Thank you, thank you and welcome everyone to Cancer Center, and really pleased with how we continue to innovate on formats in this new Zoom World of of the pandemic. And I think today’s session is going to be interesting given the nature of four speakers and various levels of their training and professional development and are. The great work that’s going on in Cancer Center in our University and health care system and you know, really focused on.
radiology and biomedical imaging
and the science associated with it,
most notably in Interventional Oncology.
Please introduce Doctor David Madoff is,
as you may recall from last week,
doctor Madoff is the Co director of Interventional Oncology of the
Interventional and college research lab vice chair for clinical research,
and the section chief for
Interventional radiology.
An Department of radiology
and biomedical imaging,
and David really has throughout his career have been an innovator in this space. And with his joining the faculty at Yale now a couple of years ago, I guess has really built out not only the capabilities in our clinical operations, but expanding research which is really exciting.

And so David I turn it over to you to sort of introduce the other speakers and share with us all this great work. OK, thanks Charlie. So I’d like to again, thank you for giving me the opportunity to speak in Yelp, Cancer Center grand rounds.

As you saw it last week I was part
Today’s session, as you stated it will be focused on Interventional oncology. Therefore, this program will focus on work being done by our trainees and not really on my own personal work. I will just be introducing the topics. And our vision and goals for the Interventional Oncology Program at Yale. So this session, as you may recall, was originally planned for March 10th and it was just after the kovid pandemic.
So interesting, Lee,
It’s actually given us more time
to make our data even more mature.
So for the audience for today.
So I’m really pleased. I think about that.

So I’m going to start and then will be followed by Julia Shapiro,
who happens to be the Co director
of the intervention college.
Live with me.
He’s actually an assistant professor
of radiology and biomedical imaging,
while actually,
and I are resident so that shows you
the level of achievement that some
NOTE Confidence: 0.8278826
00:03:01.836 --> 00:03:04.374 of our colleagues really have and
NOTE Confidence: 0.8278826
00:03:04.374 --> 00:03:06.834 then will be followed by Jessica
NOTE Confidence: 0.8278826
00:03:06.834 --> 00:03:09.398 Santana and tells Evie who are both
NOTE Confidence: 0.8278826
00:03:09.398 --> 00:03:11.559 graduate students in our lab and
NOTE Confidence: 0.8278826
00:03:11.559 --> 00:03:13.869 the work will all be talking about
NOTE Confidence: 0.8278826
00:03:13.869 --> 00:03:16.129 liver cancer and Interventional
NOTE Confidence: 0.8278826
00:03:16.129 --> 00:03:17.986 oncology related activities.
NOTE Confidence: 0.8278826
00:03:17.990 --> 00:03:20.874 So let me just share my screen.
NOTE Confidence: 0.9124253
00:03:27.170 --> 00:03:30.610 OK, so. Really,
NOTE Confidence: 0.9124253
00:03:30.610 --> 00:03:32.250 what is Interventional oncology?
NOTE Confidence: 0.9124253
00:03:32.250 --> 00:03:34.395 Well intermixed oncology is a
NOTE Confidence: 0.9124253
00:03:34.395 --> 00:03:35.682 subspecialty of Interventional
NOTE Confidence: 0.9124253
00:03:35.682 --> 00:03:37.419 radiology that utilizes minimally
NOTE Confidence: 0.9124253
00:03:37.419 --> 00:03:39.063 invasive image guided procedures
NOTE Confidence: 0.9124253
00:03:39.063 --> 00:03:41.491 to both diagnose and treat patients
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with various forms of cancer.

The benefits of primary intervention oncology treatments or its immediate tumoricidal effects.

As you I’m sure are aware, there minimally invasive, resulting in cost reductions and time Efficacy.

The goal has been to make the case as well as having minimal systemic side effects leading to an overall improved. Quality of life.

The goal has been to make the case for us becoming the 4th pillar of cancer care and over the years I believe we have and this has been shown actually in many ways.
These include having IO therapies incorporated into multiple NCCN guidelines which include colorectal metastases include HP be an even in renal cancer, having trials to assess the role of Percat Aneus management of cancer, and what I believe is most important. Is that, I believe now become a valued participator in most if not all of tumor boards. So what does it take to become a pillar of oncology? Clearly each clinical discipline needs to have a strong foundation in basic,
translational and clinical research.

We do have some work to do in this regard,

but I must say I was really thrilled to see when I was in 2016 as an invited faculty of Asco GI.

My discipline next to my name was listed actually as an Interventional Oncologist,

not an interventional radiologist,

so I was really happy at that time,

and I thought we actually made it.

However,

I really do believe that in terms of research and education of referring physicians,

I think we’re nearly there and on the right track,

but I don’t know if we’ve come there totally.
So here you can see a long list of procedures that we do, and I owe. These can range from image guided biopsy, primary tumor therapy, palliative procedures, central venous access, and managing of complications that are either a result of cancer itself or related to cancer treatments. Clearly it is difficult for Oncologist to treat patients in the absence of a diagnosis. That said,
cases such as this one should be easily doable for any experienced interventional list, and as you can see, this patient has confirmed metastatic adenocarcinoma. So here is the second case, which I would say is much more challenging due to lack of any imaging finding on CT or ultrasound and you can see here it’s closed and proximity to the heart. Fortunately we were able to get adequate tissue sampling and help this patient get the appropriate chemotherapy that they needed to be on.
So I just wanted to discuss a couple of primary intra interventional oncology tumor therapies, both of which will be discussed in research by our trainees later in the session here we have two more guided ablation or tumor image guided tumor ablation, so the goals of Ablation is to eradicate all valuable malignant cells and stem spare normal surrounding tissues, treat tissues with unfavorable location or pattern of distribution for resection and or have multiple comorbidities. These are the most often used in
patients with low volume disease and required to bulking are typically done in an outpatient setting setting and these procedures are repeatable. So if we can see here we have radiofrequency ablation and microwave which are heat based therapies. We have Cryo Ablation which is a coal based therapy and we actually have irreversible electroporation which is really to electrocute the tumors. Believe it or not, by changing the ionic potentials between the membranes. So ablation of liver tumors, which is in this was its initial indication,
00:07:31.440 --> 00:07:32.684 as shown here in.
00:07:32.684 --> 00:07:35.514 This is 1 case of a patient with
00:07:35.514 --> 00:07:38.136 HTC that needed ablation as a
00:07:38.136 --> 00:07:40.030 bridge to transplant.
00:07:40.030 --> 00:07:43.294 As we can see, 2 1/2 years later,
00:07:43.300 --> 00:07:46.919 no tumor recurrence or any residual disease.
00:07:46.920 --> 00:07:49.251 Next was the case of an isolated
00:07:49.251 --> 00:07:50.250 colorectal liver metastasis.
00:07:50.250 --> 00:07:52.707 Who here you see a pet positive
00:07:52.707 --> 00:07:54.471 or hypermetabolic lesion in the
00:07:54.471 --> 00:07:56.711 right lobe of the liver who was
00:07:56.711 --> 00:07:58.040 successfully treated with Ablation
00:07:58.040 --> 00:08:00.573 and his team are free at one year?
00:08:00.573 --> 00:08:01.239 Follow up.
00:08:03.420 --> 00:08:05.080 This is a patient who,
instead of having a liver lesion, has a lung nodule.

