
MOR

1
00:00:05,430 --> 00:00:03,110
hi welcome to the medical simulation

2
00:00:07,269 --> 00:00:05,440
laboratory just off site of johnson

3
00:00:10,230 --> 00:00:07,279
space center in houston where we have

4
00:00:12,549 --> 00:00:10,240
with us dr christian otto who is the

5
00:00:13,589 --> 00:00:12,559
visual impairment intracranial pressure

6
00:00:15,749 --> 00:00:13,599
risk

7
00:00:17,269 --> 00:00:15,759
lead scientist and he's one of the many

8
00:00:19,109 --> 00:00:17,279
people who are looking at the the

9
00:00:20,630 --> 00:00:19,119
changes we've seen in astronaut vision

10
00:00:21,910 --> 00:00:20,640
um during their stays in space and he's

11
00:00:23,189 --> 00:00:21,920
going to tell us a little bit about that

12
00:00:24,950 --> 00:00:23,199
so why don't you start by telling us

13
00:00:26,070 --> 00:00:24,960

what the visual impairment intracranial

14
00:00:28,070 --> 00:00:26,080
risk is

15
00:00:29,429 --> 00:00:28,080
yeah brandi so the the vip risk which we

16
00:00:31,349 --> 00:00:29,439
affectionately refer to it as is

17
00:00:33,350 --> 00:00:31,359
actually nasa's number one human space

18
00:00:35,430 --> 00:00:33,360
flight risk now it's a risk that

19
00:00:37,590 --> 00:00:35,440
encompasses a constellation of signs and

20
00:00:39,910 --> 00:00:37,600
symptoms that have recently discovered

21
00:00:43,270 --> 00:00:39,920
in the astronauts on the space station

22
00:00:45,830 --> 00:00:43,280
since 2005. and it's exactly as it as it

23
00:00:47,990 --> 00:00:45,840
sounds it's visual impairment so change

24
00:00:50,470 --> 00:00:48,000
in vision and change in the structure of

25
00:00:52,470 --> 00:00:50,480
the eye and we feel that that's

26
00:00:54,790 --> 00:00:52,480
precipitated possibly by elevated

27
00:00:56,630 --> 00:00:54,800
intracranial pressure the concern is

28
00:00:58,630 --> 00:00:56,640
that if astronauts were exposed to this

29
00:01:00,470 --> 00:00:58,640
for a longer period of time not just six

30
00:01:02,229 --> 00:01:00,480
months on the space station but for

31
00:01:04,549 --> 00:01:02,239
three years on a mars mission that it

32
00:01:05,750 --> 00:01:04,559
could possibly precipitate blindness in

33
00:01:07,270 --> 00:01:05,760
some cases

34
00:01:08,230 --> 00:01:07,280
so we've been i guess studying this for

35
00:01:09,990 --> 00:01:08,240
a little while now we've kind of

36
00:01:11,350 --> 00:01:10,000
developed a suite of different of

37
00:01:12,469 --> 00:01:11,360
different ways that we're collecting

38
00:01:16,070 --> 00:01:12,479

data on

39
00:01:18,149 --> 00:01:16,080
in orbit right yeah so the program has

40
00:01:19,429 --> 00:01:18,159
become more and more sophisticated with

41
00:01:21,190 --> 00:01:19,439
the suite of

42
00:01:23,350 --> 00:01:21,200
diagnostic equipment that we have on

43
00:01:25,109 --> 00:01:23,360
board now we have the diagnostic

44
00:01:27,030 --> 00:01:25,119
ultrasound device that has given us a

45
00:01:29,270 --> 00:01:27,040
tremendous insight into the changes in

46
00:01:31,429 --> 00:01:29,280
the structure of the eye in flight

47
00:01:34,870 --> 00:01:31,439
compared on the ground

48
00:01:36,310 --> 00:01:34,880
in terms of the the shape of the eye uh

49
00:01:39,510 --> 00:01:36,320
changes that are occurring behind the

50
00:01:41,670 --> 00:01:39,520
eye i'll be talking to you about the

51
00:01:44,149 --> 00:01:41,680
tonometer which measures intraocular

52
00:01:45,990 --> 00:01:44,159
pressure so that's very important what's

53
00:01:48,149 --> 00:01:46,000
happening to the pressure inside of the

54
00:01:49,670 --> 00:01:48,159
eye over the course of the flight but

55
00:01:51,270 --> 00:01:49,680
more importantly the relationship of

56
00:01:52,389 --> 00:01:51,280
that pressure to what's going on behind

57
00:01:54,069 --> 00:01:52,399
the eye

58
00:01:55,670 --> 00:01:54,079
a new device that's been on station for

59
00:01:57,830 --> 00:01:55,680
just over a year now is the ocular

60
00:01:59,910 --> 00:01:57,840
coherence tomography device

