0:00:00 –> 0:00:03.675 Funding for Yale Cancer Answers is provided
0:00:03.675 –> 0:00:07.619 by Smilow Cancer Hospital and AstraZeneca.
0:00:07.62 –> 0:00:09.8 Welcome to Yale Cancer Answers with
0:00:09.8 –> 0:00:12.379 your host doctor Anees Chagpar.
0:00:12.38 –> 0:00:14.335 Yale Cancer Answers features the
0:00:14.335 –> 0:00:16.735 latest information on cancer care by
0:00:16.735 –> 0:00:18.275 welcoming oncologists and specialists
0:00:18.275 –> 0:00:20.852 who are on the forefront of the
0:00:20.852 –> 0:00:22.628 battle to fight cancer. This week,
0:00:22.63 –> 0:00:25.143 it's a conversation about the use of
0:00:25.143 –> 0:00:27.388 nanoparticles to treat skin cancer with
0:00:27.388 –> 0:00:29.95 doctors Michael Girardi and W. Mark Salzman.
0:00:29.95 –> 0:00:32.068 Doctor Girardi is a professor of
0:00:32.068 –> 0:00:34.291 dermatology and Doctor Saltzman is a
0:00:34.291 –> 0:00:35.799 professor of biomedical engineering,
0:00:35.8 –> 0:00:37.308 Cellular and Molecular Physiology
0:00:37.308 –> 0:00:39.193 and of Chemical Engineering at
0:00:39.193 –> 0:00:40.94 the Yale School of Medicine,
0:00:40.94 –> 0:00:42.938 where Doctor Chagpar is a
0:00:42.938 –> 0:00:44.27 professor of surgical oncology.
0:00:45.15 –> 0:00:47.467 So maybe we'll start off by having
0:00:47.467 –> 0:00:50.776 both of you tell us a little bit about
0:00:50.776 –> 0:00:52.85 yourselves and what you do.
0:00:52.85 –> 0:00:55.65 Mike, maybe I'll start with you.
0:00:55.65 –> 0:00:57.534 Sure, I run a research laboratory
0:00:57.534 –> 0:00:59.973 with a big focus on skin cancer
0:00:59.973 –> 0:01:02.199 development and strategies to try to
0:01:02.199 –> 0:01:04.397 prevent skin cancer formation and to treat it.
0:01:04.4 –> 0:01:06.85 And how about you, Mark?
0:01:06.85 –> 0:01:09.058 I'm a professor in the
0:01:09.058 –> 0:01:10.7 Department of Biomedical Engineering.

0:01:10.7 –> 0:01:12.826 My training is in chemical engineering,
0:01:12.826 –> 0:01:15.367 but for my research career and my
0:01:15.37 –> 0:01:16.902 teaching career I've mainly
0:01:16.902 –> 0:01:19.2 focused on how to apply principles
0:01:19.263 –> 0:01:20.907 from chemical engineering to
0:01:20.907 –> 0:01:22.962 make new products for medicine.
0:01:22.97 –> 0:01:25.525 This is such an
0:01:25.525 –> 0:01:27.069 unusual marriage and something
0:01:27.069 –> 0:01:29.673 that I love about academia is that
0:01:29.673 –> 0:01:32.286 we can take disciplines that are
0:01:32.286 –> 0:01:34.521 truly disperate on the surface
0:01:34.521 –> 0:01:36.97 and make them collide and have
0:01:36.97 –> 0:01:38.57 really fascinating things happen.
0:01:40.57 –> 0:01:43.506 Mike, tell me a little bit more about
0:01:43.506 –> 0:01:46.639 how your research evolved and
0:01:46.64 –> 0:01:48.65 how you got to meet Mark?
0:01:48.65 –> 0:01:51.998 You know we have a really rich
0:01:51.998 –> 0:01:54.717 environment for exchange of ideas and just
0:01:54.717 –> 0:01:57.638 a tremendous breadth of faculty that is
0:01:57.638 –> 0:02:00.302 very welcoming to folks getting together.
0:02:00.31 –> 0:02:01.842 Discussing how different perspectives
0:02:01.842 –> 0:02:04.73 and takes on research can be combined.
0:02:04.73 –> 0:02:07.25 Mark and I have had a
0:02:07.25 –> 0:02:10.465 chance to see each other at various
0:02:10.465 –> 0:02:11.965 meetings and conferences here
0:02:11.97 –> 0:02:14.875 on campus and to
0:02:14.875 –> 0:02:16.839 have discussions time to time
0:02:16.84 –> 0:02:18.484 over the years after these meetings
0:02:19.72 –> 0:02:22.924 and then we really hit it off on Mark's
0:02:22.924 –> 0:02:24.773 technology of using nanoparticles
0:02:24.773 –> 0:02:27.133 to deliver anti tumor agents.

0:02:28.187 –> 0:02:30.63 And a thought bomb went off in my

0:02:30.718 –> 0:02:33.278 head regarding all the potential

0:02:33.278 –> 0:02:36.279 applications in the skin which is

0:02:36.279 –> 0:02:38.778 so accessible and such a burden on

0:02:38.778 –> 0:02:41.798 our society in terms of the

0:02:41.798 –> 0:02:45.184 number of skin cancers and the

0:02:45.184 –> 0:02:47.399 challenges in controlling these and treating them.

0:02:48.606 –> 0:02:52.345 And so I reached out to Mark after one

0:02:52.345 –> 0:02:55.697 of his talks and he was very receptive.

0:02:55.7 –> 0:02:58.584 We had a wonderful meeting and

0:02:58.584 –> 0:03:00.634 brainstorming session and that was

0:03:00.634 –> 0:03:02.86 several years ago and we've really

0:03:02.86 –> 0:03:05.079 grown with our possibilities and directions

0:03:06.49 –> 0:03:08.565 research-wise in putting

0:03:08.565 –> 0:03:09.81 our heads together.

0:03:09.81 –> 0:03:12.96 Mark tell us a little bit more

0:03:12.96 –> 0:03:16.348 about your research and this drug

0:03:16.348 –> 0:03:19.149 delivery mechanism that you have and

0:03:19.15 –> 0:03:22.069 the talk that spurred everything on?

0:03:23.318 –> 0:03:25.814 I'll start back almost 30 years ago when I first

0:03:28.648 –> 0:03:30.829 got interested in this field,

0:03:30.83 –> 0:03:32.91 we had discovered that

0:03:32.91 –> 0:03:34.574 there were some polymers,

0:03:34.58 –> 0:03:35.828 some polymer materials,

0:03:35.83 –> 0:03:38.56 plastics that one could implant in the

0:03:38.56 –> 0:03:42.089 skin or put in contact with human tissues,

0:03:42.09 –> 0:03:44.17 and they're very inert.