Here we can see that based on having heat based thermal ablation, the patient did very well at seven months. As you can see, there’s no residual tumor on the image Ng, and there was no local recurrence seen at three years. We can also treat bone metastasis. This is a patient with metastatic breast carcinoma with a focal right femoral and right hip pain limiting mobility for whatever reason, she refused radiation therapy and was treated with heat based thermal ablation and Samantha.
plasty is shown here and she had an immediate improvement in right femoral pain from 8 to 10 out of 10.

This is a very interesting use of thermal ablation in this case, with cryoablation. This patient had metastatic Rectal Squamous Cell Carcinoma who had severe intractable 10 out of 10 pain, secondary to inoperable tumor recurrence infringing on the sacral nerve roots. She was successfully treated with partial cryo ablation of the bowel and you can see right here the low density ice she had immediate
or should say complete resolution

So she had actually no.

Team up until a year, at which time she actually died

Lastly we were able to treat this liver tumor here.

That was a budding the left hepatic bile duct.

So we used Ayari again, that’s basically electrocution,

which is technically a non thermal ablation.

So about nine months later the patient has no residual disease or recurrence.

We also have more regional therapies such as transarterial embolization.
In these cases are typically reserved for patients with higher tumor burdens or are in neoadjuvant settings, or in cases where resection or ablation is in a location considered terribly difficult or dangerous.

He We see a case of a patient with HIV, cirrhosis and a 4.8 centimeters segment. HTC Embolization was performed to maintain the patient on the transplant waiting list. We see completing the Krosis, and she alternately underwent a transplant. This is a patient with compensated HTP, sarot sis, Anna Sala,
Terry HTC and segment 8 and a platelet count of 57 who also needs treatment.

There’s a bridge to transplant.

This tumor is shown here is in a very difficult location, and she successfully underwent embolization with no residual tumor,

and this patient also underwent liver transplantation.

Here we’re able to see a patient that was treated in their 90s who has a large HTC.

In this case, the ACC actually ruptured through the capsule, and as you probably are all aware,

this is associated with poor, if not dismal, prognosis were able to successfully
treat it with radio embolization,
which was done as an outpatient,
and this can be seen here.
She had complete response and lived
up to five after four years later,
and then Lastly.
This is a case of a patient that has BI lo
or HTC with extensive portal vein tumor.
Rambus, so typically this patient would
have less than six months to live,
but as expected, this is a relatively
young patient with the family,
small young children, etc.
So we try to offer procedure to help this
patient and we did Chemoembolization,
and Fortunately we were successful in prolonging his life for about 16 months.

So to wrap up, I just want to give you my five year of vision for a modern academic evidence based intervention on college program. First we want to increase the IO clinical research programs throughout the smilow cancer hospital and kiss centers throughout the area.

Further, it will be important to improve the education for the community provider of the procedures that we offer and which patients are more likely to benefit.

We also need better integration of care
into current and future oncology workflows.

We will be working on initiating some new clinical trials related to liver oncology.

As discussed last week on liver generation was, which was dragging one study, but we also are going to be involved in the leap 012 study, which is going to be an immunotherapy chemo embolization plus or minus immunotherapy that we’re going to be initiating or starting very soon. And then it’s also going to be critical to have faculty who are sub specialized to be able to
provide this level of advanced air.

We also plan to make image guided biopsies more readily available and hoping to improve turn around time.

There have been ongoing discussions with Doctor Chen Lu as you all know is the chair of pathology.

As will be seen from the next speakers, we are currently working on advanced preclinical and Translational research with a focus on molecular imaging immuno oncology.

We’re also very active in machine learning and artificial intelligence as
it relates to liver cancer and based on these interesting topics we hope to be able to achieve and expand our funding. And Lastly we have a newly established IR residency program. In this we would like to develop an Interventional Oncology Fellowship and we are looking into the possibility of applying for a T32 training grants. So with that, these are visions and goals I’d like to then introduce my Co director for the Interventional Oncology Research Lab at Yale, who will be discussing
quantitative biomarkers,

molecular imaging in artificial intelligence
to guide the therapy of liver cancer.

So thank you for your attention.

Alright, thank you very much everyone.

I’m really excited to be presenting this topic on behalf of our lab and this is more of a vision presentation of what we’ve accomplished and a couple of thoughts that we put together over the last years. None of this would have been possible without really vast infrastructure of collaborators, which I’ll be talking about a little bit later.

I want to say that I very excited about. David joining the group here and really being
our new leader and Interventional Ecology, and we all completely subscribed to the vision that she just provided. So as you know, I’m going to be focusing on the liver cancer, and primarily I’m going to start off with a BC else staging system. The most recent one was released in 2018, and even in that more recent addition to it we have seen a clear separation between intermediate station advanced stage disease, so they exist. Apparently in two separate planets, however, really in clinical practice and in signs, so they exist.
00:14:43.830 --> 00:14:45.860 this is very transitional area where both 
NOTE Confidence: 0.8774969
00:14:45.860 --> 00:14:48.398 seemed to be interacting quite extensively. 
NOTE Confidence: 0.8774969
00:14:48.400 --> 00:14:50.703 We saw a lot of clinical trials 
NOTE Confidence: 0.8774969
00:14:50.703 --> 00:14:52.978 focusing an overlap of those therapies, 
NOTE Confidence: 0.8774969
00:14:52.980 --> 00:14:55.311 and this is exactly the realm where 
NOTE Confidence: 0.8774969
00:14:55.311 --> 00:14:57.026 most patients are being diagnosed 
NOTE Confidence: 0.8774969
00:14:57.026 --> 00:14:59.308 and also the realm where you know 
NOTE Confidence: 0.8774969
00:14:59.308 --> 00:15:02.004 we think there is most room of 
NOTE Confidence: 0.8774969
00:15:02.004 --> 00:15:03.536 improvement for patient outcomes, 
NOTE Confidence: 0.8774969
00:15:03.540 --> 00:15:05.628 so systemic therapies for HTC then 
NOTE Confidence: 0.8774969
00:15:05.628 --> 00:15:08.130 and now I borrowed the slides for 
NOTE Confidence: 0.8774969
00:15:08.130 --> 00:15:09.896 from Agusan Abou Alfa, who’s? 
NOTE Confidence: 0.8774969
00:15:09.896 --> 00:15:11.776 Medical Oncologist at Memorial Sloan 
NOTE Confidence: 0.8774969
00:15:11.776 --> 00:15:14.690 and this is how the market look like. 
NOTE Confidence: 0.8774969
00:15:14.690 --> 00:15:17.082 Five years ago we just had one drug 
NOTE Confidence: 0.8774969
00:15:17.082 --> 00:15:19.790 and this it’s not even a complete view.
This is where we are right now.

So with him just five years, we have so many drugs being approved and most of 'em actually are very dedicated, specific targeted molecules and checkpoint inhibitors. This flood of novel agents actually probably means the left ship of systemic therapy in the CL. See staging system and what we will witness is a greater overlap between local, systemic therapies of immunotherapy. And this is where we come from. We focused now on the biomolecular mechanisms.
in the tumor micro environment behind those therapies and their combination.

