Speaker	Dr Brendan Kennedy
Talk title	Supercharging the surgeon's sense of touch
Venue	The Shoe
Time	Tuesday 29 October 2019, 7.00pm

Carina Marshall

Good Evening Everyone!

Welcome to the Shoe Bar! There is a bit of space up front, you are all kind of, crowded at the back. So if you wanted to come forward, you might be more comfortable, but you know, do what you feel?

So I hope you are all enjoying the "Shoe" this lovely venue on beautiful Yagan Square and you have all had a chance to get a drink and some nibbles, all of that stuff.

Welcome to Raising the Bar. Tonight twenty-two academics are speaking in ten bars all across Perth. And as someone said to me earlier, "It's a very different crowd from the usual footy game in the bar, but we're loving it!"

To start, I would like to acknowledge the Whadjuk Noongar people as the traditional owners of the lands and waters where we are meeting today and pay my respects to the elders, past, present, and emerging including any First Nations People who might be here tonight. This land in Yagan Square, in particular, has been a place to gather food and live in community. Let us remember the past and continue to gather knowledge, food and community here tonight.

At UWA, we are excited to make education a part of the cities popular culture, through transforming local city bars into a place that you can enjoy a drink, whilst learning about the impact that our research has in the community.

If you are sharing Raising the Bar on social media, please do, please use these hashtags, so that is @UWAresearch or #rtbperth19 so we can share your posts and get the word out about this incredible event.

Tonight's talks are being recorded and will be published as podcasts on our social media channels and if you registered for a ticket tonight, they will send you a link.

So, our second speaker here tonight at the "Shoe" is Dr Brendan Kennedy.

Brendan is now, Associate Professor in the School of Engineering at UWA, Laboratory Head at the Harry Perkins Institute of Medical Research and Chief Scientific Officer at OncoRes Medical. Brendan spent two years as Lecturer at the University of Santiago, Chile before moving to UWA in 2008. Since moving to UWA, Brendan has been developing a new medical imaging technique called optical

elastography. In 2014 Brendan was a WA "tall poppy". When he was told of his achievements he assumed it was for "tall scientists."

[clapping & cheering]

Dr Brendan Kennedy

Thanks very much, Carina and thanks also for robbing one of my gags for the talk.

But seriously it's great to be able to talk to you tonight and thanks to everybody for coming along and for me it's great to be able to combine, two passions of my life and talking in pubs, it comes from the Irish background I think, but … the research I will talk about is a combination of work that happens in two groups, Right Lab which is part of the School of Engineering based in the Harry Perkins Institute and also OncoRes Medical, which Carina mentioned is a UWA start-up company.

So what I will talk about here is really a combination of efforts from a lot of people in our fantastic team, so I really want to acknowledge them and just thinking about it today, I totalled it up and there are peoples from ten different countries within our groups which is great for the diversity and dynamic nature that you need for this kind of research, so thanks guys.

Yes, so I will talk about technology called micro elastography which gets more difficult to say after a few more drinks, I would say, but first of all, I will give you maybe, a bit of background on myself. I have a confession I am not from Australia.

I was originally from Dublin and when I was finishing my PhD which was in, actually, Electronic Engineering in Optical Fibre Communication Systems, myself and Magda, my beautiful wife were thinking of the next step and what we would do and originally we were thinking of coming to Australia or New Zealand and then in the department Dublin that I was working in, this ad came in for a job in Chile, which I kind of looked at and went, "sounds interesting" and then two days later, Magda and I were out for a meal and funnily enough we had a bottle Chilean wine, and I said, "Oh, you will never guess!?" and by the end of the bottle or maybe it was the second bottle, we said, "Oh sure, we might as well give it a go."

So we ended up in Chile for two years as a Lecturer in Electronic Engineering which was a fantastic experience. I learned a lot, I learned to speak Spanish, learned about the South American culture but after two years we felt, let's do something different that's going into a more routine track and going back to Ireland was one option but then we looked at the weather forecast for the next twenty years and realised it was going to rain every day, so we said, "Let's try Australia!" So, here we are.

That was in 2008 and so, we are Australians now, mate! [laughing]

Not only did that represent the change in a continent that we were living but it also, for me, represented a step-change in the research that I was doing.

