Transcript Details
This is a transcript of an educational program. Details about the program and additional media formats for the program are accessible by visiting: https://reachmd.com/programs/advanced-treatments-innovations-mayo-clinic/advances-in-radiation-for-pediatric-brain-tumors/12508/

ReachMD
www.reachmd.com
info@reachmd.com
(866) 423-7849

Advances in Proton Therapy for Pediatric Brain Tumors

Announcer:
You're listening to ReachMD, and this is *Advanced Treatments and Innovations from Mayo Clinic*. Here's your host, Dr. Charles Turck.

Dr. Turck:
As survival for patients with pediatric brain tumors improves, reducing the long-term effects of cancer treatment is increasingly important. Fortunately, several advancements like proton radiotherapy are helping us achieve that goal. And what those treatments are and how they're reducing toxicity in our youngest patients is what's to come on today's program.

Welcome to *Advanced Treatments and Innovations from Mayo Clinic* on ReachMD. I'm Dr. Charles Turck, and joining me in this discussion is Dr. Nadia Laack, who's the Chair of Radiation Oncology and a pediatric oncology physician at Mayo Clinic in Rochester, Minnesota. Dr. Laack, welcome, to you.

Dr. Laack:
Thank you so much. It's a pleasure to be here to speak about something I feel so passionately about.

Dr. Turck:
Well, let's start, Dr. Laack by focusing on proton therapy. Would you tell us what proton therapy is and how it's different from other forms of radiation?

Dr. Laack:
About half of cancer patients receive radiation as a part of their treatment, but the vast majority of patients who receive radiation are treated with X-ray treatments, the traditional form of radiation. There are new words for it, there's new ways to describe it and some people will have heard of IMRT or intensity-modulated radiotherapy, but in the end, those use X-rays as the way to attack the tumors. X-rays are the same beams that come out of chest X-ray machines or CTs, but when we use them for treatment, they're dialed to higher energies to do the work that we need them to do to kill tumor cells. But just like chest X-rays or CT scans, the radiation goes through you. You know, when they take a picture for a chest X-ray, the film is on the backside of you; the radiation goes through you and develops the film behind you and that's how you get an X-ray picture. So using those same type of X-rays is how traditional forms of radiation are performed.

With proton treatment, we're using a whole different energy particle. Proton is the center of a nucleus and it's positively charged; we use actually a hydrogen atom that we accelerate to be able to go to the depth that we need it to go to treat these tumors. But because it's positively charged in comparison to X-rays, which have no charge, because it's positively charged, we can actually use magnets that are negative and positively charged to pull the proton around, putting a negative magnet in front of a positive proton pulls it forward. So we can time and tune magnets to accelerate these protons so, within two seconds, they're two-thirds the speed of light and have gone around the earth approximately ten times and then are ready to be angled and pointed at the tumors that we need them to go to. And based on how fast we accelerate those protons, that determines how deep they will go. And so instead of going through you, they will go an inch or a centimeter or two inches or eight inches, depending on how fast we accelerate the proton and then it stops, and you don't have that exit dose. So if you put film on the backside of the someone and you're shooting from the front, the film would not be exposed. You could stand behind somebody and not get radiated with the proton treatments. So because of that, we're able to reduce the unnecessary radiation exposure that people receive when they're getting radiation treatments.

Dr. Turck:

So what are some additional details in terms of the benefits of proton therapy in terms of reducing long-term toxicities? And on the flip side, are there any risks we should be aware of associated with proton therapy?

Dr. Laack:
Proton therapy has been probably most extensively studied in children. Because children are growing, their tissues are much more sensitive to effects of radiation than adult's tissues are. Plus, in children, in particular, brain tumors, which are one of the more common solid tumors in children, when they occur, many of them still require radiation for cure and by using proton treatments, we can reduce the exposure of the normal part of the brain, the brain away from where the tumor is, which allows the brain to grow and develop normally. In previous years, when we only had X-ray treatments, many children who required radiation for brain tumors would have developmental delays or effects on their thinking and memory and learning that now, we can avoid using proton treatment.

Other things in the brain that are also really important are our endocrine system, which is what provides us with both hormones and the hormones that trigger puberty and by being more precise with radiation, we can keep those areas healthy, so we don't see those effects on growth and development that we used to do with traditional radiation.

And especially in young people, but in adults as well, by reducing the radiation exposure of the normal tissues, we can reduce their chance of secondary cancer because of radiation. Where we do know that radiation cures many cancers, but we also know that radiation exposure can put people at risk for second cancers in the future. By reducing that radiation exposure of the normal, healthy cells, proton allows us to reduce that risk of second cancers by more than 50% in almost all cases where it is used.

Dr. Turck:
Now, in ensuring that our youngest patients can access proton therapy is essential. So what support is available for patients to help make travel to proton centers affordable?

Dr. Laack:
Although the numbers of proton centers are increasing and I think there are about thirty in the country right now, it's still not widely available. But almost all proton centers have done as much as they possibly can to ensure especially the most vulnerable patients and the patients that will benefit the most from proton, which are our children, have access to treatment. Many are built near or around Ronald McDonald Houses or other charity houses where housing is often provided for free or at minimal low cost for patients that are needing treatment. The vast majority of proton centers have social work programs that work with community foundations and national foundations that provide travel grants and awards regardless of financial need and some families are worried about having to share their financial information. Many of the grants that help with travel expenses and just life expenses because families may have children that are at home and needing to have care for them if they're traveling with one of the children for treatment. And so I would say don't let finances be a deterrent, there is help out there and all the proton centers have staff that are trained to help find that kind of assistance for their patients.