0:03:44.17 –> 0:03:47.178 And the key discovery was that you could

0:03:47.178 –> 0:03:50.089 combine these materials with drug molecules.

0:03:50.09 –> 0:03:52.61 So that you could make such things

0:03:52.61 –> 0:03:54.411 like implants that you could

0:03:54.411 –> 0:03:56.577 place in contact with tissues or
0:03:56.577 –> 0:03:58.774 implant into tissues and they would
0:03:58.774 –> 0:04:00.519 slowly release the drug molecules
0:04:00.519 –> 0:04:02.689 that you had embedded into them,
0:04:02.69 –> 0:04:05.21 and so that really started me on a
0:04:05.21 –> 0:04:07.9 path to thinking about how you could
0:04:07.9 –> 0:04:10.25 both expand the range of materials
0:04:10.25 –> 0:04:12.77 that you could use in this fashion,
0:04:12.77 –> 0:04:13.85 and more importantly,
0:04:13.85 –> 0:04:16.01 how you could marry this technology
0:04:16.01 –> 0:04:17.45 to treat different diseases.
0:04:17.45 –> 0:04:20.45 And we really focused a lot on cancer
0:04:20.45 –> 0:04:22.988 because of the potential to create
0:04:22.988 –> 0:04:25.607 drug delivery systems that would be
0:04:25.607 –> 0:04:27.737 more effective at treating cancer.
0:04:27.74 –> 0:04:30.804 But at the same time would be safer
0:04:30.804 –> 0:04:34.347 and we could use the materials to sort
0:04:34.347 –> 0:04:38.237 of focus the drug action on the tumor
0:04:38.237 –> 0:04:41.249 cells rather than on normal tissue.
0:04:41.25 –> 0:04:44.099 And I think the possibilities for this
0:04:44.099 –> 0:04:46.278 really expanded about 15 years ago,
0:04:46.28 –> 0:04:48.21 when we discovered you could
0:04:48.21 –> 0:04:49.754 make not only implants,
0:04:49.76 –> 0:04:51.938 but you could make tiny tiny
0:04:51.938 –> 0:04:53.39 particles of these polymer
0:04:53.457 –> 0:04:55.567 materials and anti cancer drugs.
0:04:55.57 –> 0:04:57.868 So we call those nanoparticles because
0:04:57.868 –> 0:05:00.599 their size is measured in the nanometers.
0:05:00.6 –> 0:05:01.806 They're very small,
0:05:01.806 –> 0:05:05.423 so the particles that Mike and I have been
0:05:05.423 –> 0:05:08.722 using are about the same size as a virus.

0:05:08.722 –> 0:05:11.528 So because they're so small you can
0:05:11.53 –> 0:05:13.205 administer them easily in a
0:05:13.205 –> 0:05:14.545 variety of different settings.
0:05:14.55 –> 0:05:17.238 You can inject them easily through a needle,
0:05:17.24 –> 0:05:17.92 for example.
0:05:17.92 –> 0:05:20.3 Or you could suspend them in a
0:05:20.3 –> 0:05:22.374 solution and infuse them or apply
0:05:22.374 –> 0:05:24.753 them topically on the skin so that
0:05:24.753 –> 0:05:26.993 that gives you a lot of possibilities
0:05:26.993 –> 0:05:29.095 and thinking about how you're going
0:05:29.095 –> 0:05:31.572 to match this delivery system to the
0:05:31.572 –> 0:05:33.172 particular tumor that you're trying
0:05:33.172 –> 0:05:35.475 to treat and the other thing about
0:05:35.475 –> 0:05:37.395 being tiny tiny particles is that
0:05:37.4 –> 0:05:39.416 they're much smaller than tumor cells,
0:05:39.42 –> 0:05:41.856 and so they can actually enter into
0:05:41.86 –> 0:05:43.936 tumor cells and once
0:05:43.936 –> 0:05:45.74 they're in the tumor cell,
0:05:45.74 –> 0:05:47.858 they'll start releasing slowly their drug,
0:05:47.86 –> 0:05:49.912 and this allows the drug, the
0:05:49.912 –> 0:05:52.429 source of the drug, to be released
0:05:52.429 –> 0:05:54.565 very near its site of action,
0:05:54.57 –> 0:05:56.76 which for anti-cancer drugs is
0:05:56.76 –> 0:05:59.16 often in the nucleus of the cell,
0:05:59.16 –> 0:06:01.379 and so this gives you another level
0:06:01.379 –> 0:06:03.927 of control or design that you can
0:06:03.927 –> 0:06:06.219 introduce into the the delivery system
0:06:06.892 –> 0:06:09.244 in order to match them most
0:06:09.244 –> 0:06:10.738 effectively to treat the particular
0:06:10.738 –> 0:06:12.563 tumor that you're interested in.
0:06:12.93 –> 0:06:15.786 And so Mike, tell us more about

0:06:15.786 –> 0:06:18.199 the thought bomb that you had.
0:06:18.2 –> 0:06:20.09 You know, it certainly sounds
0:06:20.09 –> 0:06:21.98 like this technology that Mark
0:06:22.043 –> 0:06:23.867 has is incredibly innovative,
0:06:23.87 –> 0:06:26.3 but has so many possible applications.
0:06:26.3 –> 0:06:29.404 So how did you really think about its
0:06:29.404 –> 0:06:32.37 utility in terms of skin cancer?
0:06:32.37 –> 0:06:36.015 I took a broad approach at first.
0:06:36.02 –> 0:06:38.855 As to the potential applications in the
0:06:38.855 –> 0:06:41.252 skin topical application, for example,
0:06:41.252 –> 0:06:43.616 to improve sunscreen performance.
0:06:43.62 –> 0:06:46.062 Injection into tumors to improve delivery
0:06:46.062 –> 0:06:48.809 of anti tumor agents to skin cancers,
0:06:48.81 –> 0:06:51.442 but also about the potential to stimulate
0:06:51.442 –> 0:06:53.6 the immune system against cancer.
0:06:53.6 –> 0:06:55.192 How these could facilitate
0:06:55.192 –> 0:06:56.784 delivery of those agents.
0:06:56.79 –> 0:07:00.198 Mark and I also talked about the various
0:07:00.198 –> 0:07:02.332 inflammatory diseases of the skin and
0:07:02.332 –> 0:07:05.128 how we might use agents that are anti
0:07:05.128 –> 0:07:07.398 inflammatory and better deliver
0:07:07.398 –> 0:07:09.604 those agents and increase their performance,
0:07:09.604 –> 0:07:11.714 increase their safety so they're
0:07:11.714 –> 0:07:13.391 not necessarily impacting the
0:07:13.391 –> 0:07:14.459 overall immune system in a negative way.
0:07:16.26 –> 0:07:18.51 and throughout the entire body,
0:07:18.51 –> 0:07:20.76 so it's about local delivery.
0:07:20.76 –> 0:07:22.56 It's about increasing drug
0:07:22.56 –> 0:07:24.81 availability in terms of cancer.
0:07:24.81 –> 0:07:27.603 We have a huge burden
0:07:27.603 –> 0:07:29.76 with basal cell carcinoma.