So we focus on two of the well known hallmarks of cancer that are particularly relevant for HTC specifically on its ability to avoid immune destruction and the deregulation of seller energetic into metabolic phenotype.

So let’s have a look at the HTC cell, so we now it has a very pronounced Warburg effect, and this is specifically a cell that is extremely dependent on the glucose metabolism. And so called the Arabic and anaerobic glycolysis, and well,
the glucose is being taken up with that sell.

It produces lactate.

It is that essentially is D Cup from the Krebs cycle,

and this lacked.

It is then being flooded directly into the extra seller micro environment.

And because of that there was dramatic acid ification of the surrounding tumor micro environment.

And what does that really mean for us? The extracellular pH and liver cancer, especially aggressive age species known to be very, very low.

And now finding say that this is a very
important exclusion mechanism for four.

Immune cells and the mechanism of immune cell exhaustion.

So this has been previously reported and we now know more than ever that tumor infiltrating T lymphocytes depend extremely on extra seller acidity and competitive glucose deprivation, and that the reversal of this hostile tumor micro environment can actually improve their infiltration into the tumor. An immune response.

loads for seller pH is a marker of tumor aggressiveness and the presence of Protons and lactate really protects
cancer against an immune response. It promotes new angiogenesis. The lactic acidosis plays in multifaceted role that is not fully understood for all variable immune cell subgroups, and the high lactic levels are actually strong predictors of metastatic disease and poor outcome. So where does all this fit in with taste? So theoretically this is an embolus therapy that changes the tumor micro environment. And what happens is that in theory tastes me potentially exacerbate a hostile tumor micro environment that attenuates treatment efficacy.
Let’s look at it.

I mean, it induces a hypoxic injury that potentially may exacerbate the low pH even further. It potentially stimulates brand eugenic signaling and the embolization even might prevent delected transport away from the tumor. So postdates tumor marker environment was thought to be immune inhibitory, but is that really true? I mean, let’s look at HTC in general, where it stands in terms of Genomic somatic mutations as opposed to Melanoma and lung cancer.
Really, HTC is somewhere in the middle, so the idea of the Immuno and inoculation with locoregional therapies was initially discarded because of that. However, let’s have a look at the pathology of a tumor treated with taste. This is a patient with HTC. Histology was taken 11 days post locoregional therapies that was transplantation. What we see is necrotic tumor packed with drug eluting beads. And surrounding that we see a very
dense immune infiltrate and if we zoom in we really almost see a secondary immune follicles and macrophages and T cells really accumulating the transitional zone. But they can’t really penetrate into the necrotic areas of the tumor where all the good end to Jenison. Why is that? So our mission was at this point to really look at the underlying mechanisms and how do systemic therapies. How does in the immune system and local regional therapies interact? So we wanted to develop imaging instruments for noninvasive functional
characterization monitoring of the tumor microenvironment in the setting of the immune response and taste, and that was the mission of the lab that we essentially started several years ago.

So the one of the first projects that I’m going to talk about is recently published paper clinical Cancer Research. That focused on the development of an extracellular pH probe that demonstrates extracellular pH noninvasively using spectroscopic methodology, and I’m actually really appreciate it ‘cause that partnered in design and...
work on this novel mechanism with Daniel Komen and if I meet higher from the Mr Research Center who have been really instrumental and great partners in developing. And we used to model of a rabbit liver tumor, which is so far the only moderate size animal model that has a faithful reproduction. Reproduction of an HTC tumor environment and the has a high clinical relevance because we can do the embolization also image those animals in real size clinical scanners. We do have a 3T MRI system for that and also cutting edge IR suite which we use in the white Rick with the help
and support of Alston is this group.

So this is an immuno competent host.

Anna hyper glycolytic metabolic phenotype.

An essentially those tumors have been characterized previously,

is very reminiscent of the actual tumor marker environment of HTC.

So what is a good way to image pH so their sensor jeans that you can use their luminescent probes that you can translate yourselves with reporters?

But what we in radiology aim for is really the noninvasive measurement affects your seller pH and this is where our msit based spectroscopic
birds methodology comes into place.

This has been established previously in brain tumors by Daniel.

And we have translated this essentially to deliver.

This is NMR Spectra, scopic method that measures the redundant deviation of shifts and temperature in the region of the tumor, and we can generate the 3D extracellular pH map that provides us with essentially a very accurate characterization of the tumor micro environment.

So if we look at the tumor in by itself and measure it as compared to the surrounding liver tissue,
we see that the tumor by itself has much lower pH and baseline in an untreated fashion and the surrounding liver, and that’s important. And we know that this is probably due to the overt Warburg effect and overexpression of glued one and lamb two as indicators for the micro environment. Now, what does taste actually do with it? And this is where the surprising result from our study came in. We looked at the effects of embolization with little one day, one week, and two weeks after we actually
treat those tumors and measured the pH and as opposed to most of the assumptions that taste is going to actually exacerbate the The Anti. Yeah, I mean the logic, the immune, evasive tumor micro environment, it actually did the opposite. So what we see is a normalization of the tumor pH towards almost delivered background levels. Overtime after taste. And that is an important finding because that gives us an opportunity to use local regional therapy in preparation for successful anti checkpoint checkpoint inhibition.
therapy and we actually demonstrated this also with a more direct and exacerbated model. Where we.

Eustace and actually injected bicarbonate directly with taste and what we demonstrated here is that on baseline you have an acidic tumor with taste. You have a minor improvement of pH towards normal over overnight essentially, but if you add bicarb you can immediately improve the pH almost essentially to normal and yellow and green means higher levels than blue.

If we now look at, for example, H Lady are expression at baseline,
we see immune cell exclusion were really see
all the immune cells in the tumor periphery.
And with with taste alone,
you don’t really see a lot of immune invasion,
but with taste and bicarb, essentially improving and elevating a pH,
you see massive intratumoral infiltration of immune cells,
and that’s an important finding that we made here in actually an important other thought that we should be thinking about as a group generally in oncology, and what kind of agents we use.
So when we use a key mobilization with oil,
which is Lupito, we achieved, achieves seemed to be achieving very different effects. Compared to, for example, using an cuisine beads or Lumi beads, which is another flavor of beads and that is important for us to understand because through the uncle logic community taste was taste for long period of time, but in reality it is not because we know that different embolic particles will induce very different in a logical effects in very different changes
to the tumor marker environment.
And that is something that we really need to study,
especially if we want to combine the local regional therapies with systemic therapies and checkpoint inhibition.
Now another level of investigation that we took to token published recently in radiology,
again close collaboration with Daniel Komen Fahmideh Hyder but also other groups like rip Ocala’s group and also want to mention Ruth, and Joshi, who helped us generate this research.
Here we wanted to demonstrate that we can actually use molecular dedicated inmar probes nanoprobes labeled antibodies to visualize the immune system surrounding those tumors in vivo and noninvasively. So what we did is we use both iron oxide particles and the direct injection of gadolinium labeled antibodies to visualize those tumors and put those animals with those implanted tumors into them are what we demonstrated was that we were able to clearly delineate microfusion immune cell infiltration and macrophage infiltration.
and immune cell accumulation in the periphery of those tumors. On T2 MRI sequences, and that was proven in histologically with Prussian blue staining, which stands for iron. And we saw that the spines, the iron oxide particles really deposited and CD11B positive macrophages and we confirmed that later with CD 68 staining and the same thing is true for our induction injection of gadolinium labeled antibodies. You probably heard about this from the molecular imaging using pet, but here we have a much Marsh.
higher focal resolution where we label antibodies with gadolinium and then inject them directly into those tumors and through the artery, and we can see that there is very specific accumulation and staining. Of immune cells and perforate the tumor that we can now really locali characterize, and that’s that’s a big step forward because not only can we now image the tumor marker environment from a pH perspective, we can also images from a presence and functionality of immune cells. So for the first part of the conclusions are their appearance of, for example,
more than five targeted agents to treat HTC will cause a left shift of systemic therapy in the BC else, and we really must do some heavy lifting. It’s up to art actually to put the collaboration between the Interventional in college and Immuno Oncology on the right track. From a science perspective we must also work more on non invasive imaging modalities and we did so with the extracellular pH that revealed that ace actually is an inducer. Profound changes to tumor marker environment that may help immunotherapy to be more effective,
and pH is key for us as marker, but the changes in pH depends on the embolic materials that we use. We also now know that C test would lipiodol may achieve a partial reversal of the immune evasive tumor marker environment on itself two weeks after taste, and that we can use them are instruments to actually detect immune cells directly surrounding the tumor. So in summary, the for the first part of my conclusion is that local regional therapy and intervention alone college. You must be established in combination.
with each other.

