nasal congestion, polyp disease can also report a loss of smell although in the younger patients that's a little bit more difficult to get out of them.

Dr. Alyssa Smith:

And so you've already kind of touched on this, that there's two variations of sinusitis, the chronic and the acute sinusitis. Can you define those and kind of expand on the differences between them?

Dr. Frank Virgin:

Yeah. So acute sinusitis is essentially defined as symptoms that are consistent with sinusitis that lasts for 20 to 30 days. And then there's also a subclass of acute, which would be called recurrent acute, where you have symptoms that only occur for about 10 to 30 days and then they have about a 10 day symptom-free window. One to three months of persistent symptoms would be defined as subacute sinusitis and then greater than three months of continuous symptoms or 90 days of continuous symptoms would be considered as a chronic sinusitis.

Dr. Alyssa Smith:

And how common is this in children?

Dr. Frank Virgin:

Yeah. So that's a hard question to answer because the diagnosis of a patient that truly has acute bacterial sinusitis or that truly has chronic sinusitis is sometimes difficult to tease out and to put the estimates so that the prevalence of acute rhinosinusitis is about seven to 12% and that the prevalence of chronic rhinosinusitis is less than 1.5%. But that small group of patients with a chronic sinusitis typically consume a lot higher amounts of healthcare resources.

Dr. Alyssa Smith:

So moving on to pathogenesis and etiology of this, let's first discuss the timeline of the development of the sinuses. Can you just give us a brief overview of that?

Dr. Frank Virgin:

Yeah. So this is something I think that's always a little bit hard to keep straight but basically the paranasal sinuses develop from the ethmoid sinuses and the maxillary sinuses are the first ones to develop. And they typically can be seen or start to develop in around three months of gestation and then continue to grow throughout the first several years of life and then get to about age seven to 12 year, pretty close to your final size. And then the ethmoid sinuses are the second ones to develop and both the ethmoids and the maxillary sinuses would be present at birth and they reach adult size by about age 12. The frontal sinuses are typically not present at birth but can start to be seen around age six, although you will see instances where they appear early. And these continue to develop all the way into about the second decade of life. And then the sphenoid sinuses start to develop early in gestation. At birth they're usually quite small and in young kids they're also typically quite small and reach adult size by about 12 to 15 years of age.

Dr. Alyssa Smith:

And so then thinking about the development of chronic sinus disease needs pediatric patients, what are some contributing factors?

Dr. Frank Virgin:

Yeah. So I would say that the biggest contributing factor is age. Just in young children they will have around six to eight upper respiratory infections per year which puts them at risk of having or developing a bacterial infection. So that's one risk factor. There are anatomic factors especially in the middle of meatus where things like concha bullosa and Haller's cells and then just a narrow anatomy from their size and a lack of development can predispose a particular child from just having a viral URI into developing an acute bacterial sinus infection or a chronic sinus infection. Adenoids play a bigger role in pediatric patients than they do in adult patients. They can be a source of anatomical obstruction. So if they completely block the core inner, you can have residual or poor clearance of just the normal nasal secretions that can predispose to conditions that could give a bacterial infection.

They can also serve as a bacterial reservoir to increase inflammation and provide a source of a bacterial infection. And that has been shown to be independent of size. So they can play a role in recurrent sinus infections or chronic sinus infections even if they aren't fully obstructing. And then certainly there's other things such as allergic rhinitis, which is typically hard to define in children less

than five. It becomes sometimes a clear risk factor in the older children. Things like asthma is more related to kids with chronic sinus infection and can imply the presence of atopy. Reflux is something that's been thought to play a role in kids with chronic or acute recurrent sinus infections. And there is some things in the literature that suggests that that could be the cause or at least the contributor and sometimes up to 40% of patients.

I think that that's not really clearly defined, but certainly reflux is something in a pediatric patient that you would consider when you're working them up. There's also immediate efficiencies, which again especially in the kids less than five can be really difficult to sort out because a lot of those things continue to evolve over the course of a child's life, but you can have things like a low IgG, a low IgA, diagnosing common variable, immunodeficiency is something that has to be done over the course of childhood. And so you can sometimes go through a period of time where you don't have a clear diagnosis looking at a child's responses to vaccinations especially things like a strep pneumonia vaccination, where if they didn't mount a particularly good response, it could be that that low response and poor protection is predisposing them to recurrent infections.

And usually those kids will respond just to a booster but sometimes that can be a sign of underlying immunodeficiency. Now the other types of kids that you have to think of are the ones that have more of an acquired immunodeficiency. And we'll see this in individuals that have had transplants. So patients that are on medications that could potentially predispose them to having a poor response but also heart transplant patients who early in life have had a thymectomy and perhaps have a poor T-cell function. And that can be very hard to define.

You can also see that in kids that have congenital heart problems where they've had a thymectomy in the setting of a large heart repair for a congenital heart defect. And then you also have your oncology patients that are immunocompromised because of their medications. And then one that's not as common in children, but can present an issue are the diabetic patients who do sometimes have poor immunologic response and can be at higher risk for developing complications. And then there's other things like cystic fibrosis and primary ciliary dyskinesia, which are inherited conditions that can predispose a child to really have acute, but more commonly chronic sinus problems.

Dr. Alyssa Smith:

Can you talk a little bit more about cystic fibrosis and specifically as it relates to sinus disease?