0:07:29.76 –> 0:07:32.378 These are a huge number of cancers
0:07:32.378 –> 0:07:35.677 across the the world that outnumber all
0:07:35.677 –> 0:07:38.302 cancers combined in their occurrence,
0:07:38.31 –> 0:07:41.46 and often are treated by surgery or
0:07:41.46 –> 0:07:44.508 multiple surgeries on the same patient.
0:07:44.51 –> 0:07:46.315 An individual can develop many
0:07:46.315 –> 0:07:48.666 of these over a lifetime if
0:07:48.666 –> 0:07:50.558 they are fair skinned and
0:07:50.56 –> 0:07:52.57 have a lot of sun exposure.
0:07:52.57 –> 0:07:54.585 There is squamous cell carcinoma which
0:07:54.585 –> 0:07:56.6 presents another set of problems.
0:07:56.6 –> 0:07:59.018 They can be numerous as well,
0:07:59.02 –> 0:08:01.972 but they can also have a small chance
0:08:01.972 –> 0:08:04.26 of traveling throughout the body.
0:08:04.26 –> 0:08:07.081 They tend to be deeper as well.
0:08:10.696 –> 0:08:13.27 Melanoma not as common as basal
0:08:13.27 –> 0:08:15.5 cell and squamous cell carcinoma.
0:08:15.5 –> 0:08:18.314 But a whole other set of problems si that
0:08:18.32 –> 0:08:21.947 this is a real killer of young people.
0:08:21.95 –> 0:08:22.369 Melanoma is
0:08:22.369 –> 0:08:25.302 something that has a very high risk
0:08:25.302 –> 0:08:27.334 of metastasis after it obtains
0:08:27.334 –> 0:08:29.199 a certain level of depth.
0:08:29.2 –> 0:08:30.19 There are clear,
0:08:30.19 –> 0:08:32.17 unmet needs in some patients who
0:08:32.17 –> 0:08:33.964 have intermediate depth Melanoma
0:08:33.964 –> 0:08:35.832 that has already metastasized
0:08:35.832 –> 0:08:37.67 to regional lymph nodes.
0:08:37.67 –> 0:08:40.286 And there are challenges in treating
0:08:40.286 –> 0:08:42.03 these patients without necessarily
0:08:42.094 –> 0:08:44.56 giving them something aggressive

0:08:44.56 –> 0:08:46.204 and systemically delivered.

0:08:46.21 –> 0:08:48.59 Chemotherapy to the entire body.

0:08:48.59 –> 0:08:51.872 So all of these potential challenges

0:08:51.872 –> 0:08:55.285 in the world of skin cancer

0:08:55.285 –> 0:08:58.065 have areas that could be

0:08:58.07 –> 0:08:59.698 potentially leveraged with this technology.

0:08:59.698 –> 0:09:02.14 Mark and I have

0:09:02.213 –> 0:09:04.698 been really trying to look at all

0:09:04.698 –> 0:09:06.671 of the possibilities and begin

0:09:06.671 –> 0:09:08.351 to develop research programs

0:09:08.351 –> 0:09:10.44 and strategies to address them.

0:09:10.44 –> 0:09:13.2 Mark, a couple

0:09:13.2 –> 0:09:15.773 of things that struck me when

0:09:15.773 –> 0:09:18.018 you were talking about this

0:09:18.02 –> 0:09:20.678 technology, one is that these

0:09:20.678 –> 0:09:23.663 nanoparticles are so small that they can

0:09:23.663 –> 0:09:26.302 actually be engulfed by the tumor

0:09:26.377 –> 0:09:29.037 cell and have a mechanism of action

0:09:29.04 –> 0:09:30.512 at their nucleus, essentially,

0:09:30.512 –> 0:09:31.616 really targeted therapy,

0:09:31.62 –> 0:09:34.58 delivered to the source of the tumor.

0:09:34.58 –> 0:09:36.42 But my question there is,

0:09:36.42 –> 0:09:38.27 how targeted can it be?

0:09:38.27 –> 0:09:40.825 I mean can you make these

0:09:40.825 –> 0:09:43.089 nanoparticles such that the tumor cells

0:09:43.089 –> 0:09:45.644 and only the tumor cells engulf them?

0:09:45.65 –> 0:09:47.122 How does that work?

0:09:47.122 –> 0:09:48.594 That's a great question and I think

0:09:51.545 –> 0:09:53.39 there's several different aspects to that.

0:09:53.39 –> 0:09:56.141 The one that we've been talking about

0:09:56.141 –> 0:09:59.049 so far and a major

0:09:59.05 –> 0:10:01.255 one that Mike and I have been
0:10:01.255 –> 0:10:02.79 exploring is to
0:10:02.79 –> 0:10:04.56 put the particles as close to
0:10:04.56 –> 0:10:06.298 the tumor cells as possible.
0:10:06.3 –> 0:10:08.498 To physically target them,
0:10:08.5 –> 0:10:10.39 inject them into a tumor,
0:10:10.39 –> 0:10:11.024 for example.
0:10:12.926 –> 0:10:14.846 And that's possible with the skin cancers
0:10:14.846 –> 0:10:16.682 that Mike is mentioning,
0:10:16.69 –> 0:10:18.38 because they're so accessible,
0:10:18.38 –> 0:10:20.788 they're on the surface of the skin,
0:10:20.79 –> 0:10:23.286 at least some of them are
0:10:23.286 –> 0:10:25.509 exclusively on the surface of the skin,
0:10:26.692 –> 0:10:29.056 and dermatologists are very comfortable with
0:10:29.06 –> 0:10:30.88 using needles to inject locally
0:10:30.88 –> 0:10:33.103 in the skin and they're very
0:10:33.103 –> 0:10:34.758 talented as well,
0:10:34.76 –> 0:10:36.896 and so that makes a
0:10:36.896 –> 0:10:38.32 reasonable form of targeting.
0:10:38.32 –> 0:10:40.808 But you could also make it more
0:10:40.81 –> 0:10:42.79 targeted and one possible way to
0:10:42.79 –> 0:10:45.347 make it more targeted is to take
0:10:45.347 –> 0:10:46.911 the nanoparticles and engineer
0:10:46.911 –> 0:10:48.639 the surface properties of them.
0:10:48.64 –> 0:10:51.202 And one of the aspects of the
0:10:51.202 –> 0:10:52.742 technology that we've exploited
0:10:52.742 –> 0:10:55.304 in many of the projects that we
0:10:55.304 –> 0:10:57.54 worked on is to make the particles
0:10:57.54 –> 0:10:59.45 themselves very sticky to proteins.
0:10:59.45 –> 0:11:01.676 Or tumor cells that have a lot
0:11:01.676 –> 0:11:03.689 of proteins on their surface.

