1
00:00:00,550 --> 00:00:04,330
>> You know, there are literally
hundreds of experiments taking place

2
00:00:04,330 --> 00:00:06,190
on board the International Space Station,

3
00:00:06,190 --> 00:00:09,930
each and every expedition while the
astronauts and the cosmonauts are up there.

4
00:00:09,930 --> 00:00:11,400
One of the most important lessons

5
00:00:11,400 --> 00:00:15,290
that the International Space Station is teaching
us is how the human body actually reacts

6
00:00:15,290 --> 00:00:17,240
to being up there for up to six months.

7
00:00:17,240 --> 00:00:21,240
When we take a look at going to Mars, or going
to an asteroid, or those longer type missions,

8
00:00:21,240 --> 00:00:25,030
how our bodies react to those types of
journeys is going to be incredibly important.

9
00:00:25,030 --> 00:00:28,480
We're here at the cardio -- cardiovascular
lab here at the Johnson Space Center.

10
00:00:28,480 --> 00:00:32,230
I'm joined by Stuart Lee, who is one of
the lead scientists for this laboratory.

11
00:00:32,230 --> 00:00:34,890
Stuart, let's talk a little bit about

first of all what this lab does,

12
00:00:34,890 --> 00:00:37,730
and then we'll take a look at some
of these machines back behind us.

13
00:00:37,730 --> 00:00:40,580
>> Stuart Lee: So the main objective
of this laboratory of course is to look

14
00:00:40,580 --> 00:00:44,730
at how the cardiovascular system in
particular responds to the effects

15
00:00:44,730 --> 00:00:47,620
of lack of gravity or weightlessness.

16
00:00:47,620 --> 00:00:49,560
We're involved in several studies.

17
00:00:49,560 --> 00:00:53,110
One of the most important ones we're doing right
now is an integrative cardiovascular experiment.

18
00:00:53,110 --> 00:00:58,730
And the cardiovascular experiment, or
ICV, is a multi-center study headed

19
00:00:58,730 --> 00:01:06,550
up by Doctor Ben Levine at UT Southwestern,
and Doctor Mike Bungo at UTL Sciences Center,

20
00:01:06,550 --> 00:01:11,380
in collaboration with Johnson Space
Center, and with the Cleveland Clinic

21
00:01:11,380 --> 00:01:15,940
to give a good comprehensive evaluation
of what happens to the heart in particular

22
00:01:15,940 --> 00:01:17,430
as a result of being in weightlessness.

23
00:01:17,430 --> 00:01:18,780
>> So let's talk about it real basically.

24
00:01:18,780 --> 00:01:19,820
The heart's a muscle.

25
00:01:19,820 --> 00:01:20,050
>> Stuart Lee: Yes.

26
00:01:20,050 --> 00:01:22,720
>> Muscles react kind of
strangely to being up in space,

27
00:01:22,720 --> 00:01:24,310
we're still learning kind of what happens.

28
00:01:24,310 --> 00:01:24,400
>> Stuart Lee: Right.

29
00:01:24,400 --> 00:01:26,840
>> So talk about kind of what we've
learned about how the heart and the rest

30
00:01:26,840 --> 00:01:30,540
of the muscles react of what this ICD
actually looks at and how it works.

31
00:01:30,540 --> 00:01:34,740
>> Stuart Lee: So everybody probably has heard
about muscle wasting or atrophy that happens

32
00:01:34,740 --> 00:01:38,800
in the skeletal muscles in your -- particularly
in your legs, and also in your arms.

33

00:01:38,800 --> 00:01:40,960
Same sort of thing happens to the heart.

34
00:01:40,960 --> 00:01:43,810
Most people don't realize that their
blood actually has weight to it,

35
00:01:43,810 --> 00:01:47,530
and your cardiovascular system has to work
in order to get blood from your bottom part

36
00:01:47,530 --> 00:01:50,270
of your body back up to your heart,
and particularly to your brain.

37
00:01:50,270 --> 00:01:51,090
>> 'Cause of the gravity.

38
00:01:51,090 --> 00:01:51,920
>> Stuart Lee: Because of gravity.

39
00:01:51,920 --> 00:01:52,060
>> Okay.

40
00:01:52,060 --> 00:01:52,470
>> Stuart Lee: Exactly.

41
00:01:52,470 --> 00:01:58,230
And so what we're looking at is because
you lose those gravitational forces,

42
00:01:58,230 --> 00:01:59,560
it actually has an effect on the heart.

43
00:01:59,560 --> 00:02:04,430
The heart actually can get smaller as a
result of not having to work as hard in space,

44
00:02:04,430 --> 00:02:06,430

so that's called cardiac atrophy.