Dr. Frank Virgin:

Yeah. So it's an autosomal recessive disease and it's caused by a mutation in the CFTR gene. And there's really hundreds of mutations that have been discovered. And it occurs in about one in 3,500 newborns. This mutation is essentially abnormal chloride secretion via disruption in the cyclic AMP mediated chloride secretion channels. And it occurs in epithelial cells and extra congruents and it results in increased thickness of the secretions, which can lead to bronchiectasis in the lungs, chronic sinusitis and pancreatic insufficiency. And really, I think when you think about cystic fibrosis and how sinus disease evolves, you think about it in terms of impaired mucociliary clearance, which is the underlying problem in the lungs as well, the thickening of the mucosa reduces its clearance.

And then through that, you get changes in the environment within the sinuses, you get bacterial colonization and then this kind of cycle of poor mucociliary clearance that ultimately results in just thick and specific secretions that cause constant inflammation, continued reduction and drainage. And in some cases polyps. And it's around 25% is roughly what we quote is children that have cystic fibrosis that end up with polyps. But that range is all over the place in the literature anywhere from 70 to 50%, depending on what series you look at.

Dr. Alyssa Smith:

And then can you also talk about primary ciliary dyskinesia, kind of what it is, when we should suspect it and then how we even go about diagnosing it?

Dr. Frank Virgin:

Yeah. So this too is an autosomal recessive disorder and it results in actual dysfunction of the cilia themselves. And so in cystic fibrosis, the cilia function appropriately but because the secretions are so much thicker because they're dehydrated from the impaired chloride transport, that's what leads to the impaired mucociliary clearance. And primary ciliary dyskinesia, you have impaired mucociliary clearance but it's because of the cilia themselves don't function appropriately. And it's something that is less common, so the current estimates is that it's about one in 15,000 individuals, but there's a lot of people that think that it's probably more common than we actually realize. And so the times when you kind of suspected in an ENT clinic, classically are children that have chronic sinus disease. So just thick secretions and then they almost always have as well, chronic otitis media with the fusion.

And I think that's one of the things that kind of differentiates them from the CF patients is that you will see the sinus and the lung symptoms and cystic fibrosis, but their incidence of middle ear disease is not really any different than a normal child, whereas in a patient with primary ciliary dyskinesia, they almost always have a significant middle ear disease. And so the history that you sometimes get is difficulty at birth with clearing secretions and oxygen requirement. They will also frequently have just kind of nonspecific pulmonary infections. There'll be diagnosed as reactive airway disease or frequent bronchiolitis and those sorts of things. They don't tend to have the same GI issues that patients with cystic fibrosis do. And in really severe primary ciliary dyskinesia you can also start to see things like bronchiectasis which doesn't usually occur until a little bit later in life much in the same way that cystic fibrosis does.

There's also an association with primary ciliary dyskinesia with Kartagener's syndrome, which is a cytosine versus bronchiectasis and chronic rhinosinusitis. They can also have problems with infertility due to poor ciliary function. And the thing when we talked about earlier about thinking that it is potentially a more common than we realize is that the diagnosis of it can be really challenging. And the classic way to diagnose it is using electron microscopy to actually look at the cilia themselves. But multiple studies have looked at the kind of sensitivity of this and it's really not particularly good. It's great if you find something, but it's very common to not find an abnormality. And then the other things that people use is like ciliary beat frequency, which has also been shown to not be particularly specific. And frequently kind of gives you a false result.

Currently one of the newer ways of looking is nasal nitrous oxide in ages greater than five and in ages less than five, there's not really any good standard. And then also even in age greater than five, there's not a current standard but low nasal nitrous oxide can be potentially suggestive or support the diagnosis of primary ciliary dyskinesia. And currently you need to have two low levels separated by a period of time because you can also have decreased nasal nitrous oxide just in the setting of a viral URI or sinusitis. And so you have to demonstrate several values where it's low. And then genetics can also play a role. And genetics is not as far along as the genetics would be in something like cystic fibrosis, there's far fewer unknown genes.

And so frequently you will have kids where all you really have is the clinical history that strongly suggests that the child has primary ciliary dyskinesia and you're kind of forced to treat them just based on the history rather than confirmatory testing. And so I think that's an area where we're really still very much in evolution as to how to best diagnose it.

Dr. Alyssa Smith:

Let's also briefly talk about the microbiology behind this disease. So what are the most common bacteria that are typically responsible?

Dr. Frank Virgin:

Yeah. So Alpha-hemolytic streptococci, *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella catarrhalis* are kind of the typical bacteria that everyone usually thinks of are certainly in things like cystic fibrosis and patients with true immunodeficiency, other bacteria can play a role. But those are the most common ones that you see in a normal healthy individual.

Dr. Alyssa Smith:

And then moving on to work up, when you're seeing one of these patients in clinic, what are some important history questions to ask?

Dr. Frank Virgin:

Yeah. And so I think kind of one of the main things is to try and differentiate whether or not you're dealing with a child that has recurrent upper respiratory infections that are viral in nature, or whether or not they have true either recurrent acute bacterial sinusitis or chronic bacterial sinusitis. And I think in pediatrics, that's probably one of the most important things that we try and sort out when we see one of these patients that presents to our clinic. Because I think frequently children are misdiagnosed as having bacterial infections where they are likely just viral. And I think I mentioned it before that the average child will have about six to eight upper respiratory infections per year. And so for a family that's on the higher end of that, it can seem like they're sick constantly over the course of a period of time.

And those children have also frequently been treated with multiple courses of antibiotics but it may have been treatment that wasn't necessary. And so I will go through oftentimes with a family kind of the natural history of a complicated viral URI, which is where you typically will see fever in the first couple of days and then it goes away. And there may not be a whole lot of respiratory nasal symptoms, but then once the fever goes away, they will have a little bit of a spike in the respiratory symptoms that classic kind of congestion, headache, cough, postnasal drip. And then those will peak usually around the fourth to fifth day, but then start to go away. And usually by around day 10 those respiratory symptoms have started to resolve. And so I kind of try and tease out what's going on? When are they getting treated frequently? They are getting treated with antibiotics in advance of that kind of 10 day window that we look at.