We have to have a synergy between the two iOS interventional and Immuno Oncology and it’s up to us to work on that.

And that generates another bigger problem that we really workup on very closely with Jim Duncan and collaboration with that group and biomedical engineering.

And this is the overwhelming growth of data and will be talking about this little bit later.

Tall is going to be presenting on that, so we know that the data that we have specifically in imaging and.

Cancer in general explode so we have more than 20 times more data.
NOTE Confidence: 0.81775826
00:27:42.828 --> 00:27:44.664 today than we have in 2013,
NOTE Confidence: 0.81775826
00:27:44.670 --> 00:27:47.428 and so that is a huge challenge.
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00:27:47.430 --> 00:27:49.240 Anne, it’s David already presented.
NOTE Confidence: 0.81775826
00:27:49.240 --> 00:27:50.684 We have different flavors
NOTE Confidence: 0.81775826
00:27:50.684 --> 00:27:51.767 of chemo embolization,
NOTE Confidence: 0.81775826
00:27:51.770 --> 00:27:53.218 embolization with drug alluding
NOTE Confidence: 0.81775826
00:27:53.218 --> 00:27:54.304 Beatson Radio mobilization.
NOTE Confidence: 0.81775826
00:27:54.310 --> 00:27:56.356 We have a variety of different
NOTE Confidence: 0.81775826
00:27:56.356 --> 00:27:58.178 methodologies in ways how we
NOTE Confidence: 0.81775826
00:27:58.178 --> 00:28:00.370 can introduce tumor necrosis,
NOTE Confidence: 0.81775826
00:28:00.370 --> 00:28:02.575 cold heat,
NOTE Confidence: 0.81775826
00:28:02.575 --> 00:28:04.583 and electrocution in a way we have
NOTE Confidence: 0.81775826
00:28:04.583 --> 00:28:06.613 five different and more coming
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00:28:06.620 --> 00:28:08.540 all of which pose different changes
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52
to the tumor micro environment.

So we went overwhelming burden of complex data that actually may impede effective clinical practice. We need to address that. And so, how do we transform the data from burden to value? We know that we have an increase in data. We have very complex medical health records. We have genomics sequencing information. We have the availability of complex computer based algorithms and now the availability, availability of computational power at a lower cost. And that is the space where
artificial intelligence now comes in.
And this is essentially data driven.
Learning that deep down can be explained as machine learning that recognizes trends and objects in pre labeled patterns or deep learning.
and tall is going to be talking more about that where?
We use those networks to actually learn from data without pre labeling the outcome and that may hopefully increase the workflow efficiency.

improve our diagnostic accuracy really enabled predictive recommendations for us Taylor Personalized
Therapeutic recommendations and help

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us introduce Precision Medicine,

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but caution is still very important and

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AI is being hyped and I think we need

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to approach it in a gradual fashion.

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 Really see what is doable and what’s not.

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So how can this advanced data

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analysis help us?

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It can improve the diagnosis from automation

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and introduction of novel biomarkers.

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It can also help us make therapeutic

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decisions and probably introduce a

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level of better personalized care.

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Hopefully we will be able to ultimately

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improve Inter procedural guidance,

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especially with now with the
NOTE Confidence: 0.86596924
00:29:39.580 --> 00:29:41.450 introduction of robotics into IR,
NOTE Confidence: 0.86596924
00:29:41.450 --> 00:29:43.320 and specifically follow up imaging.
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00:29:43.320 --> 00:29:45.576 We hope that in the realm of tumor
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00:29:45.576 --> 00:29:47.644 response and patient patient outcome
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00:29:47.644 --> 00:29:50.044 prediction directly after the therapies,
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00:29:50.050 --> 00:29:51.738 those technologies will help
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00:29:51.738 --> 00:29:54.270 us put all this data together.
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00:29:54.270 --> 00:29:54.633 Now,
NOTE Confidence: 0.86596924
00:29:54.633 --> 00:29:56.448 prior to introducing the other
NOTE Confidence: 0.86596924
00:29:56.448 --> 00:29:58.550 speakers and talking and giving
NOTE Confidence: 0.86596924
00:29:58.550 --> 00:30:00.317 specific abstract presentations.
NOTE Confidence: 0.86596924
00:30:00.320 --> 00:30:02.546 The two larger topics that I presented.
NOTE Confidence: 0.86596924
00:30:02.550 --> 00:30:04.934 I want to really thank the sources of
NOTE Confidence: 0.86596924
00:30:04.934 --> 00:30:06.645 funding inspiration mentoring in our
NOTE Confidence: 0.86596924
00:30:06.645 --> 00:30:08.038 community. Already mentioned Drake.
NOTE Confidence: 0.86596924
56
I wanted to thank Jim sincerely and Todd and David who joined the lab. Also great partners of mine are Ruth and Nick and I really, really appreciate those collaborations that are increasingly interdisciplinary, but at the same time I wanted to also point out that mean radiology have a very large biomedical imaging collaborative network, and I want to thank from Eden, Daniel, and Larry and everyone mentioned here. I'll say I'll. From White Rick, who have been instrumental over the last five years in my personal development.
and also in the development of the lab, and I think that is the environment that we need and we need to highlight to the Cancer Center and introduce it to all of you. And I'm very happy to do so here. And, you know, there's one thing across all this. There is a single light of science,
then to brighten it anyways,
NOTE Confidence: 0.86596924

to brighten it everywhere.
NOTE Confidence: 0.86596924

This is our group model by Isaac Asimov.
NOTE Confidence: 0.86596924

And with that,
NOTE Confidence: 0.86596924

I’d like to introduce two or
NOTE Confidence: 0.86596924

students that work with us.
NOTE Confidence: 0.86596924

First,
NOTE Confidence: 0.86596924

Jessica Santana.
NOTE Confidence: 0.86596924

She’s going to be talking about
NOTE Confidence: 0.86596924

taking the molecular imaging
NOTE Confidence: 0.86596924

really to next level in our new
NOTE Confidence: 0.8340251

animal models, and Tall is going to be
NOTE Confidence: 0.8340251

talking about his role as Biomedical
NOTE Confidence: 0.8340251

Engineering graduate student within
NOTE Confidence: 0.8340251

the biomedical imaging Sciences on
NOTE Confidence: 0.8340251

focusing on predicting outcome and
recurrence of HTC after intervention.

