



## Neurosurgery for Spinal Metasases

Hosted by: Anees Chagpar, MD

Guest: Joseph Cheng, MD, MS, FAANS, FACS,  
Professor of Neurosurgery, Yale School of  
Medicine

May 21, 2017

*Support for Yale Cancer Center Answers is provided by AstraZeneca, working side-by-side with leading scientists to better understand how complex data could be converted to innovative treatments. More information is at [astrazeneca-us.com](http://astrazeneca-us.com). Welcome to Yale Cancer Answers with doctors Anees Chagpar, Susan Higgins and Steven Gore. I am Bruce Barber. Yale Cancer Answers is our way of providing you with the most up-to-date information on cancer care by welcoming oncologists and specialists, who are on the forefront of the battle to fight cancer. This week, Dr. Chagpar welcomes Dr. Joseph Cheng for a conversation about neurosurgery and cancer that is spread to the spine. Dr. Cheng is a Professor of Neurosurgery and Director of the Neurosurgery Spine Fellowship at Yale School of Medicine and Dr. Chagpar is director of the Breast Cancer at Smilow Cancer Hospital.*

Chagpar Let's off by talking about what exactly neurosurgery is and why we need to even worry about it in terms of cancer?

Cheng That is a great question. Neurosurgery is basically the surgical treatment of things related to the neurologic system, whether it is the brain, the spinal cord and actually the surrounding structures as well, for example the spinal column or the skull. It is pretty important with cancer just given the amount of patients that actually will present with cancer in their life with a large number of these metastasizing or spreading to the spine, a lot of this is just due to the fact that when cancers spread to the blood stream, the amount of bone marrow that we have in our spine makes it one of the favorite sites where cancer is lodged, similar to the lung, wherever there is a large amount of blood that passes through the structure there is a higher risk of cancer lodging there and growing.

Chagpar So when people talk about cancer spreading to other organs, it spreads to your bone, it spreads to your lung, it spreads to your liver, most people think at that point, you know, there really is not curative treatment and many people think of surgery as curative treatment, so how does neurosurgery play into all of this?

Cheng For example, focusing on spine would be one of the options for patients that present with a cancer to the spine. I am not saying that surgery is the only way to treat it and it really depends on a number of factors including what type of cancer it is, how much it is spread, its affect on other organs and so that is why we use calcification systems and really protocolize approaches using the best evidence available and choosing what patients need. Just because you have a spinal or a cancer that goes to the spine, you may have options such as radiation or chemotherapy alone or may be a need of combination of both or for certain cancers, for example very malignant cancers, like chondrosarcomas or chordomas, you may need a very aggressive surgical resection in order to keep that type of tumor in check just because those do not respond very well to either radiation and/or chemotherapy.

Chagpar So, chondrosarcomas and chordomas, those are not cancers that many of us hear a lot about. Can you tell us more about those particular cancers and their approach?

3:17 into mp3 file [https://ysm-websites-live-prod.azureedge.net/cancer/2017-YCA-0521-Podcast-Cheng\\_303767\\_5.mp3](https://ysm-websites-live-prod.azureedge.net/cancer/2017-YCA-0521-Podcast-Cheng_303767_5.mp3)

Cheng Well, those are the more malignant ones. So chordomas are types of cancers that come from remnants of tissue, something called a neuro cord that forms the inside of your disk space. When they become malignant in rare situations, they can start forming very aggressive tumors that then grow into the surrounding structures. Unfortunately, they are not very sensitive to either radiation and/or chemotherapy and so because of that, you really have to kind of remove it. I always kind of tell patients treating cancers of spine is almost like having both an exterminator and a carpenter as a surgeon or the carpenter. So the exterminator sprays for the termites that are eating away the wood and it works out well and the wood has kept its integrity, there is no need for a carpenter to come in to fix things, but if the wood is eaten away or if the termites are too deep to even reach by the exterminator, you may need someone come in and help you access that or cut it out if it is a type of bug that does not respond to anything products used to exterminate them and so that is why we work as a team.

Chagpar So a chordoma is really a cancer of the spinal cord, is that right?

Cheng Of the spinal column. There are other cancers as well that can spread to the spinal cord and that is why really a specific approach based on what the patient needs and what the tumor is really is important.

Chagpar So tell us more about how neurosurgery plays into when cancers outside of the spinal cord spread there, so you know we talk about breast cancers being really common, lung cancers being really common, and people know that these cancers can spread to bone, and often to spine. How often does that involve the spinal cord and does neurosurgery play a role in those patients.