61
00:02:01,590 --> 00:01:59,920
and this is really has been giving us

62
00:02:04,069 --> 00:02:01,600
tremendous information in terms of

63
00:02:06,149 --> 00:02:04,079

what's happening down at the level of

64
00:02:08,869 --> 00:02:06,159
the retina and the and the

65
00:02:11,350 --> 00:02:08,879
the nerves exiting the optic nerve head

66
00:02:12,550 --> 00:02:11,360
we can actually see very finite changes

67
00:02:17,589 --> 00:02:12,560
in

68
00:02:19,589 --> 00:02:17,599
the micron level so we can follow that

69
00:02:21,190 --> 00:02:19,599
during flight and we've been able to

70
00:02:23,030 --> 00:02:21,200
detect some individuals have a large

71
00:02:25,030 --> 00:02:23,040
amount of swelling others have a very

72
00:02:27,350 --> 00:02:25,040
small amount of swelling so that gives

73
00:02:28,790 --> 00:02:27,360
us tremendous insight into what may be

74
00:02:31,030 --> 00:02:28,800
precipitating the problem from a

75
00:02:31,910 --> 00:02:31,040
susceptibility and functional point of

76
00:02:34,630 --> 00:02:31,920
view

77
00:02:36,229 --> 00:02:34,640
other devices that we have we use

78
00:02:37,990 --> 00:02:36,239
transcranial doppler now that's a

79
00:02:40,150 --> 00:02:38,000
relatively new device to look at blood

80
00:02:42,309 --> 00:02:40,160
flow in the brain okay and i think today

81
00:02:44,470 --> 00:02:42,319
we're here in in particular to learn

82
00:02:46,790 --> 00:02:44,480
more about the tonometer is that how

83
00:02:49,110 --> 00:02:46,800
that's right so what i have here is the

84
00:02:50,630 --> 00:02:49,120
tonometer the tonopen which we use to

85
00:02:52,229 --> 00:02:50,640
measure intraocular pressure in flight

86
00:02:53,910 --> 00:02:52,239
and here's a model of the eye it's a

87
00:02:55,910 --> 00:02:53,920
cutaway of the eye and what you have

88
00:02:58,309 --> 00:02:55,920

here is the anterior chamber this is the

89
00:02:59,509 --> 00:02:58,319
cornea and then we have the posterior

90
00:03:01,589 --> 00:02:59,519
chamber

91
00:03:04,229 --> 00:03:01,599
and then you see the white part of the

92
00:03:06,790 --> 00:03:04,239
eye or the sclera and the astronauts

93
00:03:09,030 --> 00:03:06,800
will anesthetize the eye first with an

94
00:03:12,309 --> 00:03:09,040
anesthetic it it

95
00:03:15,430 --> 00:03:12,319
it lasts for uh just a few minutes and

96
00:03:17,190 --> 00:03:15,440
then they tap on the eye uh an ultra

97
00:03:19,589 --> 00:03:17,200
operator will tap on the eye and get a

98
00:03:21,350 --> 00:03:19,599
measurement and that way we can follow

99
00:03:22,790 --> 00:03:21,360
the pressure in the eye over the course

100
00:03:24,070 --> 00:03:22,800
of the mission

101
00:03:26,149 --> 00:03:24,080
what we're interested in is the

102
00:03:27,910 --> 00:03:26,159
pressures inside of the eye and the

103
00:03:30,070 --> 00:03:27,920
pressures behind the eye we can't

104
00:03:32,550 --> 00:03:30,080
measure pressures behind the eye but we

105
00:03:35,190 --> 00:03:32,560
can get an indirect measure from

106
00:03:37,270 --> 00:03:35,200
technologies like ultrasound

107
00:03:39,589 --> 00:03:37,280
and i can demonstrate how we might do

108
00:03:40,550 --> 00:03:39,599
that in flight i won't actually do it to

109
00:03:41,270 --> 00:03:40,560
you but

110
00:03:42,869 --> 00:03:41,280
so

111
00:03:44,550 --> 00:03:42,879
because you know

112
00:03:46,070 --> 00:03:44,560
many of our astronauts we have a few

113
00:03:47,910 --> 00:03:46,080

physician astronauts but most of them

114
00:03:49,350 --> 00:03:47,920
are not medically trained they do get

115
00:03:51,030 --> 00:03:49,360
some medical training prior to flight

116
00:03:53,830 --> 00:03:51,040
they will be trained on the tonometer

117
00:03:55,429 --> 00:03:53,840
but it is a ground-guided procedure and

118
00:03:57,910 --> 00:03:55,439
so your eye would be anesthetized so you

119
00:03:59,270 --> 00:03:57,920
wouldn't feel this put some drops in and

120
00:04:01,750 --> 00:03:59,280
then the

121
00:04:04,550 --> 00:04:01,760