And I'd like to. And now the stop sharing the screen and give it to Jessica.

Hi all, I'm Jessica. I am a master level demonologist Anna graduate student at the Yale Interventional College Lab and I'm very excited today to be presenting my work, titled, Noninvasive molecular imaging allows characterization of the immune response following hepatic radiofrequency Ablation in a mouse model. Nothing to disclose,
so giving you a brief overview

So as we know, this is a classical inflammation associated Carcinoma and now is the third most common cause of cancer related death worldwide. With the majority of patients being treated with locoregional therapy as they may alternative option over surgery. However, the problem with locoregional therapy is that a significant fraction of patients tend to recur and the causes for recurrence can vary a lot. And it has been suggested, for example, that the immune response to radiofrequency ablation can play both roles.
An Protogenic Side effects as well as abscopal effects that in turn can positively impact the immune response to cancer. However, we have currently no instruments that would allow us to non invasively monitor such immune response. So the purpose of this work is to develop a noninvasive molecular imaging instruments to visualize such immune response following RFA. So our group has built a translation of mouse model of radiofrequency ablation as a platform to develop and validate mirbase dimona probes for in
vivo imaging of the immune system.

And based on our findings, we have observed that there is a
radiofrequency ablation and normal liver. There is a strong time dependent local
infiltration of immune cells that orchestrates the tissue healing process and there is an overtime transitional
zone of those immune cell infiltrate. So having a specific cell population locally present at the transitional
zone between the necrotic area and the normal liver parenchyma at a specific time point serves us as an illegal platform to build and validate our dedicated immune probes.
So guiding you through our experimental design. We have a bladed and normal liver of a mouse, and after characterizing a large infiltration of a specific cell population is specific time point. We have established a dedicated gadolinium labeled antibody that was delivered systemically to target a specific cell population at the chosen time Point Post Ablation. And a second imuna probe also used in this study, is the small iron oxide particles, and we know that RN particles they
have been largely used in the clinical setting as the dark contrast agent and once they are delivered systemically, they are able to be phagocytosed by circulating phagocytes that once they migrate to the site of inflammation they can cause a local deposition. We have demonstrated that both gadolinium labeled antibodies inspire probes. They were able to be imaged using a higher resolution Mr animal scanner. So in our first setting of experiments we have demonstrated that the ablation zone itself can be easily imaged on a 9.4 Tesla Burger.
So here on your left you have the pictures taken seconds after ablation to show you or give you an idea of how the ablation site looks like an one week post Ablation, and we have delivered pure gadolinium systemically and we ran a T1 weighted MRI sequence and we could see precisely the Ablation. Side and on your right we have an ex vivo confirmation of what we see on them, right? But you might have been wondering why exactly 7 days post ablation. So to the best of our knowledge,
we know that our thing doost thermal tissue injury, largely contributes to a strong time dependent innate immune response at the margins of the necrotic zone. And according to our findings, we have observed the largest accumulation of city 68 positive macrophages in the transitional zone, precisely seven days post ablation. So this is the time point we decided to base our experiments on. So we have decided to deliver systemically. Those aren’t oxide particles. Seven days post Ablation and we have confirmed that there is a local
deposition of those iron oxide particles exactly 24 hours after systemic delivery. At the transitional zone. So here we have an ex Vivo Prussian blue staining, although one week post ablation, mouse liver 24 hours after systemic delivery of Spions and when we image those animals, we could demonstrate any Viva local deposition of those phagocytes at the transitional zone. So here on your left you have a teacher weighted MRI of a one week post Ablation, 24 hours after systemic delivery.
00:37:00.760 --> 00:37:02.857 of Spions and as a Redpath
NOTE Confidence: 0.77417207
00:37:02.857 --> 00:37:05.395 correlation we confirm the ex vivo
NOTE Confidence: 0.77417207
00:37:05.395 --> 00:37:07.360 specifically position of the spine.
NOTE Confidence: 0.77417207
00:37:07.360 --> 00:37:08.900 At the transitional zone,
NOTE Confidence: 0.77417207
00:37:08.900 --> 00:37:10.440 3 min inflorescence and
NOTE Confidence: 0.77417207
00:37:10.440 --> 00:37:11.830 Prussian blue staining.
NOTE Confidence: 0.77417207
00:37:14.230 --> 00:37:16.600 And As for our gadolinium based
NOTE Confidence: 0.77417207
00:37:16.600 --> 00:37:19.460 immuno probes, we have used a anti CD
NOTE Confidence: 0.77417207
00:37:19.460 --> 00:37:21.740 68 antibody tagged with gadolinium.
NOTE Confidence: 0.77417207
00:37:21.740 --> 00:37:24.351 So after XP will observing a massive
NOTE Confidence: 0.77417207
00:37:24.351 --> 00:37:26.361 infiltration of city 60 positive
NOTE Confidence: 0.77417207
00:37:26.361 --> 00:37:28.421 macrophages in the prohibition of
NOTE Confidence: 0.77417207
00:37:28.421 --> 00:37:30.499 zone we delivered gadolinium tagged
NOTE Confidence: 0.77417207
00:37:30.499 --> 00:37:32.815 with city 68 systemically and was
NOTE Confidence: 0.77417207
00:37:32.815 --> 00:37:35.665 able to see a specific position of
NOTE Confidence: 0.77417207
00:37:35.665 --> 00:37:38.330 those cells in the Prohibition of rim.
So here on your left you have the Ablation. Cite the picture taking seconds after ablation showing the ablation site. And we also have 81 way to MRI when post Ablation After 24 hours with gadolinium city 68 delivered systemically. And on your left you have the picture taken, ex Vivo confirming of what we’re seeing on the MRI. And to confirm that this parable isional darkroom is seen precisely in animals receiving those city, 68 tagged to 68 antibodies tagged with gadolinium. We also ran T1 weighted MRI with.
00:38:23.155 --> 00:38:24.325 pure gadolinium.

NOTE Confidence: 0.7773221

00:38:24.330 --> 00:38:27.434 So on your lap to have the baseline

NOTE Confidence: 0.7773221

00:38:27.434 --> 00:38:29.320 and it comparison,

NOTE Confidence: 0.7773221

00:38:29.320 --> 00:38:32.648 we have a T1 weighted MRI with pure

NOTE Confidence: 0.7773221

00:38:32.648 --> 00:38:35.454 gallium injected and we have confirmed

NOTE Confidence: 0.7773221

00:38:35.454 --> 00:38:38.286 that only with animals receiving city

NOTE Confidence: 0.7773221

00:38:38.373 --> 00:38:41.565 68 tagged with get alignment we have

NOTE Confidence: 0.7773221

00:38:41.565 --> 00:38:43.888 this precise parable itional rim

NOTE Confidence: 0.7773221

00:38:43.888 --> 00:38:46.732 showing a local infiltration of CD

NOTE Confidence: 0.7773221

00:38:46.732 --> 00:38:49.490 16 positive macrophages and therefore

NOTE Confidence: 0.7773221

00:38:49.490 --> 00:38:52.928 in vivo visualization of those cells.

