1
00:00:00,060 --> 00:00:03,310
Welcome everyone. This is

2
00:00:03,310 --> 00:00:04,750
another in our series

3
00:00:04,750 --> 00:00:06,940
of interviews
with the experts,

4
00:00:06,940 --> 00:00:09,115
heart-to-heart discussion.

5
00:00:09,115 --> 00:00:11,680
And this morning the topic

6
00:00:11,680 --> 00:00:13,120
is going to be focused

7
00:00:13,120 --> 00:00:15,220
on my myocardial blood flow

8
00:00:15,220 --> 00:00:17,665
as assessed with
PET scanning.

9
00:00:17,665 --> 00:00:19,600
In the assessment
of patients

10
00:00:19,600 --> 00:00:21,175
with chest pain.

11
00:00:21,175 --> 00:00:23,980
I'm really lucky to
have my colleague,

12
00:00:23,980 --> 00:00:26,860
Dr. John Bois, joining me

13
00:00:26,860 --> 00:00:30,775

this morning to
discuss this topic.

14
00:00:30,775 --> 00:00:32,740
Dr. Bois is a consult in

15
00:00:32,740 --> 00:00:33,850
the division of Ischemic

16
00:00:33,850 --> 00:00:35,320
heart disease and
critical care and

17
00:00:35,320 --> 00:00:36,610
has a joint appointment in

18
00:00:36,610 --> 00:00:37,900
the Department of Radiology

19
00:00:37,900 --> 00:00:40,375
here at Mayo
Clinic, Rochester.

20
00:00:40,375 --> 00:00:43,140
He's co-director of
our chest pain clinic.

21
00:00:43,140 --> 00:00:44,569
He’s a Nuclear Cardiology,

22
00:00:44,569 --> 00:00:45,680
specialist and is

23
00:00:45,680 --> 00:00:47,870
an assistant professor
of medicine.

24
00:00:47,870 --> 00:00:50,255
So welcome, John.

25
00:00:50,255 --> 00:00:52,010
Really delighted

that you could be

26
00:00:52,010 --> 00:00:53,825
here with us today.

27
00:00:53,825 --> 00:00:55,190
Pleasure to be
with you, Malcolm,

28
00:00:55,190 --> 00:00:57,215
excited to discuss
this topic.

29
00:00:57,215 --> 00:00:59,270
Yeah, so I think
it'd be a lot

30
00:00:59,270 --> 00:01:01,640
of people really asking

31
00:01:01,640 --> 00:01:03,080
the question of what

32
00:01:03,080 --> 00:01:05,390
is PET MBF. And
obviously we're

33
00:01:05,390 --> 00:01:06,950
talking about
myocardial blood flow

34
00:01:06,950 --> 00:01:10,715
and coronary myocardio flow reserve.

35
00:01:10,715 --> 00:01:12,590
So could you explain

36
00:01:12,590 --> 00:01:15,275
what this is and
how does it work?

37
00:01:15,275 --> 00:01:16,820

Sure. I think that's
an excellent question.

38
00:01:16,820 --> 00:01:18,380
We're going to see
it used more and

39
00:01:18,380 --> 00:01:20,060
more across the
country in the world.

40
00:01:20,060 --> 00:01:21,365
So good to have

41
00:01:21,365 --> 00:01:23,525
an understanding of
the key concepts.

42
00:01:23,525 --> 00:01:24,680
I think it's best

43
00:01:24,680 --> 00:01:25,940
understood when
we compare it to

44
00:01:25,940 --> 00:01:28,040
what we're typically
used to in PET imaging.

45
00:01:28,040 --> 00:01:29,510
And what we
typically see in

46
00:01:29,510 --> 00:01:31,220
PET imaging is
qualitative pet.

47
00:01:31,220 --> 00:01:33,230
So we're used to looking
at before and after

48
00:01:33,230 --> 00:01:36,440
pictures of patients

at rest and stress,

49
00:01:36,440 --> 00:01:38,270
and then looking
for any kind

50
00:01:38,270 --> 00:01:39,620
of relative
profusion defects.