So, previously as I mentioned I was using optical fibre technologies to effectively make the internet faster, which seemed a bit "naf" so coming here meant that I could take the same principles, the

same technology effectively, but point it towards applications in biomedical imaging to try and improve outcomes for patients in some diseases and in particular breast cancer and in our case, and that's a real theme that I will use in my talk and a real theme within our research group is to really be focused on trying to improve the outcomes for patients.

Before maybe getting into that, I would like you to join me in considering the kind of changes that technology has made to every facet of our society, for example, communication, travelling, socialising, you know, it has moved on in light-years effectively in how we do those things,

If we consider the written word, for example. In 1455, the first printed, mass-produced book emerged, the Gutenberg Bible, whereas nowadays, it's all about Twitter and Facebook and everything else.

If we think about travelling, for example, it was also around five hundred years ago that Columbus discovered America, it took him six weeks to get from the South of Spain to North America, which you can now do in ten hours on a commercial flight. These things are obvious, right? But if we consider how surgeons do their job and some of the key aspects of performing surgery, it's amazing to consider that actually not much has changed in the same duration of time. For sure, if you think of anaesthetics and pain relief, those major developments have obviously happened over 500 years but at the exact time, when a surgeon is trying to make the decision obviously, they have got all of the cancer out or not. They are relying effectively on the same things, and that's the sense of touch and their eyesight. I mean, as an Engineer and now as a Bio-Medical Engineer, surely we can do better than that, right?

If technology has changed every other facet of our life, surely we should be able to help those who are most needy in our society and that's really again, the focus of our research is to try and use our technical skills to work with clinicians who can guide us to try and come up with better solutions which will mean that we won't have such rudimentary tools used hopefully in the future.

Surgery is broad. If we think of it a little bit more specifically, our focus as I have mentioned is on breast cancer. So, I guess the first question, is why are we focused on breast cancer? And there is really a combination of two reasons for that really. First of all, like with most surgeries that tools surgeons have are really bad, but secondly breast cancer is a major, a huge problem. I mean, literally, thousands of Australians alone, are going to have to go for additional surgery, just because when the surgeon was performing their original surgery, they were just going by sight and touch.

I have mentioned that of course technology has made a big difference and it's the same in breast cancer surgery. So, if we rewind say forty years ago, breast surgery predominantly meant removing the entire breast which is called a mastectomy, but with the advent mammography, so X-Ray imaging there is a lot more screening these days. So, we are detecting tumours when they are at a much earlier stage and when they are much smaller and so, in this circumstance, removing the entire breast is often kind of not warranted, it is seen as an extreme.

What the surgeons do instead in countries like Australia, in around two thirds of cases now, they will aim to remove the cancer and a healthy rim of tissue surrounding the cancer so it is a much less cosmetically kind of, effective surgery but it also means that after the surgery, there are much fewer complications. It much less likely that you will get infection etc. and critically, this breast-conserving surgery or removal of just the cancer itself has the same overall outcome. So the survival rate these days is the same, whether you have a mastectomy, the entire breast removed or a lumpectomy where you … it's not a very scientific word where you have the lump removed, it's effectively the same prognosis, so this all sounds good right, not quite.

The problem comes back to that point I was making actually when the surgeon is performing the surgery, they can rely on the images they have from before the surgery, the ultra-sounds and the mammograms etc., to guide them approximately to where the cancer is but when they are actually going to make the incision, what they really need is real-time feedback, because until they start the procedure, the don't know exactly what's there, critically at the microscopic scale, which is often helped tumours progress, so that is why, because those tools don't exist, they are relying their native senses.

It's not surprising that this circumstance leads to quite a lot of … despite surgeons doing an awesome job, they get it wrong a lot of the time. So, in Perth for example, there was a study performed a few years ago which showed that 30% of patients undergoing this lumpectomy procedure had to go back for another surgery. So within weeks of having one of the most devastating experiences of their life, they are told, "Oh sorry, you have got to do it all over again!" just because there is no technology there. This is the situation right.

Not surprisingly, given the scale of the problem, lots of things have been trialled but it's mainly been trying to repurpose technologies that have been developed for other things like ultrasound and trying to fit them into this application. If that works, great, unfortunately, it doesn't, so things like X-Ray and ultrasound they are all used during the surgery to try and give that surgeon some realtime feedback but the bottom line, they are not good enough and they haven't been able to reduce the re-incision rate and the amount of additional surgeries that are needed.

That's where the technology that we are developing comes in.