NOTE Confidence: 0.7773221

00:38:52.930 --> 00:38:55.478 We have also confirmed the ex vivo

NOTE Confidence: 0.7773221

00:38:55.478 --> 00:38:57.808 a specific labeling of immune cells

NOTE Confidence: 0.7773221

00:38:57.808 --> 00:38:59.748 using imaging mass atama tree.

NOTE Confidence: 0.7773221

00:39:02.030 --> 00:39:04.094 So he ran on your left.

NOTE Confidence: 0.7773221

00:39:02.030 --> 00:39:04.094 We have the T1 weighted MRI of one
00:39:04.094 --> 00:39:06.382 week post ablation after gadolinium

00:39:06.382 --> 00:39:08.086 labeled antibody administration,

00:39:08.090 --> 00:39:10.962 where you can see the rim of the

00:39:10.962 --> 00:39:12.939 local deposition of the infiltrating

00:39:12.939 --> 00:39:14.909 cells an on your right.

00:39:14.910 --> 00:39:17.493 We have the X visual confirmation with

00:39:17.493 --> 00:39:20.062 the image Ng Masama tree of local

00:39:20.062 --> 00:39:23.090 deposition of the sea to 68 macrophages.

00:39:23.090 --> 00:39:25.890 In the transitional zone.

00:39:25.890 --> 00:39:27.555 So as the main conclusions

00:39:27.555 --> 00:39:29.220 and findings of this study,

00:39:29.220 --> 00:39:31.285 it tells us that both spines and

00:39:31.285 --> 00:39:32.598 Catalina based molecular imaging

00:39:32.598 --> 00:39:34.074 allows for specific labeling

00:39:34.074 --> 00:39:35.550 of local immune infiltrate,
and this is also a translation of study with the proof of principle for the visibility of the MRI imaging for of macrophages on a 9 point. For Tesla MRI scanners. And also tells us that noninvasive in vivo detection of the immune system can be achieved using dedicated immune probes. An ask for our future perspective and also gives us the possibility study and characterize the interplay between the tumor micro environment and the cell opinion selectivity in vivo and also gives us the possibility
00:40:13.310 --> 00:40:14.910 to integrate complimentary molecular
MRI imaging of the immune system.

00:40:14.910 --> 00:40:17.360 And let’s say the extrasolar pH
liver cancer model for simultaneous
characterization of this immuno
metabolic cross dock.

00:40:21.536 --> 00:40:23.712 This also serves us as a platform to
study strategies for local modulation
of the immune microenvironment
towards a moon are permissive
phenotype and can also serves us as
if they were gnostic immunotherapy.

00:40:32.000 --> 00:40:34.084 So I’d like to thank you for the
opportunity to present this work
as well as the yield bio medical
And now I'll give you the word to my friend, tall.

Hello everyone, my name is Charles early and I'm graduate student in the Biomedical Engineering program here at Yale and I'm a member of the Interventional Oncology lab since 2018 and today I'm going to be presenting our project on deep learning use to predict disease recurrence of HTC, based on NMR imaging.

So a little bit about ATC, so HTC is the primary tumor of delivered. It usually develops in the setting of chronic liver disease, and while the diagnosis of ATC...
could be made by imaging alone,
sometimes a biopsy may be required
to support this diagnosis.
A little bit statistics every 40 seconds at
patient diagnosed with ATC in 2020 alone,
The death rate is approximately
the 800,000 deaths worldwide.
ATC may recur and there is no
significant imaging biomarker or
clinical biomarkers to reliably predict
recurrence before location to treatment.
One of the treatment is
liver transplantation.
It helps to decrease the
chance of disease recurrence.
However, we are all aware to the shortness of organs.

Therefore, two criteria of allocations of levers are being used.

One of them is the Milan criteria, which was presented in 1996 and the other one was presented by the University of California, San Francisco on 2001 basically extended this Milan criteria.

Both of them are based on low level handcrafted features such as tumor size and number of tumors.

Using these criteria, we are seeing 15 to 20% of transplanted
00:42:44.614 --> 00:42:48.470 patient to occur within the 1st five years.

00:42:48.470 --> 00:42:49.970 So as I said,

00:42:49.970 --> 00:42:51.845 these two criterias location criterias

00:42:51.845 --> 00:42:54.308 has suffered from false positives,

00:42:54.310 --> 00:42:57.198 and our hypothesis is that there is more

00:42:57.198 --> 00:42:59.310 information in radiological images,

00:42:59.310 --> 00:43:00.978 specifically MRI that correlate

00:43:00.978 --> 00:43:02.229 and the way we’re going to try to
test this hypothesis is by using

00:43:02.230 --> 00:43:07.571 deep learning algorithm to extract

00:43:04.498 --> 00:43:07.571 and the way we’re going to try to

00:43:07.571 --> 00:43:09.791 test this hypothesis is by using

00:43:09.875 --> 00:43:12.305 features from MRI images and try to

00:43:12.305 --> 00:43:15.804 use them to correlate to ATC re occurrence.