operator would would just stabilize

122
00:04:06,789 --> 00:04:04,560
uh with their hand on your face and

123
00:04:08,630 --> 00:04:06,799
they're stabilized as well on structure

124
00:04:10,789 --> 00:04:08,640
the crew member stabilized on structure

125
00:04:12,869 --> 00:04:10,799
and then they would tap the cornea and

126
00:04:14,630 --> 00:04:12,879
you tap several times and then there's

127
00:04:16,229 --> 00:04:14,640
an audible chirp and that

128
00:04:18,629 --> 00:04:16,239
comes up with a value

129
00:04:20,870 --> 00:04:18,639
it's a activity that actually takes only

130
00:04:23,030 --> 00:04:20,880
five minutes it's quite quick does it

131
00:04:25,590 --> 00:04:23,040
does it actually hurt do you need the um

132
00:04:27,110 --> 00:04:25,600
an acidic oh yeah so it would very much

133
00:04:29,270 --> 00:04:27,120
be like getting a poke in the eye with a

134
00:04:30,870 --> 00:04:29,280
sharp stick without the anesthetic so

135
00:04:32,550 --> 00:04:30,880
that's absolutely required and then

136
00:04:33,990 --> 00:04:32,560
obviously with the crew member you want

137
00:04:35,350 --> 00:04:34,000
them to be very careful afterwards

138
00:04:37,990 --> 00:04:35,360

because they don't have that protective

139
00:04:40,710 --> 00:04:38,000
corneal reflex so they have specific

140
00:04:44,230 --> 00:04:40,720
instructions uh afterwards so why is

141
00:04:46,710 --> 00:04:44,240
that important well we really think that

142
00:04:48,469 --> 00:04:46,720
it may be an issue of the balance of two

143
00:04:49,510 --> 00:04:48,479
pressures in the eye typically the

144
00:04:52,310 --> 00:04:49,520
pressure

145
00:04:54,150 --> 00:04:52,320
in the eye is five millimeter mercury

146
00:04:56,390 --> 00:04:54,160
higher than the pressure behind the eye

147
00:04:58,710 --> 00:04:56,400
which is the intracranial pressure

148
00:05:01,749 --> 00:04:58,720
in space with the cephalad fluid shift

149
00:05:03,510 --> 00:05:01,759
with fluid moving towards the head

150
00:05:05,749 --> 00:05:03,520
we hypothesize that the intracranial

151
00:05:07,990 --> 00:05:05,759
pressure in flight may actually be much

152
00:05:09,510 --> 00:05:08,000
higher than it is on the ground what may

153
00:05:12,070 --> 00:05:09,520
be happening in space is the

154
00:05:14,070 --> 00:05:12,080
intracranial pressure rises because

155
00:05:16,710 --> 00:05:14,080
cephalad fluid shift

156
00:05:19,430 --> 00:05:16,720
because we lose the force due to gravity

157
00:05:21,990 --> 00:05:19,440
and the pressure then now behind the eye

158
00:05:24,390 --> 00:05:22,000
is larger than in front of the eye it

159
00:05:26,469 --> 00:05:24,400
could be larger by now 10 millimeters of

160
00:05:28,710 --> 00:05:26,479
mercury or more so that means that the

161
00:05:31,990 --> 00:05:28,720
resultant force is now in the opposite

162
00:05:34,230 --> 00:05:32,000
direction possibly two times or more why

163
00:05:36,550 --> 00:05:34,240

is that important well there's a

164
00:05:38,950 --> 00:05:36,560
structure in the back of the eye is then

165
00:05:41,670 --> 00:05:38,960
the the nerve optic nerve runs through

166
00:05:43,270 --> 00:05:41,680
that transduces the pressure

167
00:05:44,950 --> 00:05:43,280
when there's a pressure gradient it's

168
00:05:47,909 --> 00:05:44,960
pretty good at transducing that pressure

169
00:05:49,990 --> 00:05:47,919
gradient when it's 5 to 10. it's not

170
00:05:52,790 --> 00:05:50,000
that great when it's over 10 and that

171
00:05:55,670 --> 00:05:52,800
may be why we're seeing the swelling in

172
00:05:57,749 --> 00:05:55,680
the back of the the eye the optic disc

173
00:05:59,990 --> 00:05:57,759
and if this is allowed to persist at a

174
00:06:02,469 --> 00:06:00,000
high grade for a long period of time you

175
00:06:03,990 --> 00:06:02,479
actually kill off those neurons and the

176
00:06:05,830 --> 00:06:04,000
the crew member is susceptible to

177
00:06:07,510 --> 00:06:05,840
getting peripheral visual field loss

178
00:06:10,070 --> 00:06:07,520