0:11:03.69 –> 0:11:05.94 And so when you inject these
0:11:05.94 –> 0:11:07.83 sticky particles they will
0:11:07.83 –> 0:11:10.028 tend to be taken up by whatever
0:11:10.028 –> 0:11:12.502 cells are near the site where
0:11:12.502 –> 0:11:14.661 you've placed them and this
0:11:14.661 –> 0:11:17.328 allows the vast majority of the
0:11:17.328 –> 0:11:20.038 particles to stay in a tumor if you
0:11:20.038 –> 0:11:22.4 inject them right into the skin tumor,
0:11:22.4 –> 0:11:23.052 for example.
0:11:23.052 –> 0:11:25.334 And so that's one one way to
0:11:25.334 –> 0:11:27.623 augment the targeting that local
0:11:27.623 –> 0:11:29.519 delivery naturally provides you.
0:11:29.52 –> 0:11:31.8 A second way would be to not just
0:11:31.8 –> 0:11:33.261 use physical properties like
0:11:33.261 –> 0:11:35.311 stickiness of particles to make
0:11:35.311 –> 0:11:37.35 them attractive to tumor cells,
0:11:37.35 –> 0:11:39.13 but to make them specifically
0:11:39.13 –> 0:11:40.554 adhesive to tumor cells.
0:11:40.56 –> 0:11:41.684 So in that case,
0:11:41.684 –> 0:11:44.526 if you knew that there was
0:11:44.526 –> 0:11:47.046 a protein on the tumor cell surface
0:11:47.127 –> 0:11:49.593 that was expressed very abundantly in
0:11:49.593 –> 0:11:52.624 the tumor cells and not in normal cells,
0:11:52.624 –> 0:11:54.354 you could put some chemicals
0:11:54.354 –> 0:11:56.922 that bind to that protein on the
0:11:56.922 –> 0:11:58.358 surface of the nanoparticle.
0:11:58.36 –> 0:12:00.556 So this might be an antibody.
0:12:00.56 –> 0:12:03.395 Or an antibody fragment that
0:12:03.395 –> 0:12:06.043 is specific for that protein that's
0:12:06.043 –> 0:12:08.743 highly enriched on the tumor cell.
0:12:08.75 –> 0:12:11.336 Then that gives you an additional

0:12:11.336 –> 0:12:12.63 level of targeting.
0:12:12.63 –> 0:12:17.928 And it's even possible to think about
0:12:17.93 –> 0:12:20.114 administering those highly
0:12:20.114 –> 0:12:22.298 targeted particles systemically and
0:12:22.298 –> 0:12:25.019 and asking them to find the tumor
0:12:25.019 –> 0:12:27.406 for you instead of you using the
0:12:27.406 –> 0:12:29.686 needle to find the tumor yourself.
0:12:29.69 –> 0:12:33.362 And that's been a very active area of
0:12:33.362 –> 0:12:37.243 study over the past 10 to 15 years or so,
0:12:37.25 –> 0:12:40.869 and it turns out to be
0:12:40.87 –> 0:12:42.575 hard to achieve practically for
0:12:42.575 –> 0:12:44.28 reasons that we could discuss.
0:12:44.28 –> 0:12:46.667 But it's also a method of targeting.
0:12:46.67 –> 0:12:48.542 I would like
0:12:48.542 –> 0:12:50.967 to get into how exactly we target
0:12:50.967 –> 0:12:53.187 things and what are the challenges
0:12:53.187 –> 0:12:55.189 that are being faced in this
0:12:55.19 –> 0:12:56.9 really exciting area, but first
0:12:56.9 –> 0:12:59.393 we need to take a short break
0:12:59.393 –> 0:13:01.749 for a medical minute, so please stay
0:13:01.749 –> 0:13:03.981 tuned to learn more about nanoparticles
0:13:03.981 –> 0:13:06.447 and skin tumors with my guests
0:13:06.45 –> 0:13:07.13 Doctor Michael Girardi and
0:13:08.49 –> 0:13:09.17 Doctor Mark Saltzman.
0:13:09.85 –> 0:13:12.445 Funding for Yale Cancer Answers
0:13:12.445 –> 0:13:15.536 comes from AstraZeneca, working to
0:13:15.536 –> 0:13:18.42 eliminate cancer as a cause of death.
0:13:18.42 –> 0:13:22.188 Learn more at astrazeneca-us.com.
0:13:22.19 –> 0:13:24.34 Over 230,000 Americans will be
0:13:24.34 –> 0:13:26.49 diagnosed with lung cancer this
0:13:26.565 –> 0:13:28.405 year and in Connecticut alone

0:13:28.405 –> 0:13:31.01 there will be over 2700 new cases.
0:13:31.01 –> 0:13:33.17 More than 85% of lung cancer
0:13:33.17 –> 0:13:35.553 diagnosis are related to smoking and
0:13:35.553 –> 0:13:38.163 quitting even after decades of use
0:13:38.163 –> 0:13:40.282 can significantly reduce your risk
0:13:40.282 –> 0:13:42.64 of developing lung cancer. Each day,
0:13:42.64 –> 0:13:44.95 patients with lung cancer are surviving
0:13:44.95 –> 0:13:47.386 thanks to increased access to advanced
0:13:47.386 –> 0:13:49.058 therapies and specialized care,
0:13:49.06 –> 0:13:51.005 new treatment options and surgical
0:13:51.005 –> 0:13:53.59 techniques are giving lung cancer survivors
0:13:53.59 –> 0:13:56.766 more hope than they have ever had before.
0:13:56.77 –> 0:13:58.35 Clinical trials are currently
0:13:58.35 –> 0:13:59.93 underway at federally designated
0:13:59.93 –> 0:14:01.15 Comprehensive cancer centers,
0:14:01.15 –> 0:14:03.74 such as the BATTLE II trial at
0:14:03.74 –> 0:14:05.644 Yale Cancer Center and Smilow
0:14:05.644 –> 0:14:08.136 Cancer Hospital to learn if a drug
0:14:08.136 –> 0:14:10.826 or combination of drugs based on
0:14:10.826 –> 0:14:13.086 personal biomarkers can help to
0:14:13.09 –> 0:14:15.478 control non small cell lung cancer.
0:14:15.48 –> 0:14:17.53 More information is available at
0:14:17.53 –> 0:14:18.76 yalecancercenter.org. You're listening
0:14:18.76 –> 0:14:20.26 to Connecticut Public Radio.
0:14:21.32 –> 0:14:23.816 Welcome back to Yale Cancer Answers.
0:14:23.82 –> 0:14:26.664 This is Doctor Anees Chagpar
0:14:26.664 –> 0:14:29.338 and I'm joined tonight by my guest doctor
0:14:29.338 –> 0:14:32.14 Michael Girardi and Doctor Mark Saltzman.
0:14:32.14 –> 0:14:34.58 We're talking about research looking
0:14:34.58 –> 0:14:37.02 into using nanoparticles to treat
0:14:37.09 –> 0:14:39.346 skin tumors and right before the