00:43:02.230 --> 00:43:07.571 Then the naked eye could detect

00:43:12.305 --> 00:43:15.804 And a little bit before I start

00:43:15.804 --> 00:43:20.060

00:43:20.060 --> 00:43:22.083

78
talking about our methodology, I will talk about data driven predictive modeling and a little bit of deep learning. So when we talk about data driven predictive model, we usually refer to two different variables, the Explanatory variable and explain part of our target and we want to take these explanatory variables to feed them into predicted model which will give us the outcome of our target building which could be recurrent or not. And this predictive models has different shapes.
And algorithms which you may hurt. For example your networks this season. Trees as VM's. All in all, these algorithms that try to do the same thing they try to create or to estimate a mathematical function that correlated this input into doubt. And there are two main elements of this estimation process. One of them were trying to see what is the mathematical element interaction between our features and the mathematical operations. That’s going to be incorporated.
00:44:19.810 --> 00:44:21.282 within these mathematical function.
NOTE Confidence: 0.82661027
00:44:21.290 --> 00:44:21.912 For example,
NOTE Confidence: 0.82661027
00:44:21.912 --> 00:44:23.778 the multiplication of X1 and X2
NOTE Confidence: 0.82661027
00:44:23.778 --> 00:44:25.831 and the second thing we're trying
NOTE Confidence: 0.82661027
00:44:25.831 --> 00:44:27.877 to estimate the weight of these
NOTE Confidence: 0.82661027
00:44:27.943 --> 00:44:30.518 mathematical elements within this function,
NOTE Confidence: 0.82661027
00:44:30.520 --> 00:44:33.464 which could be seen here as better 0,
NOTE Confidence: 0.82661027
00:44:33.470 --> 00:44:35.690 better one, etc.
NOTE Confidence: 0.82661027
00:44:35.690 --> 00:44:37.867 And I'll give a short and very
NOTE Confidence: 0.82661027
00:44:37.867 --> 00:44:39.271 simplistic example of these
NOTE Confidence: 0.82661027
00:44:39.271 --> 00:44:40.899 data driven predicted model.
NOTE Confidence: 0.82661027
00:44:40.900 --> 00:44:42.200 So here we are,
NOTE Confidence: 0.82661027
00:44:42.200 --> 00:44:44.150 having having only one variable Explanatory
NOTE Confidence: 0.84268486
00:44:44.213 --> 00:44:46.789 Variable, which is the age and we are
NOTE Confidence: 0.84268486
00:44:46.789 --> 00:44:48.920 trying to predict the disease patient
NOTE Confidence: 0.84268486
00:44:48.920 --> 00:44:51.650 is positive or negative to the disease.
So for example in the right side of the screen you can see this mathematical function. Why would be considered positive if the age is greater than better otherwise negative? And as we get more and more examples we could estimate this better. For example, here we are estimating better to be 60, but as more data comes we can update modifier. Wait and basically change our function. Ann everything is OK till we have a data example that prevent us from.
creating one to use this mathematical function to a separate between these these two groups. So here we need to incorporate a new feature, for example wait when we are doing that. We can create a more complex function to separate these two groups and basically this is what we're going to try to do. Today we're going to try to find the features that will allow us to separate between the recurrence in Nonrecurring. When we're talking about deep learning where basically usually refer to neural networks, and you run networks is again an algorithm that allows us to approximate
almost any mathematical function that correlate input into output, and it does that by finding interaction between features. Convolutional neural network allow us to search for petitive patterns within an image and then correlate them to the output variable so it tries to find high level features such as edges and the more deeper we go, the more complex the feature become and allow us to separate between the groups that were trying to suffer. A little bit of our data, so we had 120 patients 18 years old or older.
88 minutes and 32 females. All of them were diagnosed with HTC between 2005 to 2018. So the patient went into MRI imaging, then were diagnosed with HTC and then got treatment 29 oblations, 32 receptions and 5:59 presentations. An time went by, some of them recur, and some of them stop their follow which we considered to be non recurrences. To this time that I can call time. To recurrence and this would be our explained variable, the variable that we’re going to try to predict. With respect to our input data,
we’re going to use conference enhanced multi
phase liver magnetic resonance imaging,
and we’re going to use three
different phases that the arterial,
the portal venous and the delay.
So the question that we’re trying
So the question that we’re trying
to answer here is can we predict ATC
to answer here is can we predict ATC
In other words, are they visual
features in free treatment MRI that
correlate with HTC disease recurrence?
So to visualize that we’re going
to use the input MRI input data
as an input data to freedom into
a predictive model which will be convolution on your network and to predict whether the patient will reoccur within one year two years after six years after treatment.

So here are the results. Here we can see the results for these 6 * 6 timeframe. So one year for occurrence, two years of free France up to 6, zero for occurrence and this figure present the relationship between the true positive rate to the false positive rate on our test cohort and seeing these 45% curve, which represents basically
a random chance to predict,

we can see that all of our curves is above that.

Which means that our model has prediction power.

Another analysis that we did was to try to use Kaplan Meier curves and our predictions to separate our cohort into risk groups.

Soloist group to recurrence in high risk to recurrence and we got significant results for your current free survival for four out of the six times you can see here, you can see the six different figures.
00:49:02.614 --> 00:49:06.488 each for one time for each time frame.
NOTE Confidence: 0.7972218
00:49:06.490 --> 00:49:07.582 So to summarize,
NOTE Confidence: 0.7972218
00:49:07.582 --> 00:49:10.130 the current state of the art criteria
NOTE Confidence: 0.7972218
00:49:10.201 --> 00:49:12.426 based on low level handcrafted
NOTE Confidence: 0.7972218
00:49:12.426 --> 00:49:15.060 radiological features such as tumor size,
NOTE Confidence: 0.7972218
00:49:15.060 --> 00:49:17.136 number of tumors and this study
NOTE Confidence: 0.7972218
00:49:17.136 --> 00:49:19.586 showed that there are still unknown
NOTE Confidence: 0.7972218
NOTE Confidence: 0.7972218
00:49:21.590 --> 00:49:24.439 MRI does correlate with recurrence of ATC.
NOTE Confidence: 0.7972218
00:49:24.440 --> 00:49:27.584 Secondly,
NOTE Confidence: 0.7972218
00:49:27.584 --> 00:49:29.675 the current state of the art selection
NOTE Confidence: 0.7972218
00:49:29.675 --> 00:49:31.735 criteria suffers from false positives
NOTE Confidence: 0.7972218
00:49:31.735 --> 00:49:33.432 and we showed by incorporating
NOTE Confidence: 0.7972218
00:49:33.432 --> 00:49:35.462 machine learning based algorithms
NOTE Confidence: 0.7972218
00:49:35.462 --> 00:49:37.261 we could potentially improve the
NOTE Confidence: 0.7972218
00:49:37.261 prediction of AGC recurrence.
Little bit of limitations and future research. We used a single site cohort from Yale Hospital, which was small 120 patient, which has the limitation of generalize the results for other sites and therefore will need to increase our sample size or incorporating patient from different side. And maybe single data modality, maybe not enough, so in future research we recommend to test interaction between imaging and clinical data,
00:50:11.460 --> 00:50:15.040 even incorporating more imaging modalities.
NOTE Confidence: 0.7972218
00:50:15.040 --> 00:50:15.988 Thank you very much.
NOTE Confidence: 0.8563696
00:50:23.210 --> 00:50:25.376 So, so that was really great.
NOTE Confidence: 0.8563696
00:50:25.380 --> 00:50:27.810 Hope you all were able to
NOTE Confidence: 0.8563696
00:50:27.810 --> 00:50:29.940 see what exciting work word.
NOTE Confidence: 0.8563696
00:50:29.940 --> 00:50:32.340 You know, doing in this lab?
NOTE Confidence: 0.8563696
00:50:32.340 --> 00:50:34.340 Does anybody have any questions?
NOTE Confidence: 0.83548236
00:50:35.410 --> 00:50:37.022 And individuals can certainly
NOTE Confidence: 0.83548236
00:50:37.022 --> 00:50:39.037 submit their questions on chat,
NOTE Confidence: 0.83548236
00:50:39.040 --> 00:50:41.176 but we did receive one which
NOTE Confidence: 0.83548236
00:50:41.176 --> 00:50:45.490 David you took the Liberty of
NOTE Confidence: 0.83548236
00:50:45.490 --> 00:50:48.706 at least answering online.
NOTE Confidence: 0.83548236
00:50:48.710 --> 00:50:51.531 Let me just toss this out so
NOTE Confidence: 0.83548236
00:50:51.531 --> 00:50:53.730 Joseph Cam asked, you know,
NOTE Confidence: 0.83548236
00:50:53.730 --> 00:50:56.205 essentially, how do you decide?
On the specific procedure be RFA, thermal abrasion, ablation, cryoablation, and also relative to contraindications. How do you make those choices? Each ablation modality has its pros and cons, and clearly my goal for today was not to go into my own personal research and discuss a lot of this. But basically you know,
for liver it’s pretty much understood that heat ablation is actually what is preferred, and that’s because over the years well, first of all it’s very effective. But over the years, there’s been concerns with Cryo Ablation on what’s called something called Cryo shock. There’s questions about fracturing the liver. There’s no way of really cauterizing any bleed that you can do with microwave or RFA and a whole bunch of others. So it’s really the complications in this in this setting that makes it less ideal than four. For the Heat base, now the one positive thing is we
00:52:23.330 --> 00:52:26.669 shown in some of the cases is that you do get the ice ball which has low density ice and that actually allows the operator to really sculpt the margins where you want to treat in other organs. Systems like the lung and kidney is really a dealers choice so that there have been papers on both. In terms of using cryoablation or heat ablation for those that we were just involved in a study that was recently published in the Journal of thoracic oncology.
trial called solstice that. 