we've not found any crew members who've

179
00:06:12,150 --> 00:06:10,080
dealt up that yet but again the time in

180
00:06:13,990 --> 00:06:12,160
flight is relatively short compared to a

181
00:06:15,110 --> 00:06:14,000
three-year mars mission so it sounds

182
00:06:16,629 --> 00:06:15,120
like you're already getting some good

183
00:06:18,070 --> 00:06:16,639
data back from what you're already doing

184
00:06:21,189 --> 00:06:18,080
on orbit right

185
00:06:23,909 --> 00:06:21,199
absolutely and so with each passing year

186
00:06:26,230 --> 00:06:23,919
with the more sophisticated technologies

187
00:06:29,189 --> 00:06:26,240
that are deployed to space station the

188
00:06:31,029 --> 00:06:29,199

data that we're collecting is giving us

189
00:06:33,430 --> 00:06:31,039
uh more and more information and

190
00:06:35,350 --> 00:06:33,440
knowledge on what may be happening and

191
00:06:38,150 --> 00:06:35,360
what may be uh

192
00:06:39,430 --> 00:06:38,160
precipitating the problem okay well so

193
00:06:41,029 --> 00:06:39,440
what are some of the next steps for the

194
00:06:43,110 --> 00:06:41,039
program

195
00:06:45,510 --> 00:06:43,120
so the first step is understanding the

196
00:06:47,510 --> 00:06:45,520
problem and so we're collecting data and

197
00:06:49,990 --> 00:06:47,520
the the research effort and the clinical

198
00:06:52,070 --> 00:06:50,000
effort i think is starting to

199
00:06:54,309 --> 00:06:52,080
get a better understanding of what the

200
00:06:57,110 --> 00:06:54,319
precipitants are so then the next step

201
00:06:59,270 --> 00:06:57,120
is to define what that is exactly

202
00:07:01,510 --> 00:06:59,280
to be sure of that and then to develop

203
00:07:03,110 --> 00:07:01,520
counter measures and so

204
00:07:04,390 --> 00:07:03,120
how do we prevent this problem from

205
00:07:05,830 --> 00:07:04,400
happening there are a number of things

206
00:07:08,469 --> 00:07:05,840
there may be individuals who have a

207
00:07:10,710 --> 00:07:08,479
certain susceptibility

208
00:07:11,749 --> 00:07:10,720
but again on a much longer mission even

209
00:07:13,909 --> 00:07:11,759
if you have individuals who are

210
00:07:16,390 --> 00:07:13,919
resistant will need counter measures so

211
00:07:18,070 --> 00:07:16,400
then the next step is to try and

212
00:07:19,749 --> 00:07:18,080
test these counter measures and see if

213
00:07:21,110 --> 00:07:19,759

they have an effect the fluid shifts

214
00:07:23,430 --> 00:07:21,120
experiment

215
00:07:25,270 --> 00:07:23,440
will begin next year starting with the

216
00:07:26,950 --> 00:07:25,280
one year crew member where we'll

217
00:07:28,790 --> 00:07:26,960
actually

218
00:07:31,110 --> 00:07:28,800
they will use the russian chibis device

219
00:07:33,510 --> 00:07:31,120
this is a an experiment with our russian

220
00:07:35,990 --> 00:07:33,520
colleagues that actually

221
00:07:37,909 --> 00:07:36,000
creates lower body negative pressure and

222
00:07:41,029 --> 00:07:37,919
so it actually draws fluids down so it

223
00:07:43,029 --> 00:07:41,039
creates more of a 1g physiological state

224
00:07:45,270 --> 00:07:43,039
we'll be able to measure those changes

225
00:07:47,189 --> 00:07:45,280
in the eye both before and after to see

226
00:07:49,430 --> 00:07:47,199
does the individual with the lower body

227
00:07:52,070 --> 00:07:49,440
negative pressure go back to a 1g state

228
00:07:53,990 --> 00:07:52,080
so that that's an in-flight experiment

229
00:07:55,270 --> 00:07:54,000
okay well it sounds very interesting and

230
00:07:57,189 --> 00:07:55,280
i'm sure we'll look forward to hearing

231
00:07:58,710 --> 00:07:57,199
more about the about the study as it

232
00:08:00,150 --> 00:07:58,720
progresses hopefully we'll get some some

233
00:08:01,589 --> 00:08:00,160
good answers soon thanks for your

234
00:08:03,830 --> 00:08:01,599
interest thank you again this was dr

235
00:08:05,749 --> 00:08:03,840
christian otto who is uh here in the

236
00:08:07,830 --> 00:08:05,759
medical simulation laboratory uh the