45
00:02:06,430 --> 00:02:09,100
And what we're doing is looking
at not just what happens

46
00:02:09,100 --> 00:02:12,500
with cardiac atrophy during a space
flight, but how it affects other things

47
00:02:12,500 --> 00:02:16,320
that you would normally do -- your blood
pressure regulation when you're standing up,

48
00:02:16,320 --> 00:02:20,530
the exercise that you would normally do, or in
the case of an astronaut the EVAs that they have

49
00:02:20,530 --> 00:02:23,750
to do, as well as just a
general function of the heart,

50
00:02:23,750 --> 00:02:26,560
and the electrical conduction through the heart.

51
00:02:26,560 --> 00:02:28,010
>> Okay. So let's talk about how you measure it.

52
00:02:28,010 --> 00:02:28,780
What the -- what is the [inaudible]?

53
00:02:28,780 --> 00:02:31,190
We've got these two machines here
which are ultrasound machines, right?

54
00:02:31,190 --> 00:02:31,780
>> Stuart Lee: Right, yeah.

55
00:02:31,780 --> 00:02:32,750

>> Okay, so let's talk about them.

56
00:02:32,750 --> 00:02:35,160
>> Stuart Lee: So what we
do normally is we look at --

57
00:02:35,160 --> 00:02:38,320
the first thing we want to do is look at
the function and the size of the heart.

58
00:02:38,320 --> 00:02:38,800
>> Uh-huh.

59
00:02:38,800 --> 00:02:43,260
>> Stuart Lee: The way that you would
do that scientifically is you'd use MRI.

60
00:02:43,260 --> 00:02:45,540
The other way that you can
do it in an ultrasound scan.

61
00:02:45,540 --> 00:02:51,450
The ultrasound scan has the -- the -- the
-- the ability to have that device on orbit,

62
00:02:51,450 --> 00:02:57,850
and so we do measurements of the heart pre and
-- and -- and post-flight using the ultrasound.

63
00:02:57,850 --> 00:03:02,090
And you can see this is an image of the heart --
actually some images that we captured early --

64
00:03:02,090 --> 00:03:02,500
>> Mm-hmm.

65
00:03:02,500 --> 00:03:04,000
>> Stuart Lee: -- showing
how the different ventricles

66
00:03:04,000 --> 00:03:06,450
of the heart, and then -- and the atrium.

67
00:03:06,450 --> 00:03:11,160
And so how blood flows through there, and
then how the -- the heart actually contracts.

68
00:03:11,160 --> 00:03:14,200
>> So this is actually what the
crew member would see [inaudible].

69
00:03:14,200 --> 00:03:16,730
>> Stuart Lee: This is what we
would collect on the ground.

70
00:03:16,730 --> 00:03:21,150
One of the neatest parts of this experiment
is that we actually collect the data on orbit.

71
00:03:21,150 --> 00:03:23,650
And rather than have the
astronauts become experts in --

72
00:03:23,650 --> 00:03:28,150
in stenography, we have one
of our experts, Doctor --

73
00:03:28,150 --> 00:03:33,580
Mister David Martin, who actually guides them
on orbit, how to do the ultrasound on orbit.

74
00:03:33,580 --> 00:03:35,720
And this is the device that we use for that.

75
00:03:35,720 --> 00:03:36,980
>> This is the actual machine that's up there.

76
00:03:36,980 --> 00:03:39,030
>> Stuart Lee: So there -- there's

one just like this on orbit.

77
00:03:39,030 --> 00:03:42,840
And what -- what David can do is he can
then tell them where to place the probe,

78
00:03:42,840 --> 00:03:45,440
how to angle it -- 'cause those
are all very important things.

79
00:03:45,440 --> 00:03:49,720
And then he teaches them, tells them how to --
what buttons to push in order to get the images

80
00:03:49,720 --> 00:03:53,090
that they -- that they need for the experiment.

81
00:03:53,090 --> 00:03:56,300
So that he's sitting in mission
control, he sees the images they see,

82
00:03:56,300 --> 00:03:58,080
and he also sees them doing the work.

83
00:03:58,080 --> 00:04:00,730
>> So it's not like they have to
become a PhD or an MD to -- to --

84
00:04:00,730 --> 00:04:01,250
>> Stuart Lee: Right, yeah.

85
00:04:01,250 --> 00:04:01,810
>> -- machine.

86
00:04:01,810 --> 00:04:04,380
They just take some basic
training, and then the -- the --

87
00:04:04,380 --> 00:04:06,150

the ground teams can really
kind of guide them through --

88
00:04:06,150 --> 00:04:06,480
>> Stuart Lee: Right.

89
00:04:06,480 --> 00:04:07,120
>> -- you know.