Did show benefits of cold, 

you know, 

for for lung nodules and then I 

already as I kind of explained, 

it’s kind of a niche application. 

Mostly used in pancreas, 

but it’s in an area where it’s 

difficult to treat. 

Areas which have vital structures 

in your body, 

so that’s the I guess summary 

of that so thanks. 

So let me ask a follow up question ’cause 

you great deal of the work is really 

advancing understanding the nature of
the immune infiltrate post procedure.

And Moreover, how to address how to make the environment more hospitable?

Two immune cells, Sony aspid,

be both with regard to the imaging techniques monitoring techniques and perhaps the introduction of bicarbonate.

How much you leverage all of this to think about combining these approaches with ongoing immunotherapy immuno therapies that are under development in HTC?

Right, I mean that’s a really important question that we’re actually trying to answer ourselves.

As David mentioned,
I mean, we're right now.

Actually submitting one or an application after the other because we want to investigate exactly those points we generated.

This preliminary data.

Now we want to take it to the clinical perspective and do also trials and immediate future.

So I think there is a couple of limitations that we first need to address, and for the pH Image Ng, this is certainly the contrast agent, which is not done yet. Applied and in the human scenario, so we need to make sure that we
00:54:51.052 --> 00:54:53.218 can do that safely, you know.

00:54:53.218 --> 00:54:53.542 Secondly,

00:54:53.542 --> 00:54:56.161 I think you know the imaging of the

00:54:56.161 --> 00:54:58.401 immune system is a very hot topic and

00:54:58.401 --> 00:55:00.336 is being hotly discussed and worked

00:55:00.336 --> 00:55:02.552 up on both by the nuclear medicine

00:55:02.552 --> 00:55:04.729 community as well as you know us,

00:55:04.730 --> 00:55:06.428 and I think that both approaches

00:55:06.428 --> 00:55:08.479 have their merits in their drawbacks,

00:55:08.480 --> 00:55:10.286 and I think that this will

00:55:10.286 --> 00:55:11.490 definitely bring a breakthrough

00:55:11.548 --> 00:55:13.158 in terms of imaging biomarkers.

00:55:13.160 --> 00:55:15.962 As we know in HC see only 20% of

00:55:15.962 --> 00:55:17.541 the patients at Prof. Roundabout.

00:55:17.541 --> 00:55:18.534 Respond to immunotherapy.
But we treat a lot of them with it, and so we want to make sure we choose their right patients for the right therapy. And that's the whole goal. As for you, As for the real application of bicarb, that is an approach that could be translated into clinical trial very easily. I mean, bicarbonate is not a harmful substance. It could be used in just used in a clinical trial with taste, and I think we need to really think about using using that as an addition and an additional.
Arm, possibly in one of the clinical trials that David is bringing on board to use taste in combination with the immuno therapies. And I think that that would be a very simple initial fix. To do that. I mean there is very little Harmon. Probably you know some major benefit that we could get from that. So we need clinical trials in this respect and we need more translational contrast agent and more research. And I think we do have an
amazing infrastructure with RMR

Research Center here and the Pet Center on the other hand 2.

To actually do that kind of research.

So let me ask, given what you’re describing in the nature of the immune.

Desert potentially suggests that any efforts right now to combine a checkpoint inhibitor with tastes or other ablation procedure may not be yet optimized.

Turn to really achieve what we hope they would achieve because of the nature of the environment absolutely,
and this is exactly what I showed. If you remember one of the slides, had different embolic agents, and so we’re using various symbolic agents, various agents. If we inject into the tumor, that may be pro or anti inflammatory. We then also combine taste and checkpoint inhibition in tumors that may be hot or immunologically cold. So essentially you know a lot of these trials will probably have very non significant results and probably will never achieve. Yeah, it is certain level of clinical
00:57:24.000 --> 00:57:26.536 Just because we don’t know what we’re doing.
NOTE Confidence: 0.83878195
00:57:26.540 --> 00:57:28.358 Essentially so when we combine Interventional
NOTE Confidence: 0.83878195
00:57:28.358 --> 00:57:30.030 in college and Immuno Oncology,
NOTE Confidence: 0.83878195
00:57:30.030 --> 00:57:32.649 we just go about it and say one size
NOTE Confidence: 0.83878195
00:57:32.649 --> 00:57:35.244 fits all and that is something that I
NOTE Confidence: 0.83878195
00:57:35.244 --> 00:57:37.905 feel like is is the major key point
NOTE Confidence: 0.83878195
00:57:37.905 --> 00:57:40.485 that we need to address and one of
NOTE Confidence: 0.83878195
00:57:40.485 --> 00:57:42.375 these issues is that in Interventional
NOTE Confidence: 0.83878195
00:57:42.375 --> 00:57:44.347 Ecology Community would just did not
NOTE Confidence: 0.83878195
00:57:44.347 --> 00:57:46.313 have the academic culture and you
NOTE Confidence: 0.83878195
00:57:46.313 --> 00:57:48.137 know research environment so far and
NOTE Confidence: 0.83878195
00:57:48.137 --> 00:57:49.760 this is across multiple institutions
NOTE Confidence: 0.83878195
00:57:49.760 --> 00:57:51.180 across our entire community.
NOTE Confidence: 0.83878195
00:57:52.830 --> 00:57:54.822 and I think now we as we more
00:57:54.822 --> 00:57:56.544 understand that our therapies are necessary in our increasingly combined with systemic therapy,

00:57:56.544 --> 00:57:58.096 we need to investigate that,

00:57:58.096 --> 00:58:01.410 and I think that we’re going to have major breakthroughs in the next three to five years. Thank you.

00:58:01.410 --> 00:58:03.818 and I want to thank Jessica and tile.

00:58:03.818 --> 00:58:05.370 Julius and David for really a remarkably stimulating body

00:58:05.370 --> 00:58:07.662 Well, I know where at the top of the hour,

00:58:07.662 --> 00:58:10.980 and I want to thank Jessica and tile.

00:58:10.980 --> 00:58:13.220 Julius and David for really

00:58:13.220 --> 00:58:15.223 of work and Bradley bring to our

00:58:15.223 --> 00:58:16.603 attention what can be accomplished in Interventional Onkologie So you know,

00:58:16.603 --> 00:58:19.116 thank you for this continued education

00:58:19.116 --> 00:58:21.255 thank you for this continued education

00:58:21.255 --> 00:58:23.130 thank you for this continued education
00:58:24.972 --> 00:58:26.867 for the great work you’re doing

NOTE Confidence: 0.84226775

00:58:26.867 --> 00:58:28.736 and everyone on line. Thank you.