We think that we have to be able to do better than this, so, our technology is squarely focused on trying to give the surgeon tools during surgery to improve the situation.

Breast cancer as I have I mentioned, because of the scale is our first kind of target, but this imaging can be adapted to many other surgeries.

Another good example is brain surgery. You want to be even more sure that you have got all of the tumours out and you also need to be a little more careful that you don't remove too much tissue in that scenario.

In prostate and all of these different surgeries, the surgeons need additional tools.

So, how do we propose to do it?

There are lots of different ways that you could potentially identify a tumour but we … and I think it's because at the start we were very, very closely linked in with Christobel *Saunders who is a world-leading breast cancer surgeon here in Perth. She is really one of the team and a key collaborator in this whole kind of endeavour.*

So we really went back to what to do the surgeons now, that works.

Simple as it is, the sense of touch is actually pretty for what it is. So what is it about the sense of touch, that is to some extent effective in identifying cancer? And, what it is, is that cancer in the breast and elsewhere is typically stiff. It is often how cancers present. Somebody might be in the shower for example and they feel a stiff lump and then they go to the doctor and they get a diagnosis, so, the reason for that is that a tumour is kind of characterised by cells rapidly producing. That leads to a very high cell density which gives the feeling of stiffness.

The problem with touch is that you can't see very small regions of tissue. As I mentioned, cancer is characterised by microscopic growths but with your finger, it's not very kind of specific, you can't see really small microscopic traces. That's problem number one and the second problem is that, how can you, who determines how stiff is too stiff. Everybody senses stiffness in a slightly way so it is a very difficult thing to teach somebody, "Oh, that's too stiff."

So, what we are trying to do instead is to create a medical image which represents stiffness. It basically maps stiffness into an image and for every pixel in the image, corresponds to the stiffness of the tissue in that location.

If we make that kind of assumption, that "stiff" corresponds most likely to a tumour, this information could potentially help the surgeon during the surgery. How we do that is not very sophisticated, we basically push the tissue, look at how the tissue moves and figure out from that the stiffness of the tissue.

I will ask you to use your imagination if I describe that in a little bit more detail.

If you imagine a golf ball as a tumour embedded in a bowl of jelly, the surrounding healthy tissue. If you shake the bowl, for the sure the jelly will squish. "Squish" is a technical term which means "how much stuff squashes" by the way. The jelly will definitely squash, the golf ball, on the other hand, it will definitely move, because it is embedded in this soft jelly but it doesn't compress. It doesn't squish.

If we are able to figure out, somehow, how much each of the things squishes, we can basically say, stuff that squishes more, corresponds to softer tissue.

If we were a political party, that would be our tagline.

What we really need to do is figure out, so the analogy, I have just mentioned shaking a bowl of jelly. The problem with that is we have to figure out how much the tissue has actually moved, so we could have philosophical arguments about if trees fall, and forests and no one is there to see it, does it make a sound, or instead we take pictures of it.

We basically take very rapid images of the bowl as it is, kind of, squishing and from that, we are to plug that into equations where we relate how much the tissue or jelly moves to the stiffness.

So, that's the first key step in the process.

The next step, as I mentioned, the second deficiency of touch, is, we need to be able to see really, really small details, so we use a kind of optical imaging technique, its effectively like a high resolution microscope that can be made in a very compact factor and where each pixel in this kind of microscope corresponds to a size of about one hundred times smaller than a millimetre, so, we are able to pick up on how the tissue is moving on a cellular scale which critically again, is related to how the cancer is spreading.

That's what we did, we started to work with Christobel *not long after I got here, a lot of the grey hair would explain all the efforts to try and make it work, but about six or seven years ago, we built a prototype in the lab and when we started this it was a concept, it had never been done, but we managed to get together a system that we could bring to Royal Perth Hospital to trial on tissue. So, obviously, like any research project at that stage, it was nowhere near good enough to go near diagnostic tissue, so we worked with a pathologist to get regions of tumour that were not part of the diagnosis of the patient and then we would work to try and make an image and the first question was, "do we see anything?" and we were really surprised at actually what we saw, that the elevated stiffness really did correspond to what the pathologist was seeing and that … one of the things I would not have thought of ahead of time is that I would have thought, you build a system, you bring it to the hospital, you trial it on tissue and, "yay!" it works. It is a kind of a linear process.*

But, really, a lot of the technical development only really started when we started to work with tissue because we would assume it would just work and then we would "Oh, it didn't work at all because of this, this and this" and back to the lab for a few months and then this dynamic process of working with surgeons and pathologists, improving the technique, seeing it didn't work and reiterating it as being really critical to what we had been doing.