Dr. Turck:
For those just tuning in, this is *Advanced Treatments and Innovations from Mayo Clinic* on ReachMD. I'm Dr. Charles Turck and today I'm speaking with Dr. Nadia Laack about advances in radiation for pediatric brain tumors.

Now, Dr. Laack, if we look beyond proton therapy, what are some of the other advanced imaging techniques available, and how are they impacting the precision and accuracy of our radiation?

Dr. Laack:
We talked about how precise proton treatment can be, but because we can direct it, we can make it stop exactly where we want to and that reduces the radiation exposure to normal areas of the brain. But if we can't find or localize the treatments, then it's like we don't have a sight on our sniper rifle. We have this super precise machinery, but without the best imaging, we may not be able to take full advantage of the capabilities of this highly accurate machine. So we've also been studying different ways that we can find tumors that are hiding in our traditional imaging, most tumors are found with CT's or MRIs, but in radiation oncology, we've learned over many years of studying tumors and how they regrow or recur that there are often fingers or tentacles of the tumor that we can't see that are, kind of, the root system of the tumor that we can't see mixed in with normal brain or normal muscle or normal bone, depending on where the tumor is.

There are advanced treatments, specialized PET scans, for example. We use amino acid PET scan called F-DOPA that we have been able to use to see brain tumors, for example, that are hidden in normal brain that are not visible on MRI. There are other advanced types of MRIs where things are done to find areas of high blood flow or changes in basically the pressure or elasticity that would suggest there's other things beside normal muscle mixed in with the muscle that you're seeing on an MRI elastography, so there are newer imaging techniques that help us take full advantage of the highly accurate and precise radiation that we're able to do now.

The other thing that we're using, and people have heard a lot about this recently, is artificial intelligence or machine learning neural networks. Basically, we're using machines to help us look at scans and see things that aren't visible to the naked eye. So we can train computers, it's called radiomics when we are training radiographic images, we can train computers to look through multiple different features of MRIs and tell us that there's something hiding in this area of the MRI that we can't see with the naked eye. And it can tell us things about the aggressiveness of a tumor, how quickly it's dividing based on the different densities that it's seeing that we can't see. We've been able to use radiomics to tell us, even without a biopsy what type of brain tumor it is or how aggressive the sarcoma is, tell us genetic features. We've learned that some tumors have certain genetic features that predict their responsiveness to radiation or chemotherapy and now we're able to use radiomics to look at these MRIs and say, 'There's a 90% chance that this tumor has these gene deletion, which means it's going to be much more sensitive to radiation and/or chemotherapy'.

Dr. Turck:
And as I understand it, we're also seeing some advances related to the combination of radiation with new medical treatments like you were just describing now. What more could you tell us about those?

Dr. Laack:
Radiation and chemotherapy, as well as combinations with surgery, have been the cornerstone for many cancer treatments for many years now. What's changing is in the past, we would have to study a hundred patients, use radiation and chemotherapy A and say, 'Well 70% of those patients did well with those treatments, 30% didn't', but we weren't really able to figure out ahead of time which 70% really benefited and which 30% were not going to benefit from these treatments.

What we're doing now, and this has been coined personalized or precision medicine, but we're increasingly able to do with pediatric tumors as well as adult tumors is review the genetics of the tumor before we even get started, get a genetic profile of the tumor to understand based on the genetic components that it has, which chemotherapy choices are going to work, which chemotherapy choices are less likely to work, is it going to be more or less sensitive to radiation so we can either reduce the radiation dose, if it's going to be a sensitive tumor. We've done that with head and neck tumors now where we can treat some head and neck tumors with much lower doses than we've ever had to in the past because we've been able to see that ones that are associated with some of the virus like HPV are much more sensitive to treatment. And other tumors that have genetic mutations that make them more resistant, and we need to increase the dose of radiation if we want to have a chance for success.

The other area that's growing really rapidly in cancer treatment is the combination of radiation and immunotherapy. And immunotherapy is basically trying to simulate your body to find the cancer, it's like trying to get a vaccine to help your body find a virus. We're using medications that help train the body to find specific cancers as well as increase the immune system's effectiveness. And sometimes what we've done is use radiation as a vaccine. We'll use radiation to blow up a small area of a cancer so that releases those antigen particles, like you would with a vaccine, it releases the bits of cancer that make the immune system be able to find the cancer where it was before, able to evade and stay under the radar for immune system. So by combining radiation with these immune drugs, we're helping the body find the tumor in other parts of the body as well.

Dr. Turck:
Now before we close, Dr. Laack, what's the most important takeaway you'd like to leave with our audience today?

Dr. Laack:
The vast majority of children with brain tumors and honestly children with tumors in almost any part of their body will benefit from proton therapy if they need radiation to treat their tumor. The advances that we have developed, both in proton radiation as well as in the precision and individualized treatment, the targeting, the localization, the combinations with immune therapy are making brain tumor treatment more effective and safer, significantly less toxic than it ever had been before.

Dr. Turck:
Well considering the number of children who are diagnosed with brain tumors each year, it's great knowing that certain options are advancing our ability to reduce radiation toxicities in our youngest patients. And with that, I'd like to thank Dr. Nadia Laack for joining me to discuss those developments. Dr. Laack, it was great having you on the program.

Dr. Laack:
Oh, thank you so much for having me.

Announcer:
You've been listening to *Advanced Treatments and Innovations from Mayo Clinic*. To access other episodes of this series, visit reachmd.com/mayo-clinic-innovations/ where you can Be Part of the Knowledge.