And so I think that's a particularly important thing to sort out. The other thing that I frequently ask about is whether or not they have sleep disordered breathing, mouth breathing even when they are well. So if they aren't having fevers, aren't having a lot of nasal drainage, are they still congested? And that can signify a mechanical obstruction, the most common thing being adenoid hypertrophy. And then we also will frequently ask about things like allergic rhinitis. Are there environmental situations or exposures that seem to exacerbate the symptoms? Is there a seasonal variation to the symptoms? Is there a family history of allergic type symptoms? I'll then also ask about things like asthma or reactive airway disease and whether or not the individual has that problem or family history of it. And then while you're talking about cystic fibrosis, primary ciliary dyskinesia, always ask about a family history of those two things, or a family history of kind of chronic sinus and lung problems that could potentially signify an undiagnosed genetic issue.

Dr. Alyssa Smith:

And then when you're performing your physical exam, what are some specific things that you're looking for?

Dr. Frank Virgin:

Yeah. So I think with a lot of these kids your first just kind of impression of them, how they look. So there's the classic adenoid faces where the kid's going to have dark circles under the eyes, their mouths hanging open, sometimes in the bad ones you can kind of see a nice little crease on the bridge of their nose where they're constantly wiping their nose. A lot of times you can walk in the room and before you even start your conversation, you can then say that child has pretty significant nasal obstruction and the most common thing being adenoid hypertrophy. So that's kind of the first general impression. Chronic sinus disease and an acute infection can also have a pretty significant impact on quality of life. And so a lot of times you can just kind of get a sense for like, this child looks like they're pretty miserable.

And then the next thing is looking at the ears. I do kind of my physical exam and it's the same way every single time, which is ears. Then I look at the nose. Then I look at the mouth and neck, but in somebody that has a chronic history, I'm going to look at the ears and make sure that they don't have a chronic otitis media with a fusion, or I guess an otitis media with a fusion is something that I want to rule out. And then I'm going to do anterior rhinoscopy and the things that I'm kind of specifically looking at or whether or not there's a large degree of inflammation. Do I see kind of a pale boggy mucosa with mucus stranding that could signify a child with allergic rhinitis? Do I see purulence? Do I see nasal polyposis? Do I see obvious kind of anatomic deformities? Anterior rhinoscopy is somewhat limited but you could see something like a significant nasal septal deviation. So those are the primary things that I look out first.

Dr. Alyssa Smith:

And then can you comment on the role of endoscopy in clinic?

Dr. Frank Virgin:

Yeah. So I think endoscopy is really important. And I would say that children can be difficult but they are not impossible. And I think every child requires a little bit different approach. There are some that will be completely cooperative with everything that you ask them to do and then there's others that you kind of have to coax through it and engage the parents to help you get them through it. But I think it's a critical part of the evaluation. When I make a decision about whether or not I'm going to use a flexible versus a rigid scope, in large part, that depends on whether or not the child's previously had an operation. And so in general, if they haven't had prior surgery, I tend to use a flexible scope. It is a little bit more forgiving. I think it's a little bit less intimidating for the child to see the kind of bendy, not too sharp, not scary looking camera, whereas the rigid scope tends to be a little bit more intimidating for them.

And really, I think when I do a scope on a child that hasn't had prior surgery, I'm looking for the presence of nasal polyposis. I'm looking for purulence and really I'm looking at an initial visit does this child have adenoid hypertrophy or not? And the flexible scope will allow you to carry that out pretty easily. If it ends up being that I want to take a culture or there's something where I need a little bit more dexterity to where I can use one hand for the camera, and then another hand for an instrument or a suction, then I can always switch over to a rigid scope from the flexible. And usually once the child's had the flexible scope and realize that it's not that bad, they're a little bit less intimidated by the rigid scope.

Dr. Alyssa Smith:

And then thinking about imaging, who do you obtain imaging on?

Dr. Frank Virgin:

Yeah. So I think this is an important part of all this because I would say that in general, imaging doesn't have a role in diagnosing or differentiating a URI from a bacterial infection. And I rarely in the end, so it is not necessary to make those diagnoses, their clinical history and physical examination. And so the use of imaging is primarily reserved for individuals in which are concerned that there may be a complication of sinusitis such as orbital abscess or an intracranial complication. The other time that I use it is when I feel like I'm going to potentially perform sinus surgery on a patient. And I think the other piece that's important about imaging is that it needs to be obtained in a controlled manner. And what I mean by that is that getting a CT scan at a random point in time can give you misleading information.

And there's evidence in the literature that if you took a bunch of children and put them in a scanner at any point in time, upwards of 50 to 60% of them could have evidence of sinus disease regardless of symptoms or regardless of the reason why they got those images. And so I typically only get imaging after I've gone through a controlled treatment process. So I kind of know what I'm getting and whether or not I can make decisions based on the imaging.

Dr. Alyssa Smith:

And then can you discuss the role of some other adjuvant tests that are available?

Dr. Frank Virgin:

The adjuvant tests are mainly reserved for those individuals that truly have either chronic sinusitis or the acute recurrent sinusitis. And I would say that probably allergy testing and immunodeficiency testing is probably one of the more common things that we get, because if we send somebody for allergy testing, we will also say, "Hey, just check out the immune function as well." That's typically done in children that have a pretty strong history that suggests that the allergic rhinitis could be playing a role in this. And I would say it's also done pretty routinely in children in which you're thinking that you're going to end up having to operate on. Because the goal of the evaluation of a child with chronic or acute recurrent sinusitis is to figure out what's the underlying cause of this. And if it can be managed medically then that's what we want to do rather than managing it surgically.