At this stage, over the last number of years, we have scanned tissues from around 250 patients and last year we completed the study, we locked down the design of the system and we did a study on 90 patients to try and establish what the accuracy was. So, usually for engineers, if something works once, "yay!" it's going to work forever, but because of the diversity of patients and how different tumours present, we really have to make sure we have the statistics to back up what we are seeing.

We were really pleasantly surprised that the accuracy is about 96% which far outperforms anything else that's either on the market or being trialled.

So, if those results were to translate to eventual routine use, throughout the world, we might be able to reduce the number of patients that have to go back for a follow up surgery from, let's say, 30 in every 100 patients to maybe 4 in every 100 patients and maybe we can even do better, because the more we scan tissue, the more understand how it works, we can maybe improve on that even more and I know it's a bit of a buzz word, but Artificial Intelligence on all of the images we have gathered so far, can really help to tease out that extra few per cent which, even if 4 women in every 100 is a great improvement, it still means that four people have to go for this unnecessary surgery.

That study that I have mentioned was performed on the excised tissue. The model that pathologists currently use and that a lot of techniques use is that you scan the excised lump if there is a tumour right at the edge, chances are there is cancer left-back in the patient. That's no ideal, though, is it? Really what you want to know is if there is cancer left in the patient, but most technologies and most ways that you can address this problem are inherently limited to scanning the lump.

One of the big problems with that is that tissue is very soft and it deforms and squashes, that's what we use for. But trying to relate, if you have got 100% on where cancer is at the edge of a specimen, trying to relate that back to exactly the region that it originated from, is nearly impossible and through our link with Christobel, we have talked to a lot of surgeons in Australia and around the world and they all really see this as a key problem, so that is not ideal. You have this high-resolution technique to see microscopic traces of stiffness but at the end of the day, the surgeon is going to have cut way more tissue than they really need to, because they don't know exactly where your microscopic image came from.

I think the combination of us being able to realise this by closely aligned with surgeons with the flexibility of the imaging technique, one of the advantages of using optical fibres is you can make really small probes and really small compact designs.

What we did, I guess this was around three years ago when we started this, was to try and take the big bulky benchtop system which scans lumps and make into something like a very slender handheld probe that the surgeon can actually as they are performing the surgery, they are going that doesn't look good, hand me the squisher, the squash it and then they can take the tissue out right there and then. That's the goal of this different way of looking at it.

From a clinical point of view, that's totally the way to go, from a technical point of view, it's not straight forward because high resolution is great, but if it means if the surgeons had one too many coffees, for example, they might shake a little bit and now your high-resolution image is all blurry and also we had to develop ways to control for how much they are pushing. So, if they push a little bit too much, then the tissue will stiffer than it really is. One of the core pieces of ID that we have protected is a way to calibrate that out of the system.

By the way, I should mention when I talk about "squishing" that sounds like we are really pressing on the tissue. Because we can detect motion on the scale of almost a nanometre, so a billion times smaller than a metre, we only have to push very faintly on the tissue. The surgeon wouldn't even realise what's happening.

We have worked really hard and again, thanks to the really great team of engineers we have got, we have figured out how we can make really small mirrors sit inside this probe and how we can make those mirrors go fast enough that we can go faster than how the surgeons hand moves and at this stage now, we are able to generate images that are equivalent, you really wouldn't be able to tell the difference between images that were taken with the benchtop version of the technology and that handheld technique.

The next step … so, first of all, we demonstrated that on the excised tissue, the lump but we have recently, in August we have translated that now to actually scanning patients which was a massive milestone for the development. We have scanned three patients now with the surgeon using the device during the surgery. Again, it's in a research context, it's not influencing the diagnosis yet, but the results have been really positive so far and we have managed to overcome all of the technical hurdles which should absolutely be the case, there's a lot of those hurdles before you can get technology like this into use in an operating room with a patient.

We are also … how are we going for time, by the way, as I have no concept of that at the moment? [laughing] Okay. I am actually going to take a drink so talk amongst yourselves there for a minute.