0:14:39.346 –> 0:14:42.032 break we were talking about how these
0:14:42.032 –> 0:14:44.615 nanoparticles are so small and how we
0:14:44.62 –> 0:14:47.399 can try to make them really attack
0:14:47.399 –> 0:14:50.02 tumor cells rather than normal cells.
0:14:50.02 –> 0:14:52.72 So Mike, Mark was
0:14:52.72 –> 0:14:55.17 talking about how
0:14:55.17 –> 0:14:57.86 we can make nanoparticles sticky.
0:14:57.86 –> 0:15:00.748 We can try to get them in an
0:15:00.748 –> 0:15:03.418 area where these cancers exist.
0:15:03.42 –> 0:15:07.263 What have you explored in terms of
0:15:07.27 –> 0:15:10.694 trying to treat these skin cancers?
0:15:11.139 –> 0:15:13.773 What are the exciting
0:15:13.773 –> 0:15:15.4 developments and where are
0:15:15.4 –> 0:15:17.112 we with this research?
0:15:17.112 –> 0:15:20.111 So I think there's several features that
0:15:20.111 –> 0:15:22.657 we're really leveraging about the sticky
0:15:22.657 –> 0:15:25.59 type particles and these will bind to proteins.
0:15:25.59 –> 0:15:28.008 Any proteins they come in contact
0:15:28.008 –> 0:15:30.429 with but what's really special about the
0:15:30.43 –> 0:15:32.55 tumor microenvironment is that it's
0:15:32.55 –> 0:15:35.099 very protein rich tumor cells secrete
0:15:35.099 –> 0:15:37.277 a lot of proteins.
0:15:37.28 –> 0:15:39.29 They create their own matrix.
0:15:39.29 –> 0:15:41.31 This is helpful for them.
0:15:41.31 –> 0:15:44.874 We think they perceive it as such so they
0:15:44.874 –> 0:15:48.969 can grow so they can begin to want to travel
0:15:48.97 –> 0:15:52.186 if we personify the tumor cells that way,
0:15:52.19 –> 0:15:54.062 and so these particles
0:15:54.062 –> 0:15:57.803 will bind to both tumor matrix proteins and
0:15:57.803 –> 0:16:01.23 bind to the surface of the tumor cells,
0:16:01.23 –> 0:16:03.738 so this really not only gets

0:16:03.738 –> 0:16:06.57 the drugs into the tumor cells,
0:16:06.57 –> 0:16:09.174 but creates anti-tumor
0:16:09.174 –> 0:16:11.47 agents all around the tumor.
0:16:11.47 –> 0:16:14.445 We think this is really important for
0:16:14.445 –> 0:16:17.699 trying to target and eliminate the tumor.
0:16:17.7 –> 0:16:20.202 We also have worked on strategies
0:16:20.202 –> 0:16:22.994 and how we deliver these tiny
0:16:22.994 –> 0:16:25.078 particles beyond the simple
0:16:25.08 –> 0:16:26.728 syringe and needle strategy,
0:16:26.728 –> 0:16:28.376 which is actually quite
0:16:28.376 –> 0:16:30.159 effective in and of itself.
0:16:30.16 –> 0:16:32.506 But for certain tumors,
0:16:32.51 –> 0:16:33.254 for example,
0:16:33.254 –> 0:16:35.114 ones that are more broad
0:16:35.114 –> 0:16:37.199 but thin and shallow,
0:16:37.2 –> 0:16:39.155 they can create surgical challenges
0:16:39.155 –> 0:16:42.714 to cut out a large piece of skin when
0:16:42.714 –> 0:16:45.012 something is really not that deep.
0:16:45.02 –> 0:16:47.533 That lets us wonder if there is a
0:16:47.533 –> 0:16:49.71 way to deliver these agents,
0:16:49.71 –> 0:16:52.056 for example over a larger area,
0:16:52.06 –> 0:16:56.3 but not as deep and so Mark and I have
0:16:56.3 –> 0:16:58.26 explored strategies using what's called
0:16:58.26 –> 0:17:00.56 micro needling or micro needle pads,
0:17:00.56 –> 0:17:02.495 and so the particles might
0:17:02.495 –> 0:17:04.43 be loaded into these hollow
0:17:04.43 –> 0:17:07.118 very tiny needles and in
0:17:07.118 –> 0:17:10.116 many cases they can be made to be
0:17:10.116 –> 0:17:12.372 painless because they just don't
0:17:12.372 –> 0:17:15.221 get to the depth where they're going
0:17:15.221 –> 0:17:17.5 to trigger the nerve endings and