And so the two are commonly done. Sweat chloride testing and testing for primary ciliary dyskinesia, I would say is not universally done. But it's done in the kids where you have kind of a high index of clinical suspicion. And so things just aren't adding up. And a lot of times the kids have had allergy testing, they've had immune testing and they're still and you've kind of tried all the different treatments that you can think of trying and it's just not kind of giving you the answer and you're not getting where you want to be, then you have to start thinking about other causes. The other thing like with primary ciliary dyskinesia is just the history, the clinical history of terrible ears, terrible sinus problems. And then some kind of non-specific pulmonary symptoms would send you down that path.

And then for cystic fibrosis, it's sometimes there's a family history, but not always. The thing about cystic fibrosis is since 2010 all 50 states and Washington, D.C. have done newborn screening for cystic fibrosis. And so now here we are in 2020, so anyone over the age of 10 potentially wasn't tested. And so we will and have seen teenagers that we end up discovering have cystic fibrosis that was primarily just with sinonasal symptoms. And so I think you have to always consider that in the cases that just aren't fitting. And then the other kind of group where I really tend to think about CF and PCD are

the kids that have bilateral nasal polyps especially if there's an absence of positive allergy testing, then I think that those children also need to be tested.

Dr. Alyssa Smith:

Next, let's talk about treatment. Can you discuss the overall treatment approach for patients and if it differs at all between younger and older patients?

Dr. Frank Virgin:

Yeah. So I think in general, it's trying to be as conservative as you can be because in pediatrics things are evolving and the kids get sick a lot and they have a lot of risk factors for having recurrent infections. And so frequently time is on your side. And if you can get a patient through a difficult time with doing kind of as little as possible, then frequently when you get to the other side, they're better. That is for sure the case in the children that are less than 12. And when you get to the age kind of teenagers to young adults, things have kind of sorted out.

They are not as much in that risk age for recurrent upper respiratory infections. Their anatomy is more kind of in line with the adult sized anatomy. And so the conservative approach is probably a little bit less common in somebody that's having a lot of trouble in the older group than it would be in the younger group. But in terms of the things that you think about differentiating whether it's viral or bacterial the use of antibiotics, the use of steroids, thinking about adenoids in your algorithm and then the kind of the progression to ultimately sign a surgery if necessary is not that different between the two age groups.

Dr. Alyssa Smith:

So first thinking about medical therapy, what are some different options that are available?

Dr. Frank Virgin:

So certainly if you're thinking that allergic rhinitis is kind of an inciting factor of this treating with allergy, so an oral antihistamine, and there's a number of those that can be used. Nasal steroid spray is a common one. It's a great treatment for just the chronic rhinitis, whether or not it's allergic rhinitis or non allergic rhinitis. And so daily nasal steroids, nasal saline irrigations have been shown to improve clearance and improve mucociliary clearance. How well children will use those is really variable. But I will try sometimes to upfront use nasal steroids along with a nasal irrigation or just daily nasal saline spray to see if that can have some improvement. But then if you really are dealing with a child that has true on of either acute sinus disease or more importantly chronic bacterial sinus disease, then we usually treat with antibiotics and it's antibiotics that are directed towards the most common bacteria that we discussed earlier.

The duration of treatment is usually recommended that you want to treat for seven days past kind of the resolution or the near resolution of the symptoms. And so that can vary from child to child. But I think one of the common things that we see is that a child gets on the cycle of an acute infection and they get treated with a short course of antibiotics, sometimes appropriate antibiotic choice, sometimes not appropriate antibiotic choice and they get better. But then very shortly after the stopping of the seven day course or 10 day course their symptoms return. And so I personally tend to treat if I'm going to treat as if it's a chronic infection attend the treat for 21 days with antibiotics. When I think in some individuals, you can give them instructions that you want them to continue with the course from seven days after a resolution of symptoms and that can vary.

I also think that systemic steroids are very important. The antibiotics will reduce bacterial load and will cause some improvement in inflammation just from that. But really to maximize the kind of anti-inflammatory effects of the antibiotics you do to use systemic steroids for the first portion of the treatment to try and make sure that I maximize the ability of those sinuses to drain and clear. And so my typical routine is at about a 12 day kind of tapered course of steroids, but there's not really any consistent guidelines on what's the dosage, what's the timeline. And I think if you questioned people, they would all tell you something a little bit different, but I do feel like using systemic steroids is important.

Dr. Alyssa Smith:

So with these topical steroids, sprays, saline irrigations, I've talked to many parents that really struggle with getting their kids to tolerate these topical therapies, are there any tips or tricks that you discuss with parents to help with the administration of them?

Dr. Frank Virgin:

Yeah. So I think that like if we're talking about the nasal steroid it can be difficult to get it started especially on the really young children. And so I tend to tell parents to try and use kind of a reward system, which is frequently something that they've done in other areas of their life. And so give the child M&M or a little piece of candy if they take their nasal steroid and that's usually necessary for the first bit, at least it is for some kids. But what I've found is that if the nasal steroid truly does help, the kids will recognize the benefit of it and reward and kind of coaxing will not be necessary anymore. If it doesn't really do very much and the child doesn't perceive any benefit, then it'll continue to be a struggle. And that's something I've seen in my patients and I've seen it in my own children who needed kind of coaxing to start using a nasal steroid, but then during their seasonal allergies they start to actually ask for the nasal steroid because they know that it helps.