90
00:04:07,120 --> 00:04:09,190
Now talk about [inaudible]
kind's of interesting,

91
00:04:09,190 --> 00:04:12,420
because our astronauts are incredibly
smart people, but we miss color coding.

92
00:04:12,420 --> 00:04:13,130
Talk about -- about it.

93
00:04:13,130 --> 00:04:16,130
It makes it a little bit easier for them
basically know which button to push.

94
00:04:16,130 --> 00:04:16,870
>> Stuart Lee: Right.

95
00:04:16,870 --> 00:04:19,060
So, you know, there's lots
of different buttons on here,

96
00:04:19,060 --> 00:04:22,550
and they've got all their own little labels on
it, and it means a lot to the stenographers,

97
00:04:22,550 --> 00:04:27,060
the people who normally do this stuff, but it
doesn't necessarily mean a lot to, you know,

98

00:04:27,060 --> 00:04:29,460
an astronaut who hasn't had as much training.

99
00:04:29,460 --> 00:04:33,100
So David could say, you know,
push pink number 2 --

100
00:04:33,100 --> 00:04:33,360
>> Mm-hmm.

101
00:04:33,360 --> 00:04:35,880
>> Stuart Lee: -- and -- and that -- they
would know exactly where to go to it.

102
00:04:35,880 --> 00:04:39,530
This is a template specifically
designed for this purpose by NASA

103
00:04:39,530 --> 00:04:41,600
to be able to do this sort of stuff.

104
00:04:41,600 --> 00:04:46,680
One of the neat earth applications of this
is that if you're in a remote environment

105
00:04:46,680 --> 00:04:51,360
and you needed ultrasound, you could
actually have a non-expert collect ultrasound

106
00:04:51,360 --> 00:04:56,040
in the same fashion that David or -- or someone
like him could guide them through the procedure,

107
00:04:56,040 --> 00:04:58,950
and -- and do a diagnosis
where there is no doctor.

108
00:04:58,950 --> 00:05:02,110
>> Yeah. So you could just -- this
has applications here on earth --

109
00:05:02,110 --> 00:05:02,580
>> Stuart Lee: Yeah.

110
00:05:02,580 --> 00:05:05,330
>> You know, you're not physically there with
your doctor, somebody telling you what to do --

111
00:05:05,330 --> 00:05:05,480
>> Stuart Lee: Yeah.

112
00:05:05,480 --> 00:05:09,610
>> But you can actually kind of sort of -- I
think I could probably even figure this out.

113
00:05:09,610 --> 00:05:09,680
[Laughter]

114
00:05:09,680 --> 00:05:10,730
>> Stuart Lee: It's a neat little system.

115
00:05:10,730 --> 00:05:14,240
>> So talk about, you know, this ICV experiment,
what -- what have we learned about the heart?

116
00:05:14,240 --> 00:05:15,770
And -- and -- and you know,
you said it gets smaller,

117
00:05:15,770 --> 00:05:17,670
but how do you -- how do you combat that?

118
00:05:17,670 --> 00:05:19,060
Like what -- what would you do to --

119
00:05:19,060 --> 00:05:20,830
>> Stuart Lee: Well, the
best way that we know how,

120
00:05:20,830 --> 00:05:23,770
and the way we're doing it now is with exercise.

121
00:05:23,770 --> 00:05:28,410
And so exercise on the ground makes muscles
grow, it also helps the heart as well.

122
00:05:28,410 --> 00:05:30,950
And so we do the same sort of thing on orbit.

123
00:05:30,950 --> 00:05:34,640
The astronauts participate in treadmill
exercise, and cycling exercises,

124
00:05:34,640 --> 00:05:36,760
as well as weight lifting type exercises.

125
00:05:36,760 --> 00:05:39,690
And all those sorts of things
are good for the human body.

126
00:05:39,690 --> 00:05:42,080
What we've learned so far
is kind of interesting,

127
00:05:42,080 --> 00:05:47,110
but we expect there's a certain amount of
individual variability among astronauts.

128
00:05:47,110 --> 00:05:50,080
Some people lose more, some people lose less.

129
00:05:50,080 --> 00:05:55,070
What's pretty cool about the preliminary data
so far suggests is that the amount of exercise

130
00:05:55,070 --> 00:05:57,620
or -- or work, you know,
cardiac work that your heart does

131
00:05:57,620 --> 00:06:01,160
on orbit is actually related to
the amount of atrophy we see.

132
00:06:01,160 --> 00:06:06,360
So somebody who does a little more loses less
of their cardiac mass, and people who end

133
00:06:06,360 --> 00:06:09,450
up doing less than they would normally
do on the ground would lose more.