Everything, I have described until now has been a research project, really. As I mentioned, our ambition is that this technology is going to be used, not only in one hospital in Perth but everywhere in Australia and around the world. There is really a big problem here that needs to be addressed. So, as long as we just remain in a research context, working as researchers, we are probably going to get some really neat research papers, which is great but ultimately pretty useless for the patients who have to go back for additional surgery, right.

What we really need to do, it's kind of like a computer game, level one is, "Does the technology work?" Level two is, "Does it work on real tissue?" It's getting more difficult as we go, but level three is really, "How do we commercialise this technology?" What I mean by that is, how do we make this technology into a product that we can sell to hospitals so that we can get it to surgeons all around the world.

Around late 2016, we were fortunate enough to get some venture capitals [inaudible 25:15] funding to start that commercialisation journey and to create a start-up company OncoRes Medical which is really an extension of the work that we have already been doing, but now looking at all those things that you don't look at as an engineer or condition in a research project.

It's really been a step-change in what we are doing and we now have to start thinking about business plans and financial models and things about the technology that we never would have considered like what is the price that the market can tolerate for such a device because there is no point in making a device that works all the time and costs half a million dollars because no one is going to look at it.

That's been fascinating and what is really a constant learning experience but one of the things that I really took from it is that, you really acknowledge that you need much more expertise than you have got as engineer and you really need to acknowledge that you need to be open to other people's

perspectives and to think of how more commercially orientated people view the project because sometimes … engineers are nuts and bolts, it's all about we do this, then this, then this, then this, so when someone with a commercial background comes along and says, "Yes, but what about in three years' time?" [gasp] "Tomorrow!" It's been … it's funny, it reminds me of that George Bernard Shaw thing, I don't know if you have heard of it, that the US and the UK two great nations separated by a common language and it really feels like that sometimes when we are engaging with the more commercial people. Engineers again … you never dream of an Engineer of making a decision without having all of your facts lined up and you are able to write a research paper to justify every decision you have made, whereas, and this isn't a criticism, this is just a recognition of the different perspectives that need to come to the project.

The more commercially orientated person to put a business plan together, for example, you need to look at a much vaster array of information and condense that all down to a plan that is actually going to work and is actually going to ensure we have funding to keep this going.

You would want to be a fly on the wall with some of the conversations we have where we try and nut this out but I think what's really worked well and what has enabled us to continue on the right track, is the key recognition that I have come back to is that, ultimately, everybody's skills are needed and we are all trying to get to the same goal, we are trying to improve the outcomes for patients.

If we have any kind of discussions needed to debate about we are trying to do, once we all just realign on that, there is no problems and luckily again, not only the technical expertise and the business expertise of the team that we have got, but everybody is open enough to be able to do that and I think again, to go back to the diversity of backgrounds we all come from, both culturally and in terms of expertise, it is really critical and it's not often something that's really recognised. You don't see that in papers or anything else, but it's really critical.

At the moment, we are working in the next stage to try and get the technology out of the lab. Sounds a bit weird? You would think we would want to keep it there, but, one way or another, either we fail and we don't do it anymore or it is a success and we get it out of the lab. So, we need to really work hard to give it to the people who are also engineers, who understand the processes that need to be put in place to make a technology that can be used, that you can make a thousand of these things, rather than just one or two.

That's an exciting time for us!

Also really exciting is, we spend time in places like Silicone Valley and everybody goes on about it but there is no reason why on Earth we can't do the same thing. All it takes is resources and there is a lot of wealth in this town and people … this is the critical thing … people who know what they are doing and who have done it before, really I think those places like Silicone Valley are just a network of people who understand what they are doing, so maybe we don't get to that scale but I hope that [inaudible 29:16] OncoRes Medical, myself and my colleagues are able to transfer the learnings that we have got and things like regulatory approvals or how do you get insurance companies to sponsor a device, that we are able to take that beyond OncoRes and hopefully after OncoRes is successful,

to other ventures of this nature around the town, because the bottom line is, if you walk around a hospital, it is astounding how many inefficiencies there are and how many opportunities there for technologies to make a real genuine difference and if we can do that, that would be amazing.