I think that the saline is a little bit more difficult or can be a little bit more difficult because the benefits to the child are not quite as apparent. But I find that using a nasal saline spray either the squeeze bottle or the aerosol bottle is usually easier to get the kids to do on a routine basis. The nasal irrigations are a little bit harder and I think that that takes some time and it definitely takes patience on the parent's part and a willingness on the child's part. But again, I think it all comes down to like, if you're recommending a treatment and it's helping, they usually will come around. If it's not helping then you're probably going to continue to struggle with the administration of it.

Dr. Alyssa Smith:

So how do you counsel parents who are worried about effects of longterm topical steroid use?

Dr. Frank Virgin:

Yeah. So I would say that there are different things out there that talk about stunted growth and whether or not there can be impacts on just the more systematic sub systems. And none of the data is really strong. And so the more common risk I think is kind of injury to the nasal mucosa and epistaxis and you see that frequently. But I would say that in general with steroids, be it nasal steroids or top oral or systemic steroids, I tend to counsel families and say, really, we just need to use this only as much as it helps or is necessary. And so for somebody that has seasonal allergies, then over time, you can develop a timeline of when things get worse and you only use the treatment at those times. If it's something that is more longterm, are there alternatives? So if in the allergic kid, are there environmental changes that we could make that could reduce the amount of nasal steroid that we're having to use?

And then if it's not working, if it's not making as much difference then we need to recognize that and we need to discontinue its use. So I try and take an approach to say we're going to work on this and we're going to try and use it in as little as possible and minimize your child's exposure as much as we can, but for some kids, it provides significant benefit. And so I think really that the quality of life benefits and disease benefits from it in most cases are far worse, far more than the risk.

Dr. Alyssa Smith:

So you previously touched on antibiotic therapy and directing those antibiotics towards the most common pathogens that we see, but is there any role for culture directed antibiotic therapy?

Dr. Frank Virgin:

So I think there is. In just kind of a routine patient that comes in with an acute sinusitis, I don't think that there probably is. It can be very difficult to obtain cultures sometimes from a child. But if you have a child that has failed your traditional treatment then I think that that's a place where a culture is a value. I think culture directed antibiotics is a critical in treating patients with primary ciliary dyskinesia and cystic fibrosis because they can have very different kind of chronic bacterial colonization. And you want to make sure you're treating what bugs they actually have. And if I see somebody that's failed multiple treatment regimens potentially that's had surgery I think that it's critical to get culture directed antibiotics, because the reason that you're struggling may just be that you're dealing with a bug that you weren't expecting. And so I do frequently use culture directed antibiotics but not for just kind of routine non-complicated cases.

Dr. Alyssa Smith:

And then how do you decide what patients are good candidates for surgical intervention?

Dr. Frank Virgin:

It's a hard decision frequently because there is not a nice recipe book for which children need surgical intervention. I think that the failure of medical management that's commonly used in the adult world also applies to the pediatric world. But I think where it differs is that one of our goals is to make sure that we differentiate, is this a child that just has recurrent viral infections or do they in fact have recurrent bacterial infections? And so I think if we've established that yes, in fact, they've had bacterial infections, then that puts them in this group to where we're going to need antibiotics, if they'd broadly covered the normal bacteria, if those fail culture directed antibiotics, topical and systemic steroids and then utilizing the kind of our evaluation to rule out any underlying medical causes such as the ones we've discussed previously, allergic rhinitis, immunodeficiency, some sort of genetic abnormality.

There are a group of children that you see that have these kind of chronic sinus infections, chronic sinus problems and this is where the nasal endoscopy comes up that have just 100% obstructing adenoids. And in that group of patients, it's usually an adenoid problem and you don't necessarily have to go through all the steps of failing maximum medical therapy. And so those are kids that if it's just an adenoid problem, then you probably upfront or are going to offer adenoidectomy whereas the kids that don't have big adenoids or have had prior adenoidectomy, then you're going to work through that process of maximizing your medical management before making a surgical decision.

Dr. Alyssa Smith:

And so you kind of just touched on this a little bit with the decision about whether or not to pursue adenoidectomy, but can you discuss the decision making related to the surgical approach whether that be adenoidectomy or a full FESS or sinus wash out?

Dr. Frank Virgin:

My kind of surgical algorithm really almost always starts with adenoidectomy. And that really kind of even includes children that have cystic fibrosis and primary ciliary dyskinesia because in the young children especially, adenoid hypertrophy can make an underlying condition worse and it can make the management more difficult. And so in my mind if we're talking about kind of moving through it, if a child moving through kind of your algorithm, if a child has been through kind of the medical workup and treatment and they truly are a chronic sinus patient, then I think a first line step is to perform adenoidectomy because if you haven't done that, I think it's hard to make a decision as to whether or not that would be treatment enough or if they need a more aggressive surgical treatment. So I think that's the first step.

The sinus wash out and balloon sinuplasty, I think is something that's controversial. There is stuff in the literature that talks about combining adenoidectomy with one of those procedures and potentially increasing cure rates or increasing success rates however it is that you define that. You will get lots of opinions from other people or from different providers and I'm not really sure that one is right over another. I can say that the way I think about it is that adenoidectomy alone if you're talking about chronic sinus patients or recurrent sinus nasal obstruction, adenoidectomy alone can be successful in anywhere up to 50 to 60% of the patients. And so in some of the studies in the literature if you add balloon sinuplasty or you add a sinus wash out, you're potentially going to increase that success rate up higher.