0:17:17.5 –> 0:17:20.165 these pads could be applied and the
0:17:20.165 –> 0:17:22.993 particles can be delivered in that fashion.
0:17:23 –> 0:17:25.28 We've also looked at strategies where
0:17:25.28 –> 0:17:27.38 we've accelerated fluid that contains
0:17:27.38 –> 0:17:28.248 the nanoparticles
0:17:28.248 –> 0:17:31.72 in a way that can push them with
0:17:31.805 –> 0:17:34.559 a high pressure system through the
0:17:34.559 –> 0:17:37.872 surface of the skin into a tumor
0:17:37.872 –> 0:17:39.72 and the surrounding area.
0:17:39.72 –> 0:17:43.376 Kind of like a high pressure micro waterjet,
0:17:43.38 –> 0:17:46.355 so we're really looking at ways that
0:17:46.355 –> 0:17:49.089 we can empower health care providers
0:17:49.089 –> 0:17:52.295 to be able to use this technology
0:17:52.383 –> 0:17:54.798 to best serve their patients.
0:17:54.8 –> 0:17:57.968 But in a number of different
0:17:57.97 –> 0:18:00.17 tumor settings, different tumor types,
0:18:00.17 –> 0:18:01.484 different tumor sizes,
0:18:01.484 –> 0:18:03.236 and different tumor depths.
0:18:03.24 –> 0:18:03.68 That's
0:18:03.68 –> 0:18:06.572 really interesting, and I guess the
0:18:06.572 –> 0:18:09.82 other way to do this is,
0:18:09.82 –> 0:18:12.9 as you both were talking about earlier,
0:18:12.9 –> 0:18:14.696 was injecting this systemically.
0:18:14.696 –> 0:18:18.297 So I would think intravenously to try and
0:18:18.297 –> 0:18:20.799 hone these nanoparticles to their target
0:18:20.8 –> 0:18:23.428 whether it's an
0:18:23.428 –> 0:18:26.241 antibody or other mechanism to
0:18:26.241 –> 0:18:29.133 try to find these cancer cells
0:18:29.14 –> 0:18:31.17 and target them that way.
0:18:31.17 –> 0:18:33.19 Mark, you know another concept
0:18:33.19 –> 0:18:34.806 that you had mentioned,

0:18:34.81 –> 0:18:37.77 or I think Mike had mentioned before the
0:18:37.77 –> 0:18:40.268 break was using nanoparticles to kind
0:18:40.268 –> 0:18:43.32 of prime the immune system.
0:18:43.32 –> 0:18:46.02 Often on this show we're talking about
0:18:46.02 –> 0:18:48.759 immunotherapy and the fact that these
0:18:48.759 –> 0:18:51.748 cancers kind of evade the immune system
0:18:51.748 –> 0:18:54.821 whose job it is really to get rid of
0:18:54.821 –> 0:18:57.9 things that we don't want in our body,
0:18:57.9 –> 0:18:59.229 whether it's infections,
0:18:59.229 –> 0:19:01.887 or whether it's tumor cells.
0:19:01.887 –> 0:19:04.489 Tell us a little bit more about
0:19:04.489 –> 0:19:06.482 how you can engineer nanoparticles
0:19:06.482 –> 0:19:09.127 to trigger the immune system,
0:19:09.13 –> 0:19:12.147 and how that's working in treating cancer?
0:19:13.89 –> 0:19:15.606 I'd be happy
0:19:15.606 –> 0:19:16.75 to start addressing that,
0:19:16.75 –> 0:19:19.315 but Mike is really the expert on that part,
0:19:19.32 –> 0:19:21.552 but so I'll talk about the parts that
0:19:21.552 –> 0:19:23.899 I know and maybe he can follow up.
0:19:26.19 –> 0:19:27.936 One of the interesting things about some
0:19:27.936 –> 0:19:30.532 of the cells of the immune system is
0:19:30.532 –> 0:19:32.242 that their naturally bagocytic
0:19:32.25 –> 0:19:35.028 and part of their job is to take up
0:19:38.07 –> 0:19:39.478 particles from the environment
0:19:39.478 –> 0:19:41.985 and to sample them to look for
0:19:41.985 –> 0:19:43.317 danger signals,
0:19:43.32 –> 0:19:44.528 and so you can
0:19:44.528 –> 0:19:46.34 exploit those cells by
0:19:46.411 –> 0:19:48.351 creating nanoparticles that look
0:19:48.351 –> 0:19:50.703 like the natural kinds of things
0:19:50.703 –> 0:19:53.118 that they would take up and ingest.

0:19:53.12 –> 0:19:55.129 And you can do that by controlling
0:19:55.129 –> 0:19:57.406 the size of the particle and by
0:19:57.406 –> 0:19:59.428 controlling its surface to make it
0:19:59.495 –> 0:20:01.967 most attractive to those
0:20:01.967 –> 0:20:04.012 macrophages or antigen presenting cells.
0:20:04.012 –> 0:20:05.188 But in addition,
0:20:05.188 –> 0:20:07.148 you could further
0:20:07.148 –> 0:20:09.068 augment the activity of those
0:20:09.07 –> 0:20:11.744 particles by putting in the kind
0:20:11.744 –> 0:20:14.16 of danger signals that they might
0:20:14.16 –> 0:20:16.542 find from a microorganism and that
0:20:16.542 –> 0:20:19.247 revs up their their immune activity.
0:20:19.25 –> 0:20:21.686 And so we've been exploring that
0:20:21.686 –> 0:20:24.001 and also exploring the idea
0:20:24.001 –> 0:20:27.406 that you could present these
0:20:27.41 –> 0:20:29.29 signals to immune cells
0:20:29.29 –> 0:20:31.59 in a variety of different ways,
0:20:31.59 –> 0:20:33.49 either by slowly releasing them,
0:20:33.49 –> 0:20:35.836 the concept we talked about before,
0:20:35.836 –> 0:20:38.245 or by presenting them in different
0:20:38.245 –> 0:20:40.549 fashions on the surface or the
0:20:40.549 –> 0:20:42.789 interior of the particle and looking
0:20:42.789 –> 0:20:45.628 to see if by changing the way that
0:20:45.628 –> 0:20:47.842 the particle is engineered with these
0:20:47.842 –> 0:20:50.587 signals for the immune system,
0:20:50.59 –> 0:20:51.682 if that changes
0:20:51.682 –> 0:20:54.23 the speed or the aggressiveness
0:20:54.303 –> 0:20:56.253 that you can introduce into
0:20:56.253 –> 0:20:57.423 the immune response.
0:20:58.69 –> 0:21:01 So Mike, do you want to
0:21:01 –> 0:21:03.43 kind of pick up on that?

0:21:03.43 –> 0:21:05.692 I mean, oftentimes when we're thinking

0:21:05.692 –> 0:21:07.78 about generating an immune response,

0:21:07.78 –> 0:21:10.15 we kind of talked about

0:21:10.15 –> 0:21:11.73 two kinds of systems.

0:21:13.206 –> 0:21:16.07 One that's a more generalized immune response,

0:21:16.07 –> 0:21:17.745 and one that's more targeted.

0:21:17.745 –> 0:21:20.274 Talk a little bit about how you

0:21:20.274 –> 0:21:21.453 envision nanoparticles really

0:21:21.453 –> 0:21:24.002 working in terms of the immune

0:21:24.002 –> 0:21:25.55 response against cancers.

0:21:26.51 –> 0:21:29.604 Yeah, I think it's a critical question.