Cheng It does and I think one of the things we will have to clarify is when it comes to surgery of the spine, neurosurgery actually covers the gamut. People always think of things of bone being orthopedics and nerves being neurosurgery, but the majority of spine work is actually done by neurosurgeons based on statistics on the amount of surgery. So for example, things like lumbar fusions, lumbar discectomies, and even spinal deformity surgeries are things that neurosurgeons will do as far as you know treating patients. So if a neurosurgeon is going to be operating on the bones, for example in spinal deformity, which is again something I do, it only makes perfect sense that I would also then want to take care of tumors of the bone that are surrounding that area of the spine.

Chagpar So how do you figure out in a given patient whether they need a neurosurgeon or whether they can have their metastasis treated just with chemotherapy or with radiation, like how does that decision happen?

Cheng Great question. It really starts off by understanding that we do have ways of classifying and putting up with protocols for patients with cancers. So for example, looking at things like

6:34 into mp3 file [https://ysm-websites-live-prod.azureedge.net/cancer/2017-YCA-0521-Podcast-Cheng\\_303767\\_5.mp3](https://ysm-websites-live-prod.azureedge.net/cancer/2017-YCA-0521-Podcast-Cheng_303767_5.mp3)

where the tumor is spread, what type it is, and really what else has it affected as far as organs among other factors like the patient's overall status of health, something we call a Karnofsky scale or their ability to function. So for example, if we have a tumor that a biopsy shows to be something as radiation sensitive like a lymphoma or plasmacytoma, unless there is a fracture or instability of the spine, most of these tumors are recommended to have radiation to it. If it is a minor fracture or something that is not grossly unstable, then you may even have more minimally techniques like kyphoplasty or vertebroplasty where cement is put in to stabilize the bone. On the other hand, if the tumor is more malignant, say a metastatic renal cell carcinoma or a cancer from the kidney that require surgery or a tumor like that does push against the spinal cord causing spinal damage, then a more aggressive surgery may be needed with coil embolization or using catheters to block off the blood flow to this cancer before even tried to treat it and so that is why it is really important to understand that the diagnosis of cancer is pretty important along to help derive the rest of the treatment options. As far as the treatment, it also depends on where the tumor is and what the patient expects, so for example for cases like chordomas that you mentioned before, sometimes in order to promote the most amount of life we focus on two things, the quantity of life and then the quality of life. If it is a metastatic disease, we know surgery won't improve the quantity of life with surgery, then really we focus our surgery on how to improve the quality of life for the patients, so a patient with the metastatic disease that has no problems and no symptoms, probably won't have surgery right away, just because we are not going to be able to help them significantly. On the other hand, if it is a tumor where we are working on the quantity of life that is something that we know by an aggressive surgical resection, we can improve their life span, then we have to have that tough discussion about what type of residual problems or you know disabilities the patient is willing to accept in exchange for trying to take out a tumor with margins or at least enough to get some good control so it does not come back pretty quickly.

Chagpar So just so that we are clear, when you are operating to extend somebody's longevity, that is really for tumors that are of the spinal cord, these chordomas. Can you extend quantity of life in metastatic disease with surgery that is metastasized to the bone or does that depend on the tumor type or how does that work?

Cheng It totally depends on the tumor type. So some of the more common ways we look at tumors are as far as the issue with the metastatic disease is one, is it isolated to the spine as far as the metastatic disease or is it in other organs such as the brain, the kidney, and the lungs? For example, if someone has multiple metastatic lesions, not just of the spine, but of the brain and liver, the odds of us offering a big surgery are pretty low because we are not really going to be able to help that patient either way. On the other hand, if it is a tumor, such as an adenocarcinoma or even renal cell where it is an isolated area in the spine and there does not seem to be any visceral or that has metastasized to the other organs and it is also a tumor that is moderately sensitive to chemotherapy or radiation therapy, then we may talk to the patient

about doing a more aggressive resection including having to pick up more bone and do a bigger reconstruction just so that we can give them better chance of what is called local control or control of tumor in that area and so those are all why it is important when patients come in, to be able to kind of look at them individually and not make blanket judgments on what they need and really tailor it to their disease process.

Chagpar So when you are thinking about these surgeries, you are taking out pieces of bone, you are kind of working alongside the spinal cord. What are the risks of that surgery, a lot of patients might have some trepidation about the side effects of surgery.

Cheng Absolutely, the side effects of surgery are everything from bleeding, infection, leakage of the spinal fluid around that area with damage to the spinal cord, causing things like paralysis, bowel, and bladder loss come up, you can die, the hardware can fail, the bones could break.

Chagpar Dr. Cheng, this is not sounding very good.