My thought though is that in order to get another 10 to 20 patients better, if you include something like balloon sinuplasty or wash out on every child that you do an adenoidectomy on, you're going to be doing a lot of extra surgery and both sinus wash out and balloon sinuplasty, although they're less invasive than a true traditional FESS, they're not noninvasive. You still have to access the sinuses. You still have the potential of causing scarring. And I would tell you that anecdotally, I have ended up having to do sinus surgery, formal sinus surgery on a number of patients that have had a balloon sinuplasty or wash out early in life and have developed scarring within the middle of the meatus. And so I personally don't combine those procedures with adenoidectomy upfront.

And I think that in children that have already had adenoidectomy, I believe there's a very limited role for those two things. And I think it's a role that hasn't clearly been defined in pediatrics as of yet. In terms of who I end up doing a functional endoscopic sinus surgery on, it's basically those children that have had adenoidectomy, that have had maximum medical management, that have had a full medical workup and we're still dealing with consistent symptoms and still in most cases dealing with findings on a CT scan. And so my kind of process for getting to the point of surgery is that I've done my medical workup as I saw necessary. And then if we've got and they've had adenoidectomy and then we've gotten to the point where we're considering sinus surgery, at that point what I do is I treat with 21 days of antibiotics, either just broad spectrum or culture directed and that varies from case to case.

Oral steroids always have them on a topical nasal steroid unless there's a reason that they can't tolerate that. And then at the minimum nasal saline spray but hopefully nasal irrigation. And then I treat for that period of time, which is roughly three weeks. And then about a week after that treatment is concluded, I obtain a CT scan of the sinuses. And the reason for waiting a week is there's that group of patients that have acute recurrent to where you can medically clear them, but they very quickly start having problems again after treatment. And so if you did the CT scan immediately after your treatment,

you may miss that group. And so I wait one week after treatment to get the scan. And then based on the scan, we make a decision about whether or not a surgery is indicated. And if surgery is indicated, what exactly is it that we're going to do?

And so that's kind of how I get to that point, but I think that in general, sinus surgery has been demonstrated to be safe in children and it's also been demonstrated to be effective in children. It's just making sure that you appropriately select the patients that need it. And then inferior turbinate reduction is something that I do do. And that is something that I will do in combination with an adenoidectomy if the adenoids are small and we're taking out the adenoids just as an idea that they're serving as a bacteria reservoir. And if nasal obstruction is one of the patient's primary symptoms. The other place that I think inferior turbinate reduction can be helpful is in younger children with significant septal deviation.

And if you're trying to wait on formerly repairing the septum, reducing the size of the turbinates can sometimes have enough of an impact on that internal nasal valve to buy you some time before doing a formal septoplasty. So I do think it has a role if the children have significant nasal obstruction. The other group that I think it really helps are the kids that have allergic rhinitis. You're not curing their disease by reducing the turbinates but certainly, I think it allows your medications specifically your nasal steroids to be more effective.

Dr. Alyssa Smith:

So specifically thinking about functional endoscopic sinus surgery, how does the surgical tactical approach differ in children compared to adults?

Dr. Frank Virgin:

So I think that probably in general it is more conservative. The sinuses are still evolving, especially the frontal sinuses and the posterior ethmoid sphenoid complex. And so I try and address only what seems to be impacted. And in large part, I use the CT scan to help me decide that. And so frequently I will see children that come in with a CT scan and the CT scan was obtained during acute illness and they have pansinus disease, but then... And so you kind of, I don't know where the problem is, is it truly chronic pansinus disease or do they have a specific area their sinuses that is the meatus for these kind of recurrent infections that they're having. And so I'll do the medical management that I described earlier and then get a CT scan. And then frequently what you will find is that the majority of the sinus is clear and you have one area or a small couple of areas that seem to be the most likely problem spaces. And those are the ones that I will operate and I won't touch anything else.

And so in pediatrics, it tends to be the middle meatus is the most common side of obstruction just from size. It's more prone to having a blockage and subsequent infections. And so maxillary antrostomy, especially in the presence of a Haller's cell is sometimes enough to open things up so that that side drains sometimes a limited ethmoidectomy along with the maxillary antrostomy is enough. And so I would say that it's as conservative as you can be and I'll always explain to families that this is the approach that I'm taking and it may end up being that in being conservative, we have to come back another day, but I would rather do that. And it proved that the conservative approach fails rather than taking a more aggressive approach up front.

Dr. Alyssa Smith:

And do you use image guidance when you're operating?

Dr. Frank Virgin:

So I don't use it for every case. If I'm doing a limited surgery like just a maxillary antrostomy and limited anterior ethmoidectomy, I don't necessarily use it. If I'm doing a more comprehensive surgery then I do use it. The reason for that is that I feel it is an added measure of safety although I strongly believe that you shouldn't rely on image guidance to kind of tell you where you are. But I think it helps you verify where you think you are.

The other thing that I think it does, if you're doing your comprehensive surgery is I think it helps you be more complete in the dissection that you do, especially when you get up within the frontal recess it can be very helpful there to kind of verify that you've done what you set out to do. I also always use it in revision cases because frequently your landmarks aren't there any longer. And so it becomes more difficult to know exactly where you are. Polyp cases things, cystic fibrosis and those sorts of things, I pretty much routinely use it but not for the more limited procedures and first time procedures.

Dr. Alyssa Smith:

And when you're operating if you encounter any purulence, do you frequently obtain a culture?

Dr. Frank Virgin:

Yes, I would say I always do. Yes, I always do because I think it can be valuable information if you've... Typically, these patients have been treated multiple times before prior to having a surgery. And so the fact that they have bacteria there despite multiple treatments makes the potential for a resistant bug or an abnormal bug higher. And so I want to get that so that in the future I will have an ability to direct my antibiotic treatment rather than just kind of making a selection based on what it may or may not be.