I will maybe finish up … but I just wanted to say about … yes, that focus on the need. We were looking, because we had Christobel, that from the start, she made sure we were focused on the outcome that she identified in breast cancer and you would think that's how it would be done but it is amazing in academia how often it doesn't happen like that. Very often … clinicians are very busy people, they are looking after their patients, so to have the opportunity to engage with someone like Christobel is amazing and as an engineer for your research career, you just need to publish papers. It's quite easy engineers to … I wouldn't say to take the easy road, but it's the comfort zone. You go into this loop, create a technique, publish a paper and carbon copy. It is funny, you can waste a lot of time and money if you do it like that.

There is this French company I know who work in similar technology to ours and I just cracked up when I heard this, but the Chief Technical Officer of the company was talking about their early stages and they had this technique that also imaged stiffness, not on the micro-scale but a similar idea to jelly and golf balls and stuff. But, their first application was actually to image the stiffness of cheese! I just thought, "That's so beautifully French!" They wanted to image the stiffness of cheese to be able to improve the quality of it.

It's like an Irish guy developing a technology to improve the quality of Guinness. It's great, but ultimately probably not that useful.

Now, I should say, that company, actually identified a problem in the liver and became extremely successful but you can waste a lot of time and money if you don't focus from the start.

I just wanted to give a shout out to Perth Biodesign which is a program here in Perth that came over from Stanford a few years ago. It's at the very early stages, you don't even need to have an idea, but it puts together engineers, scientists, business people and people from all different walks of life and basically puts them in a hospital with a clipboard and pen to identify problems and then to come up with ideas around how they might solve this problem and then put in place the structure, to be able to go and seek funding and I think it is a really exciting time for this kind of activity in Perth and also in UWA we have just launched a UWA Biomedical Engineering Masters which, some of the students are here tonight, actually, which I dread a little bit because last week I was judging their medical device presentations and I was trying to drum up support for people to come along, so I said, "Come tonight and you can mark me!" So, I am looking forward to my emails in the morning. I will check it out on LMS!

Thanks very much for listening to me and I am happy to answer any questions if I can.

[clapping]

Carina Marshall

Thanks, Brendan that was fantastic.

One of the things Brendan didn't mention is that he and his team were one of the winners of Pitch@***Palace*** Australia, I believe.

Dr Brendan Kennedy

I have a funny story about that actually. I forgot to say, I am Irish, I am drinking, I am going to talk. We only found out on a Thursday and I was in Sydney, that we needed to go to this event which was fantastic, but we flew on the Saturday, so we didn't leave a lot of time to … sorry, on the Sunday … it didn't give a lot of time to get there. So, we planned it that we arrived at 5:00 am in the morning but the problem was that our bags didn't arrive at the same time as us and the event started at nine o'clock. Luckily I had my suit on the plane with me, but I didn't have a shirt, so I had to rock up to this event with all these fancy English people with my Qantas pyjamas under my suit, so it's really fun doing this as well, sorry! [laughing]

Carina Marshall

Thereby fulfilling all the stereotypes of the colonials showing up to the Palace! Well done, well done!

[laughing]

Brendan is happy to answer questions. I am short, you have to put your hand up nice and high – there's one at the back.

Audience

You talked about identifying lumps in microscope levels, I was wondering if you see any applications in say, I don't know … expeditions or in military aspects where, you know, shrapnel is a huge thing that can't be identified just through the sense of touch and you do need something like a microscope that's compact and with you. And another thing to add to that, do you ever see this device being something alongside a defibrillator with its AI in field surgery or something like that?

Dr Brendan Kennedy

Thanks for the question.

The military applications are not something that I have really looked at myself. One of the … it could work, the limitation is that when you use optics, it is quite a niche technology because you get the high resolution but the trade-off is that you don't see very deep into the tissue because if you ever put a torch around your hand, its lights up your hand because the light just goes everywhere. If there was an application in military where you wanted to see stiff things quite close to the surface, sure, we could do that but I think using the same idea but instead of using the microscope to take the picture, if you used ultrasound then you would be able to see deeper and maybe you could help with that application.

In terms of the *defibrillator*, it's not something I have thought of and I would need to probably … maybe we can chat a bit after about how exactly it might be used but ….

Carina Marshall

Hands up high if there is another question.

Audience

Is there a particular type of breast cancer you were looking at or …

Dr Brendan Kennedy

Thanks for the question, you sound like you are from the same part of Perth as me [laughing]

No, we look at all … as you might know, breast cancer is really a family of diseases which is again, when we first started to talk to the pathologists, we describe the lump and the surrounding tissue but actually, it's a lot more complicated than that. We look at all cancers but most of the ones we have looked at are invasive ductal carcinoma and *ductal carcinoma in situ which make up, I think eighty or eighty-five per cent of breast cancers.*

We have also seen quite a lot of invasive lobular carcinomas and *Mucinous carcinomas, but really because the first two are the main ones, we mainly looked at them.*

Audience

First of all, it's a really good talk …

Dr Brendan Kennedy

Thank you.