0:21:29.61 –> 0:21:32.592 I think that cancer therapy today is

0:21:32.592 –> 0:21:35.016 about targeting the tumor and

0:21:35.016 –> 0:21:37.287 it's about manipulating the immune

0:21:37.287 –> 0:21:39.969 system to to maximize the effects

0:21:40.045 –> 0:21:42.46 of the tumor targeting strategies.

0:21:42.46 –> 0:21:45.112 No cancer therapy can ignore today

0:21:45.112 –> 0:21:48.048 what's going on with the immune system.

0:21:48.048 –> 0:21:50.364 It's too powerful an ally in

0:21:50.364 –> 0:21:53.32 the fight against the cancer and

0:21:53.32 –> 0:21:55.308 there's obstacles to overcome,

0:21:55.31 –> 0:21:57.822 so let me explain.

0:21:57.822 –> 0:22:01.59 That first dichotomy is

0:22:01.59 –> 0:22:04.602 that we have evolved to recognize

0:22:04.602 –> 0:22:05.606 foreign substances,

0:22:05.61 –> 0:22:08.646 including antigens on tumor cells

0:22:08.646 –> 0:22:12.226 and we can stimulate the heck out

0:22:12.226 –> 0:22:14.666 of that process through agents,

0:22:14.67 –> 0:22:17.73 as Mark has described, that might

0:22:17.73 –> 0:22:19.77 be considered dangerous signals,

0:22:19.851 –> 0:22:22.719 molecules that might be for example,

0:22:22.72 –> 0:22:25.23 normally found on infectious agents,
0:22:25.23 –> 0:22:28.236 molecules that might be produced by
0:22:28.236 –> 0:22:31.918 our own cells when they have sensed
0:22:31.92 –> 0:22:34.14 that they are infected, for example.
0:22:34.14 –> 0:22:36.868 We can begin to try to trick
0:22:36.868 –> 0:22:38.21 the immune system
0:22:38.21 –> 0:22:40.38 in looking at the cancer cells in
0:22:40.38 –> 0:22:43.491 a way that makes them appear as if
0:22:43.491 –> 0:22:45.601 they're a foreign infection,
0:22:45.61 –> 0:22:47.46 whether that be viral resemblance
0:22:47.46 –> 0:22:49.31 or bacterial resemblance or others.
0:22:49.31 –> 0:22:52.64 And we can do that in a general way,
0:22:52.64 –> 0:22:55.405 and so those are common molecules that
0:22:55.405 –> 0:22:57.82 are found on a bunch of microorganisms,
0:22:57.82 –> 0:23:00.45 so we can just introduce those types
0:23:00.45 –> 0:23:02.35 of compounds into the nanoparticles.
0:23:02.35 –> 0:23:04.69 Then we can try to facilitate
0:23:04.69 –> 0:23:07.175 how they're seen by the immune
0:23:07.175 –> 0:23:09.683 system in a more optimized way.
0:23:09.69 –> 0:23:11.73 In a more specific way,
0:23:11.73 –> 0:23:14.178 we might try to load what
0:23:14.178 –> 0:23:15.81 are called tumor antigens,
0:23:15.81 –> 0:23:18.228 so these might be real signatures
0:23:18.228 –> 0:23:20.709 on very specific types of cancers,
0:23:20.71 –> 0:23:23.152 and they may be even specific
0:23:23.152 –> 0:23:24.373 to each patient.
0:23:24.38 –> 0:23:25.565 In this way,
0:23:25.565 –> 0:23:27.935 we're trying to stimulate a very
0:23:27.935 –> 0:23:30.09 directed killer T cell response.
0:23:30.09 –> 0:23:33.036 That's akin to a vaccine, for example.
0:23:33.036 –> 0:23:36.207 That you know is being discussed

0:23:36.207 –> 0:23:39.595 these days for a bunch of other reasons,
0:23:39.6 –> 0:23:42.68 and so we can use nanoparticles to
0:23:42.68 –> 0:23:45.321 develop anti tumor vaccines that
0:23:45.321 –> 0:23:47.793 could more specifically stimulate
0:23:47.793 –> 0:23:49.647 the immune system
0:23:53 –> 0:23:54.908 to attack the cancer.
0:23:57.24 –> 0:23:59.21 And on another consideration though,
0:23:59.21 –> 0:24:02.138 we have to realize that tumors evolve and
0:24:02.138 –> 0:24:05.486 grow to try to suppress the immune system.
0:24:05.49 –> 0:24:07.848 And this is a major major
0:24:07.848 –> 0:24:09.42 consideration in treating cancer,
0:24:09.42 –> 0:24:11.39 immune checkpoint inhibitors or something,
0:24:11.39 –> 0:24:13.435 for example, that are delivered
0:24:13.435 –> 0:24:16.32 throughout the body to try to alleviate
0:24:16.32 –> 0:24:18.606 some of these controls that the
0:24:18.606 –> 0:24:21.209 tumor has put on the immune system.
0:24:21.21 –> 0:24:24.052 But we can also try to target
0:24:24.052 –> 0:24:25.97 that with nanoparticles locally.
0:24:25.97 –> 0:24:28.802 So for example, there are immune cells that
0:24:28.802 –> 0:24:31.79 try to suppress the antitumor effects,
0:24:31.79 –> 0:24:35.82 and these need to be
0:24:35.82 –> 0:24:37.85 dealt with in a way,
0:24:37.85 –> 0:24:39.88 especially at the tumor site,
0:24:39.88 –> 0:24:42.292 so that the tumor can become
0:24:42.292 –> 0:24:45.158 what we call hot and not cold.
0:24:45.16 –> 0:24:48.24 Hot, meaning it can be recognized by the
0:24:48.24 –> 0:24:50.439 antitumor immune system more readily.
0:24:51.83 –> 0:24:54.398 And it sounds like
0:24:54.398 –> 0:24:56.307 you have so many possibilities
0:24:56.307 –> 0:24:59.079 in terms of how you can fashion
0:24:59.155 –> 0:25:01.637 these nanoparticles, so you can

0:25:01.637 –> 0:25:03.94 target the tumor on one

0:25:04.021 –> 0:25:06.281 side and potentially attract the

0:25:06.281 –> 0:25:09.025 immune system on the other side

0:25:09.025 –> 0:25:11.867 and get these two systems in

0:25:11.867 –> 0:25:14.284 close proximity to each other in

0:25:14.284 –> 0:25:16.289 addition to delivering drugs.

0:25:16.29 –> 0:25:19.013 Now the other thing that you mentioned

0:25:19.013 –> 0:25:21.95 before the break was using nanoparticles

0:25:21.95 –> 0:25:24.908 relating to skin cancers,

0:25:24.91 –> 0:25:27.868 but more on the prevention side.