Cheng There are a lot of potential risks, but it is also one of the reasons why training in neurosurgery in order to treat patients is not something that you can do in a 2-week course or a 6-month course and it takes a few years of experience through residency and so forth with many surgeons doing a fellowship even afterwards in complex spine including in order to manage these types of tumors. However, that being said, it is not that if you don't do surgery, none of these risks are there. The reason we offer surgery for many times are because those risks or those complications are happening without surgery, so patient with a metastatic disease to the spine that is growing or it is pushing on the spinal cord causing paralysis sure, there is always a risk of paralysis with surgery, but we already know the patient is progressing to paralysis without surgery, so these are not what we would consider elective procedure, so it is not like plastic surgery with a facial lift, where you may or may not really need it. No one really takes a vacation to have neurosurgery on a site as much as you come in because there are no other good options.

Chagpar So are these surgeries often things that are emergent, like they have to be done within 24 hours or these things that you know you really need to plan or is it somewhere in between or it is dependent on the case?

Cheng It really depends on the case. There are some patients where they have a metastatic tumor that is seen before there is a fracture or before it grows and starts compressing the spinal cord, in those you have more options as far as how do you treat it. Unfortunately, sometimes they get to the point where patients may have some back pain, they really do not realize that they have an ongoing issue and they present to the emergency room because they have a sudden fracture or lose the ability to walk, they are unable to control the urine or ability to go

to a bathroom and when they come into the ER in that sense, then we do not have a lot of options, but to try to act pretty quickly and so it really depends on the patient and really the presentation.

Chagpar So there is a lot going on in neurosurgery when it comes to cancer and I want to find out more about the advances that have been made in neurosurgery and the treatment of tumors that go to the spine right after we take a short break for a medical minute. Please stay tuned to hear more from my guest, Dr. Joseph Cheng.

### *Medical Minute*

*Support for Yale Cancer Answers is provided by AstraZeneca, a biopharmaceutical business that is pushing the boundaries of science to deliver new cancer medicines. More information at [astrazeneca-us.com](http://astrazeneca-us.com).*

*There are many obstacles to face when quitting smoking as smoking involves the potent drug, nicotine, but it is very important for lifestyle change, especially for patients undergoing cancer treatment. Quitting smoking has been shown to positively impact response to treatments, decrease the likelihood that patients will develop second malignancies and increased rates of survival. Tobacco treatment programs are currently being offered at federally designated Comprehensive Cancer Centers, such as Yale Cancer Center. The American Cancer Society estimates that more than 60,000 Americans will be diagnosed with head and neck cancer this year, although the percentage of oral and head and neck cancer patients in the United States is only about 5% of all diagnosed cancers, there are challenging side effects associated with these types of cancer and their treatment. Clinical trials are currently underway at federally designated comprehensive cancer centers such as Yale Cancer Center and Smilow Cancer Hospital. Smilow Cancer Hospital's tobacco treatment program operates on the principles of at the US Public Health Service clinical practice guidelines. All treatment components are evidence based and therefore, all patients are treated with FDA-approved first line medications for smoking cessation as well as smoking cessation counseling that stresses appropriate coping skills. More information is available at [YaleCancerCenter.org](http://YaleCancerCenter.org). You are listening to WNPR Connecticut's Public Media Source for news and ideas.*

Chagpar Welcome back, we are talking about neurosurgery and neural surgery, particularly in the context of cancer that is spread to the spine and right before the break, we were talking about the complexity of neurosurgery and Dr. Cheng gave us a whole laundry list of all of the potential side effects of surgery of the spine, but noted that cancer left unabated also has many side effects, but Dr. Cheng are we moving towards better surgical techniques, are there new technologies, fancier things that we can do more minimally invasive things that we can do that are minimizing the side effects of surgery and making it safer?

Cheng Absolutely, one of the main side effects of surgery is actually performing surgeries, cutting into tissues, accessing the cancer that is there and creating side effects from the damage that