Dr. Alyssa Smith:

And then thinking about management postoperatively, how are these patients managed? Do they have packing? Are they supposed to do rinses?

Dr. Frank Virgin:

I try to not use any packing. I think that there are a lot of products and lots of techniques that can be used. I have not been convinced that any of them have made a big difference in my practice. The main thing that I worry about in children and the main reason that I do use a pack is if I'm worried about the middle turbinate scarring to the lateral nasal wall, in which case I'll use as limited of a spacer as I can to try and prevent that from happening. One of the goals of surgery is that you provide access to the sinuses for topical treatment so that they can drain. And if the middle turbinate scars over, you've lost that ability. You've kind of lost that benefit. And so if I'm worried about the middle turbinate lateralizing, then I put in a spacer. I've tried a lot of different of the absorbable packing with, I would say, anecdotally kind of mixed success.

There are times when I have a patient, a polyp patient I would say specifically, that has been difficult to treat, then using some of the absorbable packing with steroid I think is something that I've found can help. But I don't do that as a matter of routine. I kind of think of those absorbable type packs as just a tool in the toolbox that I may use in very specific instances. As far as rinses, I think at least in the initial postoperative period, the first week or two, I think that's probably the most critical thing. Because the drying and crusting in the nasal cavities and the more rinse they can use, the less those will build up, and those crust tend to be kind of the way I think about it and the way I explain it to the families is the scaffold for scar formation. And so I try and get everyone to use nasal rinses. If they will not do nasal rinses, then I get them to do nasal saline spray either with the squeeze bottle or an aerosol bottle as many times a day as they can.

I try and tell them at a minimum do it five times per day. So I think that having that saline and keeping things moving is a critical portion of their postoperative care. I would say that in terms of debridements and second looks I've evolved over time and in the literature there's some studies that suggest that a second look and debridement in pediatrics, if you can do nasal irrigation is not important. But there's literature in the adult population that suggests that debridement is extremely important for longterm benefit. I think in pediatrics, we have the kind of challenge of dealing with a patient population that's not always overly cooperative and that it's not always going to let you spend a long period of time digging in their nose if they're going to let you do it at all.

And I used to do second looks pretty routinely, but I've found in my practice, it doesn't seem to change things for me a whole lot. And it's an added anesthetic. And in general, in pediatrics, one of our underlying goals is to minimize episodes of general anesthesia. And so I've stopped doing second looks as a matter of routine, but I do sometimes do them. And the way that I kind of decide whether or not I'm going to do one is if I put in stents, I will have a conversation with the family afterwards. Do you think that your child is going to allow me in the clinic to take out these stents and some will say, "Absolutely not, there's no way it's ever going to happen." And so those, I will set up for a second look. Others will say, "Yeah, I think we can make it happen." And so then I will see them in clinic. If I'm successful in taking out the stents, they will usually allow me to do some degree of debridement and so I will do that.

If we get into clinic and it's not going to happen, then I can set them up for a second look. The other ones that I would do is if there's no stent and I see them in the clinic and we're seeing substantial scarring, they're having substantial symptoms that are suggested that things just aren't draining like they're supposed to, then I'll have a discussion with the family. We can kind of wait this out and see what happens or we can go back in and we can do a more aggressive debridement and potentially put in stenting if it seems necessary. But it's not something that I do on a scheduled basis.

I've also found that even young children, if you spend time developing a rapport with them and a trust, they will let you do more and more over time. And so I frequently will not push initial scope and try and get away with doing more because the subsequent time they tend to let me do more. And I have children less than 10 that will let me clean out their nose and debride their nose 30 minutes at a time without saying anything. And so it can be done it's just sometimes it's a little bit more challenging.

Dr. Alyssa Smith:

So what are some surgical complications that we should be thinking about when managing these patients and also that you counsel patients and their parents on?

Dr. Frank Virgin:

So I think this is a place where it's pretty similar to what you would tell an adult patient, the bleeding and I specifically will talk about things like the anterior ethmoidal artery. I talk about that bleeding is normal to some degree, but in rare instances, we have to do nasal packing or take them back to the operating room for repair although that's uncommon. I'll also talk about orbital injury specifically injury to the fat orbital hematoma, the risk of injury to the muscles and to the globe itself are extremely rare, but I still bring those up.

Spinal fluidly because it's another thing that I bring up, and when I talk to families about this prior to surgery, I pull up the CT scan and kind of show them all these things, try and explain to them, this is where we're working, this is the area that I'm trying to clean out. And as you can see, the boundaries of that include the orbit and the skull base. And so I speak to them about that. But I think the biggest thing that I try and kind of make sure that they understand is that there's the scarring and the

continued kind of evolution of the sinuses within a pediatric patient. And because I'm taking a conservative approach, there is a potential that we would end up having to go back and do additional surgery.

Dr. Alyssa Smith:

And then what does longterm followup look like for these patients?

Dr. Frank Virgin:

So a lot of it depends on what we're doing the surgery for. And so some patients have an anatomical abnormality that has predisposed them to developing recurrent infections in one specific area. And then for instance we're having problems with asthma control because they keep getting infections and those kids, you do a limited surgery, they heal up, see them about two weeks afterwards to make sure things are going well. And then if things are going well at that point, then I see them again usually in one to three months. And once they've healed and there's no scarring, then those are ones that I usually don't follow longterm because you fix the anatomical problem. And children that have a more of like chronic underlying problem, the surgery that you do is helping your management, but it's not necessarily curative.