Audience

… very interesting.

My question is you use the analogy of a golf ball in the jelly [inaudible 36:45] cancer is usually irregular shapes, so how do you tackle that irregular shape within the actual tissue.

Dr Brendan Kennedy

That's a great question. My analogy of a golf ball was a pretty simple one, but that's where the high resolution comes in. We are able to pick out traces of cancer that are almost down to the cellular scale, so independent of the structure or the irregularity, once there is a change in stiffness on the scale of like, a hundredth of a millimetre, we are able to pick that up.

I was waiting for it! This is one of the students from Biomedical Engineering who is really good at asking questions.

I would be disappointed otherwise!

Carina Marshall

He is absolutely not allowed to give a distinction! [laughing]

Audience

You are doing well, you are doing well.

Dr Brendan Kennedy

Thanks, mate.

Audience

I have heard a little bit about this device before and it is fascinating. You say that its … I mean that we know that it's almost like a world-first in this specific area of medicine and a combination of techniques that are used. What do you think would be in the future, an area of medical environment where this device is a pioneer? What do think the possibilities of that field of medicine would be, even beyond … I mean I am not wishing your device bad health or anything … but even beyond your device, what do you think the ramifications of this ground-breaking technology could be further along the line?

Dr Brendan Kennedy

So, in terms of how this technique could make a difference to other areas or to patients?

Well, I guess the ultimate goal is if we can get it into hospitals at a price that is affordable for hospitals, etc., then we are going to dramatically reduce the number of patients that have to go back. That's the bottom line. That's what it really is about.

As I said, if translate it to other cancers, there is much more, again in neurosurgery, it is really a problem. We sat down with a neurosurgeon a few times and talked to him about the decisions they are making and they really haven't a clue on exactly where the tumour lies.

I think from a commercial point of view which we have to engage in to try and get the technology out, a big question is the market size. That's one reason why breast cancer is good from a commercialisation perspective because it is a big market and investors can go, "Yes, that's a big problem." If we are successful there, then hopefully we are able to … fairly efficiently transfer it to other areas where maybe the market isn't as big but the impact on patients might be even worse.

I think for me, that's the … that would be the dream is to get a platform from helping outcomes for breast cancer patients and translate that into other areas where there is maybe not as many people with the problem but the problem is as big or bigger for those patients.

How was that!?

Carina Marshall

I think you might have got the distinction on that, I am not sure?

Any other questions.

Oh, another one.

I'm running!

Audience

Hi Brendan.

Dr Brendan Kennedy

Hey! [laughing]

Audience

The tables have turned [laughing]

Just curious, how well is this device taken by other surgeons and the one you are working with?

Dr Brendan Kennedy

Great question.

What we want to do is, we want to make sure that we talk to a lot of surgeons globally and they all tell us this is a big problem and they have all verified and validated that this handheld probe is the way to go but because we have only scanned several … three at the moment … patients, we don't want to give it to other surgeons other than the ones here in Fiona Stanley Hospital until we are sure that what we are doing is useful for surgeons because you get one shot with surgeons who are again busy people etc.

Christobel, as I said, is one of the team so we can give her earlier versions of the technology but we want to get it to a point where we give it to surgeons and they go, "Yes! That's absolutely what we want." They would all like the technology but we don't want to give it to them until the technology is ready and it's also a massive amount of effort and cost to have a clinical trial in multiple different sites. Eventually, we would like to get it to the US and Europe for example. We want to stage it so we do it at the appropriate time in the development.

Carina Marshall

[inaudible 41.24] everywhere now!

Audience

So, with all that in mind, what do you foresee the timeline would be to commercialisation, how far away are you?

Dr Brendan Kennedy

It's difficult to say exactly because we need work, we need to make a number of decisions in the near term about the regulatory pathway, so, we could already have a device on markets if that was our focus, but the problem is, we want to have a device on market that has the best chance of success. So, it's this trade-off.