0:25:27.87 –> 0:25:30.936 So Mark talk a little bit about

0:25:30.936 –> 0:25:32.92 using nanoparticles to make

0:25:32.92 –> 0:25:35.256 sunscreens more effective.

0:25:36.34 –> 0:25:39.08 Yeah, I'd be happy to do that and that was one of

0:25:39.15 –> 0:25:42.11 the first big projects that Mike and I

0:25:42.11 –> 0:25:44.836 worked together on and it was quite successful.

0:25:44.84 –> 0:25:48.24 So the idea was that we NOTE Confidence: 0.9900481

0:25:48.24 –> 0:25:50.739 knew that we could make these

0:25:50.739 –> 0:25:52.737 nanoparticles that would adhere to tissues

0:25:52.737 –> 0:25:55.552 and we tested them to see if you just

0:25:55.552 –> 0:25:57.76 suspended these particles,

0:25:57.76 –> 0:26:00.273 these sticky particles and NOTE Confidence: 0.9900481

0:26:00.273 –> 0:26:03.581 you put that water on the skin would

0:26:03.581 –> 0:26:06.27 the particles adhere and in fact they did.

0:26:06.27 –> 0:26:08.998 And they adhered very strongly to the skin.

0:26:09.909 –> 0:26:12.03 You could put some particles on the

0:26:12.1 –> 0:26:14.396 skin and then you could wash the

0:26:14.396 –> 0:26:16.204 skin extensively and the particles

0:26:16.204 –> 0:26:18.472 would just stay there and resist

0:26:18.472 –> 0:26:19.91 removal with washing.

0:26:19.91 –> 0:26:22.635 And so we knew that there was something
0:26:22.635 –> 0:26:23.999 special about that technology,
0:26:24 –> 0:26:26.238 because if you can apply something
0:26:26.238 –> 0:26:28.388 topically to the skin and it
0:26:28.388 –> 0:26:30.14 stays there for a long time,
0:26:30.14 –> 0:26:31.85 that might have some value.
0:26:31.85 –> 0:26:34.73 And so in the second phase we learned that
0:26:34.799 –> 0:26:37.619 one could take common sunscreen ingredients
0:26:37.62 –> 0:26:40.357 and load them at very high levels
0:26:40.357 –> 0:26:41.53 inside these nanoparticles,
0:26:41.53 –> 0:26:43.485 so that the nanoparticle itself
0:26:43.485 –> 0:26:45.05 was 50 percent, 60%,
0:26:45.05 –> 0:26:47 sometimes even 70% sunscreen agent.
0:26:47 –> 0:26:50.072 And then if you apply those to the
0:26:50.072 –> 0:26:52.48 surface of the skin, they stuck.
0:26:52.48 –> 0:26:54.82 They don't penetrate into the skin.
0:26:54.82 –> 0:26:57.17 They don't wash off very easily,
0:26:57.17 –> 0:27:00.296 but they're sitting on the skin now in
0:27:00.296 –> 0:27:03.422 a position to be between the skin and
0:27:03.422 –> 0:27:06.55 any ultraviolet light that falls on the skin,
0:27:06.55 –> 0:27:08.58 and so they could be
0:27:08.58 –> 0:27:11.165 very effective at screening that
0:27:11.165 –> 0:27:13.75 ultraviolet light and and absorbing
0:27:13.833 –> 0:27:16.527 it and blocking it without anything
0:27:16.527 –> 0:27:19.059 ever entering your body and they
0:27:19.059 –> 0:27:21.362 stay on there for a long time.
0:27:21.37 –> 0:27:24.628 And so we did a number of studies
0:27:24.628 –> 0:27:27.754 trying to understand how this works and
0:27:27.754 –> 0:27:30.622 trying to perfect it using combinations
0:27:30.622 –> 0:27:34.101 of sunscreens so that we could block
0:27:34.101 –> 0:27:35.923 all wavelengths of ultraviolet

0:27:35.923 –> 0:27:38.826 light and ultimately did a

0:27:38.826 –> 0:27:41.098 small pilot clinical trial

0:27:41.1 –> 0:27:43.767 here at Yale showing that

0:27:43.767 –> 0:27:46.453 indeed you could put these on the

0:27:46.453 –> 0:27:48.649 surface of the skin of volunteers

0:27:48.731 –> 0:27:51.447 that they were completely safe and

0:27:51.447 –> 0:27:54.208 Mike can talk about the details of

0:27:54.208 –> 0:27:57.03 that and that they would perform just

0:27:57.03 –> 0:27:59.55 as well as the kinds of sunscreens

0:27:59.55 –> 0:28:02.22 that you can buy at the drugstore.

0:28:02.22 –> 0:28:04.518 So we're very excited about that

0:28:05.67 –> 0:28:08.575 and new ways

0:28:08.575 –> 0:28:09.82 to use technology

0:28:09.82 –> 0:28:11.308 to prevent skin cancer.

0:28:16.992 –> 0:28:19.375 And my grandparents all worked on

0:28:19.375 –> 0:28:21.748 farms and so are very familiar with the

0:28:21.748 –> 0:28:24 devastating effects

0:28:24 –> 0:28:26.37 of skin cancer.

0:28:26.37 –> 0:28:28.335 Doctor W. Mark Saltzman is a professor

0:28:28.335 –> 0:28:29.514 of biomedical engineering,

0:28:29.52 –> 0:28:31.256 cellular and molecular Physiology

0:28:31.256 –> 0:28:32.992 and of chemical engineering

0:28:32.992 –> 0:28:34.961 and Doctor Michael Girardi is

0:28:34.961 –> 0:28:36.681 a professor of dermatology at

0:28:36.681 –> 0:28:38.578 the Yale School of Medicine.

0:28:38.58 –> 0:28:41.13 If you have questions the address

0:28:41.13 –> 0:28:41.98 is canceranswers@yale.edu.

0:28:41.98 –> 0:28:43.75 And past editions of the program

0:28:43.75 –> 0:28:45.868 are available in audio and written

0:28:45.868 –> 0:28:47.188 form at yalecancercenter.org.

0:28:47.19 –> 0:28:49.43 We hope you'll join us next week to

0:28:49.43 –> 0:28:51.583 learn more about the fight against

0:28:51.583 –> 0:28:53.498 cancer here on Connecticut Public

0:28:53.498 –> 0:28:55.407 radio funding for Yale Cancer

0:28:55.407 –> 0:28:57.232 Answers is provided by Smilow

0:28:57.232 –> 0:29:00.072 Cancer Hospital and AstraZeneca.