16:15 into mp3 file [https://ysm-websites-live-prod.azureedge.net/cancer/2017-YCA-0521-Podcast-Cheng\\_303767\\_5.mp3](https://ysm-websites-live-prod.azureedge.net/cancer/2017-YCA-0521-Podcast-Cheng_303767_5.mp3)

we cause as surgeons and that is one of the reasons why more minimally invasive techniques are really taking hold, things you know using, you know, microsurgical techniques, you know things that are percutaneous or using needles, like I mentioned before like putting in bone cement into the tissue or into the bones such as vertebroplasty or kyphoplasty. We also have a move towards using a lot more image guidance, so instead of using a larger incision, so that as surgeons we can see the tissues, see the bones, see the tumor and see what is going on, we are now able to use things like intraoperative CT scans which we convert to a 3-dimensional model and using imaging guidance for navigation that tell us where our tools are, where we are cutting, what bone were affecting and then it allows us to really treat tumors and this is really kind of an irony with surgical precision than what we used to do as surgeons which we thought we had a lot of surgical precision already. There is also a lot of technologies, for example, with robotics that allows us to be able to make finer cuts, address things in a smaller space, to be honest even though we are surgeons and we feel pretty full ourselves at times, we are still human and we are still limited by our technical abilities with our hands and using things like robotics, it really gives us a better ability for finer control more accurate placement, for example of screws, hardware in order to reconstruct a spine and those are really exciting advances that we are seeing in the area of spinal surgery.

Chagpar      So I have a few questions. The first is with regards to robotics, you talk about robotics giving you finer precision in terms of placement of things instead of using your hands. It is not like a robot actually doing the surgery right, there is a surgeon controlling the robot?

Cheng        There is and it is funny, so even though we use the word robotics because that is what we are used to, one of the terms that are really coming up is something called co-bot, that is a robot does the procedure, while the co-bot is a tool that helps us perform the procedure or robotic assisted surgery and so absolutely, the surgeon still guides the tool per se using the robotic hands, but really what the robot does is, it allows us to do things in a more precise way to plan trajectory, so for example, once we navigate the amount of tissue we want to cut in the spine where we want to access the tumor, we can more precisely using a robot remove those tissues or again put in hardware, reconstruct the spine. There are so many variations that are still continuing to evolve as far as what we use our tools for.

Chagpar      People are talking about this book that came out *Industries of the Future* and I think there was an episode of *60 Minutes* about how robots are going to take over all of our jobs and I just wanted to make sure that your job was safe in terms of being a neurosurgeon and that a robot is not going to take out somebody's cancer without having somebody who has been to school for many years to know what to take out. So we have to make sure that is the case. The second question, with regards to intraoperative imaging. Tell me more about how that works, you mentioned intraoperative CT scan and some people who may have had the CT scan know

that a CT scan is kind of a like a donut that you go into and the thing takes pictures, but is the patient on an operating room table, is there also a donut there, and are you in the donut, I thought you cannot be exposed to x-rays, how does all of that work?

Cheng Great question, so the CT scan is a donut and the intraoperative CT scans, the donut actually opens up to almost like a C-shape so that the patient can be within the donut per se. The patient is on an operating table and just one of our regular operating tables and the donut or the big intraoperative CT is actually wheeled into the room by our x-ray technicians, they open up the gantry of the hole so that we can slide it over the patient and then it closes back over the patient to do that and that is how we obtain our intraoperative CT scans.

Chagpar So then, how do you operate if they are in these donuts?

Cheng So we don't operate within the donut, so the donut that is a CT scan does the CT and collects the images of the spine. While we do this, there is something called fiducial which is a marker that we put outside the patient's body, but it is anchored in the bone, typically the iliac crest with a hip or another bony surface and the navigation technology that allows us to navigate on the CT images based on where this fiducial is, where this frame is attach to the patient, so we know where the tools are, so once we collect the CT images, the donut is actually removed, the CT scan, and then we use the navigation system based on the CT scan images that we see on the screen to see where we are.

Chagpar So that navigation system directs you to where you need to operate?

Cheng Absolutely and one of the reasons we do that is CT scans, x-rays have a lot of radiation. By collecting the image once and then navigating based on the image of the patient using the navigation system, we do not have to expose the patient to continuous CT scans or continuous x-rays that we used to have to do with fluoroscopy or intraoperative x-rays compared to using the navigation systems.

Chagpar It seems to me that these two technologies, this intraoperative imaging as well as the robotics, they seem to be complementary, is that right or do you kind of use one or the other?

Cheng Very complimentary, but it builds on each other, so we can use the navigation system without the robot, but robotic system requires a navigation system to be effective.

Chagpar And so that brings me to the next question, which is, does everybody get their surgery with intraoperative imaging and/or robotics or is traditional plain old open neurosurgery of your spine happening?

Cheng All the above and the reason why is that even though navigation and the new technology that we are using is helpful for patients, not every patient needs it and so for those patients that need it absolutely, we will make sure that they get the best options possible, but any center that takes care of cancer will definitely want to offer it, but not everybody will need it and sometimes even those techniques may not be the best if you have tumors that are in certain locations, maybe closer to surface and to the soft tissues where by putting in the retractors, the tumor moves and therefore, the navigation system will by definition be off when the tissue shifts around it, so there is a lot of variables that are still needed for the surgeon to think about.