And so I will see those kids two weeks after their surgery. And then usually one to three months, depending on how they're doing, sooner if it's necessary, if they're having a lot of crusting and a lot of problems. And then once I get them to where they're on a pretty stable regimen, then the followup is typically three to six months. And in some cases a year and some of my cystic fibrosis patients, we get to a point where we've got things stable enough and they feel comfortable enough with the regimen that they then just call me when they need me. But for the chronic patients with a chronic disease primary ciliary dyskinesia, cystic fibrosis, immunodeficiency, really bad allergic rhinitis with polyps, allergic fungal sinusitis is another one, I will see those children longterm at least every six to 12 months when they're really stable.

Dr. Alyssa Smith:

And then finally, what are some complications of a patient that has untreated chronic sinusitis?

Dr. Frank Virgin:

Yeah. So certainly there's always the risk of developing something like orbital abscess, intercranial complication. It's really uncommon to see those things in children that have chronic sinus disease. It's usually most commonly kids that don't have chronic sinus problems and develop an acute infection with a bad acting bacteria. But there is always that possibility that you could develop that. In truly kind of trapped sinuses, you can develop a mucocele or an expansion of the sinus that can cause erosion into the skull base, erosion into the orbit and then those can get eventually infected and develop something known as a mucopyocele. And so that would be kind of an acute type of complication. In terms of individuals that have allergic rhinitis, nasal polyposis and asthma, the poor sinus disease can make the asthma very difficult to control. And that's under that unified airway hypothesis and the link between the upper airway specifically the sinuses and asthma has been very well established that if you improve control of chronic sinus disease and those asthmatic patients, you can improve control of their asthma.

In the cystic fibrosis population, that link hasn't been as well established, but there is evidence that if you can improve their sinonasal disease that you could potentially reduce frequency of their exacerbations and hospitalizations for bronchopneumonia. There's not really any good evidence that it does anything to improve their pulmonary function, which is something that those of us that take care

of patients with CFC, but it just hasn't really been proven in any of the literature. And then there's also just the quality of life kind of impact. I mean, the chronic sinus disease is going to have a significant quality of life impact on both children and adults and in treating it, you can improve that quality of life and not treating it you're just kind of leaving a child feeling pretty miserable all the time.

And so I would say that those are kind of the main kind of generalize things. There's also specifics like with allergic fungal sinusitis, that is a process that will continue to expand and you can get into really quite significant complications, blindness from compression of the optic nerve and stuff lesion from erosion of the skull base and infectious type complications both in the orbit and intercranial vault from not treating that.

Dr. Alyssa Smith:

Dr. Virgin, thanks again for joining us. Is there anything else you'd like to add?

Dr. Frank Virgin:

No, I don't think so. I appreciate you having me. Hope this is helpful.

Dr. Alyssa Smith:

In summary, pediatric patients with chronic sinusitis present with symptoms such as persistent nasal congestion, dark colored drainage, postnasal drip and cough. Acute sinusitis is defined as symptoms less than 30 days while in chronic sinusitis patients should have continuous symptoms for at least 90 days. Some contributing factors to the development of chronic sinusitis or recurrent respiratory infections, anatomic factors such as concha bullosa, and Haller's cells, adenoiditis, which can act as a bacterial reservoir in various comorbidities, such as allergic rhinitis, immunodeficiencies, immunocompromised patients after transplant or thymectomy, cystic fibrosis and primary ciliary dyskinesia. When evaluating a patient, it's important to differentiate between viral upper respiratory infection and bacterial sinus disease. And this can be done with both history and physical exam.

Interior rhinoscopy and combination with rigid or flexible nasal endoscopy is helpful when looking for a purulence, polyps, septa deviations, mucosal inflammation, anatomic deformities and adenoid hypertrophy. Medical therapy includes nasal steroid spray, saline sprays or irrigation, any oral antibiotics, any histamines or systemic steroids if indicated. Patients that fail medical therapy are good candidates for surgical intervention. Adenoidectomy plays a big role in the management of these patients and is often the first step. Patients with persistent symptoms after adenoidectomy in medical therapy are good candidates for functional endoscopic sinus surgery. Adequate treatment of chronic sinus disease can help maintain good control of asthma as well as improve quality of life for these patients.

I'll now move on to the question portion of this podcast. As a reminder, I will ask a question, pause for a few seconds and then give the answer. The first question is what is the timeline of the development of the sinuses? The maxillary sinus, ethmoid sinuses and sphenoid sinuses are all present at birth. The maxillary sinus is the first to develop, which starts developing at three months gestation and grows to full size by ages seven to 12. The ethmoid sinuses are the second to develop and reach adult size by age 12. The sphenoid sinuses also develop during gestation, are present but small at birth and reach adult size by 12 to 15 years of age. The frontal sinuses are not present at birth and start to be seen around age six. They continue to develop until about the second decade of life.

The second question is how do cystic fibrosis in primary ciliary dyskinesia lead to chronic sinusitis? Both cystic fibrosis and primary ciliary dyskinesia lead to chronic sinusitis by causing impaired mucociliary clearance. Cystic fibrosis leads to increased viscosity of mucus, which prevents normal

clearance in the sinuses. The stasis of mucus leads to chronic inflammation. In contrast, primary ciliary dyskinesia leads to abnormal functioning of the cilia, which also causes mucus stasis in chronic inflammation. The third question is what are the most common pathogens typically responsible for chronic sinusitis? The most common pathogens are Alpha-hemolytic streptococcus, Staphylococcus aureus, Streptococcus pneumoniae, Haemophilus influenzae and Moraxella catarrhalis. Thanks for listening. And we'll see you next time.