134
00:06:09,450 --> 00:06:11,050
>> So there's a direct correlation between --

135
00:06:11,050 --> 00:06:11,340
>> Stuart Lee: Yes.

136
00:06:11,340 --> 00:06:11,840
>> -- basically how much --

137
00:06:11,840 --> 00:06:12,710
>> Stuart Lee: So far.

138
00:06:12,710 --> 00:06:13,910
>> That's fascinating.

139
00:06:13,910 --> 00:06:14,240
>> Stuart Lee: Yeah.

140
00:06:14,240 --> 00:06:17,430
The study is about halfway through
so we're still learning a lot,

141
00:06:17,430 --> 00:06:18,980
so I don't want to put too much --

142

00:06:18,980 --> 00:06:19,340
>> Yeah.

143
00:06:19,340 --> 00:06:19,880
>> Stuart Lee: -- stock in that.

144
00:06:19,880 --> 00:06:21,440
>> It's being going on for three --
three years, is that what you said?

145
00:06:21,440 --> 00:06:22,290
>> Stuart Lee: Three years.

146
00:06:22,290 --> 00:06:26,620
We've got three crew members on orbit right
now, and we've got a couple more after that.

147
00:06:26,620 --> 00:06:28,460
We should be done in the next couple
of years, and we should be able

148
00:06:28,460 --> 00:06:30,630
to start disseminating results at that point.

149
00:06:30,630 --> 00:06:32,290
>> How often do they -- do
they do this [inaudible].

150
00:06:32,290 --> 00:06:35,050
I mean they're very busy up there,
so how often do they actually, you --

151
00:06:35,050 --> 00:06:37,600
you know, work with this type of experiment?

152
00:06:37,600 --> 00:06:38,880
How often do they participate in it?

153
00:06:38,880 --> 00:06:42,020

>> Stuart Lee: So we have a couple data --
or several data collections before flight,

154
00:06:42,020 --> 00:06:46,040
so we get an idea of what their heart looks
like and how it functions on the ground,

155
00:06:46,040 --> 00:06:49,450
as well as we get an idea
of -- of the amount of work

156
00:06:49,450 --> 00:06:53,130
that the heart does using what's called
ambulatory monitoring, where we --

157
00:06:53,130 --> 00:06:56,780
we measure blood pressure and
heart rate throughout 48 hours.

158
00:06:56,780 --> 00:07:00,820
We get a baseline of what they
normally do their typical day,

159
00:07:00,820 --> 00:07:03,450
and then we repeat that five times on orbit.

160
00:07:03,450 --> 00:07:08,490
So early in the mission, all the way to the end
of the mission we'll repeat those measurements

161
00:07:08,490 --> 00:07:11,840
of stenography, and then the
cardiac work measurements.

162
00:07:11,840 --> 00:07:17,440
The stenography, you know, takes about half
an hour, 45 minutes to do the measurements.

163
00:07:17,440 --> 00:07:20,190
We do it both at rest and during exercise.

164
00:07:20,190 --> 00:07:25,370
And then the -- the other stuff that we call
ambulatory monitoring, where they wear the --

165
00:07:25,370 --> 00:07:29,190
it's an EKG and blood pressure
monitor, that they wear --

166
00:07:29,190 --> 00:07:32,920
wear for 48 hours, and it doesn't
really interfere with their day per se.

167
00:07:32,920 --> 00:07:35,140
So they're able to do their normal
activities, 'cause what we're trying

168
00:07:35,140 --> 00:07:37,920
to capture is what they normally do.

169
00:07:37,920 --> 00:07:38,840
>> That's fascinating.

170
00:07:38,840 --> 00:07:41,260
It's interesting that we're still
learning about the human body and how it --

171
00:07:41,260 --> 00:07:43,580
how it behaves up there, 'cause
it is -- it's quite different.

172
00:07:43,580 --> 00:07:43,940
>> Stuart Lee: Right.

173
00:07:43,940 --> 00:07:46,740
There's a -- there's a lot to learn,
and -- and everybody is different.

174
00:07:46,740 --> 00:07:51,060

And we're trying to figure out what the best
counter measures are to get us to Mars, and --

175
00:07:51,060 --> 00:07:55,240
and to other planetary surfaces so we
can learn more about our solar system.

176
00:07:55,240 --> 00:07:55,910
>> Thanks a lot, Stuart.

177
00:07:55,910 --> 00:07:56,160
>> Stuart Lee: Thank you.

178
00:07:56,160 --> 00:07:57,780
>> We'll be back in just a few
minutes, and we'll be talking about

179
00:07:57,780 --> 00:08:00,800
yet another experiment that's going to be on
board the space station that the crew is going

180
00:08:00,800 --> 00:08:04,030
to be participating in in the future
that uses this same type of equipment,