Chagpar So it is not always that these navigation systems are better?

Cheng That is right, so all these tools that we have are really just various tools in our tool box and so sometimes the hammer is the best tool, sometimes the wrench, sometimes the power screwdriver, sometimes not, and that is why we have to think of it as a way of all of these things whether it is cooking using spices or using a tool box to fix your deck, you just want to make sure that you have the ability to have the right things available for what you want to do, but there is no one perfect tool that does everything that we use on everybody.

Chagpar Which brings me to another concept, which is so often on this show, we have talked about multidisciplinary care and kind of bringing entire teams together to think about optimal management of a patient with cancer and it seems to me that, you know radiation and chemotherapy may also be tools in your tool box. Can you talk a little bit more about how that multidisciplinary aspect plays into what you do in terms of surgery for spinal metastasis or spinal tumors?

Cheng Absolutely, the whole idea of team based approach is really important because patients do not come to us for a surgery, they come to us for a disease or problem and whether it is spinal metastasis or for example, Parkinson's disease, patients do not come so we can put stimulators in their brain, they come to us to help treat Parkinson's. Seeing a surgeon is just one of the entry ways into the system, but whether a patient with spinal metastasis sees an oncologist, sees a radiation-oncologist, sees a neurosurgeon, sees a primary physician, they are all these ways where they can get into the right system and so the whole idea is that based on the disease, based on the presentation of the patient, how much the cancer has spread, what structures it is against will then determine how we treat it. So if I see a patient with a lymphoma or plasmacytoma or a radiation-sensitive tumor, will I offer surgery right away, absolutely not. If we know that, it may be a referral to one of our radiation-oncologist. Even for cancers that may need surgery, they may be a candidate for what is called radiosurgery which is using high focus radiation to target tumors in a way that is less invasive than open surgery depending on where it is. We are also doing new novel techniques which we are

26:59 into mp3 file [https://ysm-websites-live-prod.azureedge.net/cancer/2017-YCA-0521-Podcast-Cheng\\_303767\\_5.mp3](https://ysm-websites-live-prod.azureedge.net/cancer/2017-YCA-0521-Podcast-Cheng_303767_5.mp3)

about to launch here at our center, but are done at other centers using things like laser interstitial therapy that is using laser ablation that lasers to heat up tumors to separate it from that, options including using a combination above for we do small surgeries called separation surgery, just getting the surgery away from the spinal cord, so you can radiate that field. The main problem with radiation around the spine is that the spinal cord does not tolerate the radiation very well, so if you are trying to avoid paralysis or spinal cord injury that is an issue, so we may not even take up the whole tumor, we just create a mote around the spinal cord to give it room, so that we can give a larger dose of radiation around it, so there is all sorts of different things that we can do as far as treating spinal tumors.

Chagpar      What about chemotherapy? I mean a lot of people talk about chemotherapy and difficulties with the blood-brain barrier. How does chemotherapy work in terms of spinal cord cancers?

Cheng        That is an excellent question. It really depends on the cancer as far as how you want to treat. So for example, a patient with a small round blue cell tumor like a Wilms tumor for example, may actually benefit from preoperative chemotherapy to actually shrink it before we go in surgically to remove it. As far as the blood-brain barrier, the metastatic tumors we talk about do not have one, just because they are outside of that boundary, they actually will interface with the drugs pretty well. However, those are within the blood-brain barrier. There are a lot of novel techniques that are done by some of our endovascular neurosurgeons in order to deliver focused chemotherapy to that area, what we call, catheter-based delivery or other things like convection therapy where a catheter is put in and chemotherapy is dripped into that area to do a local spread, similar to if you have dandelions growing in your yard, but you do not want to spray the whole yard, you may just want to target and spray one area using a garden hose, or whatever weed killer that you have. I know it may sound silly, but it is really similar where when you are treating cancer, you know, you need to think about how do you deliver the toxins or the chemotherapy just to the cancer and try to protect the good structures, the stuff that you don't want to be affected by the drugs.

*Dr. Joseph Cheng is Professor of Neurosurgery and Director of the Neurosurgery Spine Fellowship at Yale School of Medicine. If you have questions, the address is [canceranswers@yale.edu](mailto:canceranswers@yale.edu) and past editions of the program are available in audio and written form at [YaleCancerCenter.org](http://YaleCancerCenter.org). I am Bruce Barber reminding you to tune in each week to learn more about the fight against cancer here on WNPR, Connecticut's Public Media Source for news and ideas.*