To get approval from the TGA here in Australia or the FDA in the US, you can have a device that has a very low claim. You can say, our device images tissue and that's it, but then it's not that useful for surgeons and ultimately in a lot of jurisdictions, the insurance companies need to reimburse a technology before it's justifiable for a hospital to use it.

From that perspective, it is sometimes better to make a more … to wait and have larger clinical trials and then be able to make a bolder claim, but then you need data to back it up.

With all that in mind, to answer your question, I think, three or four years and we should have the device on market, but then it's actually able to do what we claim and hopefully, then it actually really helps the patients.

Audience

Because you have got such high resolution, do you think you would be able to pick up local lymphatic spreads? Because I feel that is a big reason a lot of people go back into theatre.

Dr Brendan Kennedy

In the lymph nodes, you mean? And the metastatic, the sentinel lymph nodes? Yes?

We actually did a study on that because when we were in the hospital environment and as you may know, they remove the lymph nodes sometimes to check if there is cancer in the lymph nodes because if there is cancer in the first lymph node from the breast then it is likely that the cancer has spread.

When we are there we have had the opportunity to scan lymph nodes as well and, technology did pick it up but at the time, there was some debate about whether intraoperative analysis of lymph nodes was actually valid? So, we were thinking, we could put a lot of effort into this and then it could turn out that surgeons are moving away from that as a diagnosis but, I think the indications are that always will be important, so it is something that we could come back to. But we also have to balance, like I have mentioned, we could potentially apply this to brain surgery, prostate etc., but we are really focused at the moment. We want to really try and make an impact in one area first, but once we have done that, if the market supports it, then the lymph node analysis would absolutely be something we could come back to.

Audience

So, how does the AI component of the development work? Is that purely about developing a catalogue of the different stiffness's of different cancers? Or is there something else to that?

Dr Brendan Kennedy

It's really about … we have got lots of different sub-types of images actually, I mentioned we use a camera. So, we have got an image that is just how much light comes back from the tissue. Then we have got this stiffness information and we have also got just a photograph which can be helpful and we have got about five or six different kinds of types of images that all derive from the same data set.

It's difficult to analyse all of those images on the flyer or to present that information to a surgeon in a way that they could easily use it and then one of the first questions was that there are lots of different types of breast cancer, so, it's a pretty complicated scenario, where if we had enough images, we could put all of our sub-images into these different cases and have a ground-truth in histology, so that is the current gold standard and then we could train a network to say, "this, this and this pattern in your different types of images usually corresponds to this type of cancer," for example.

It's a way to … I don't think it is really necessary to do it, but it could be a way that we could eke out that extra few per cent to hopefully ensure that no-one has to go back for additional surgery.

Carina Marshall

Okay, we might leave it there, thank you so… oh, wait, oh, one more, one more, lucky last, hang on.

Audience

Thank you, Brendan, for the very insightful talk, I was just wondering in any of your trials did you look at any pre-operative for patients there for pre-operative chemo or radiotherapy due to the density change from those …?

Dr Brendan Kennedy

That's a great question.

Yes, we did, we did but we didn't have enough of those cases to really … to statistically come with a scenario. So, what happens sometimes is they have radiotherapy before a surgery to try and shrink the tumour down so that it is easier to operate on and what Christobel tells us, and I think where a lot of the feel of breast cancer is going, is that, that radiation process can stiffen the tissue as well, so, it can be difficult for a surgeon again, just using their finger to distinguish the tissue that's healthy effectively, but has been eradicated from the tumour. Christobel has identified that's what we should really target because the extra resolution and sensitivity of our technique might mean that

we can get at that but we just have not as yet had enough of those cases, but it is something that is definitely on our radar.

Carina Marshall

Okay, now I am really going to cut it off, but I think Brendan can hang around for a few minutes if you have some further questions.

Dr Brendan Kennedy

Thanks!

Carina Marshall

[laughing]

Thank you so much, Brendan, and thank you, everyone, for coming tonight, I hope you have enjoyed yourself, sparked some curiosity, raised some questions.

If you are interested in the podcasts of tonight's talks, not just this one, but the ones in all the other bars across Perth, check our social media channels at UWA Research, on Instagram, Facebook and Twitter in the next month and links will be emailed to all the ticket holders once they have gone live.

Enjoy the rest of your evening and we hope to see again at future research impact events.

Thank you.

[clapping]

Dr Brendan Kennedy

And thank you, Carina!

[clapping]