51
00:01:39,620 --> 00:01:42,440
So that's the, the old
tried and true way.

52
00:01:42,440 --> 00:01:44,720
What quantitative
PET does is it takes

53
00:01:44,720 --> 00:01:46,130
this technique a step

54
00:01:46,130 --> 00:01:48,680
further and moves
into,

55
00:01:48,680 --> 00:01:50,810
quantifying blood flow
to the heart tissue.

56
00:01:50,810 --> 00:01:52,610
We are able to do that in

57
00:01:52,610 --> 00:01:54,110
mils per minute per

58
00:01:54,110 --> 00:01:55,220
gram of myocardial tissue.

59
00:01:55,220 --> 00:01:56,900
How much blood is
flowing there?

60

00:01:56,900 --> 00:01:58,550
And you may say, Well,
how do we do this?

61
00:01:58,550 --> 00:02:01,970
And we do this by adding
a dynamic or what

62
00:02:01,970 --> 00:02:04,100
we call lists
mode capability,

63
00:02:04,100 --> 00:02:05,390
the PET imaging.

64
00:02:05,390 --> 00:02:07,580
So if we think about
old pet or their

65
00:02:07,580 --> 00:02:08,630
traditional PET as taking

66
00:02:08,630 --> 00:02:10,655
a photo of the heart
before and after.

67
00:02:10,655 --> 00:02:12,830
What this is is taking
a video and it's

68
00:02:12,830 --> 00:02:14,120
the video of the blood flow

69
00:02:14,120 --> 00:02:16,040
into the heart over time.

70
00:02:16,040 --> 00:02:17,810
And you can say,
how can we see

71
00:02:17,810 --> 00:02:19,340
the blood flowing into
the heart of the time?

72
00:02:19,340 --> 00:02:20,630
We do that by looking at

73
00:02:20,630 --> 00:02:22,580
the radio tracer that
we inject in here we

74
00:02:22,580 --> 00:02:24,290
use ammonia 13 and

75
00:02:24,290 --> 00:02:25,160
we measure it flowing into

76
00:02:25,160 --> 00:02:26,390
the heart over time.

77
00:02:26,390 --> 00:02:27,815
And we're able to
build something called

78
00:02:27,815 --> 00:02:29,600
time activity curves.

79
00:02:29,600 --> 00:02:31,520
And through
computational modeling,

80
00:02:31,520 --> 00:02:32,870
we can then
quantitate again

81
00:02:32,870 --> 00:02:34,460
this blood flow to
the heart in mils

82
00:02:34,460 --> 00:02:37,910
per minute per gram
of myocardial tissue.

83
00:02:37,910 --> 00:02:39,485
And we do that at rest.

84
00:02:39,485 --> 00:02:40,730
And we do that a stress.

85
00:02:40,730 --> 00:02:42,215
So that's myocardial
blood flow at rest.

86
00:02:42,215 --> 00:02:44,030
Myocardial blood
flow stress.

87
00:02:44,030 --> 00:02:44,750
So obviously we need

88
00:02:44,750 --> 00:02:46,310
a stress agent to do that.

89
00:02:46,310 --> 00:02:48,095
We Use Regadenoson here.

90
00:02:48,095 --> 00:02:50,030
And then we use
the ratio of

91
00:02:50,030 --> 00:02:52,730
the blood flow at stress to rest.

92
00:02:52,730 --> 00:02:54,590
And that allows
us to calculate

93
00:02:54,590 --> 00:02:55,730
myocardial flow reserve,

94
00:02:55,730 --> 00:02:57,410
which is what we report.

95
00:02:57,410 --> 00:02:59,630
So this is obviously
very different

96
00:02:59,630 --> 00:03:02,450
to what we've
grown up using

97
00:03:02,450 --> 00:03:05,255
in terms of myocardial
perfusion imaging

98
00:03:05,255 --> 00:03:07,520
with system maybe
for example.

99
00:03:07,520 --> 00:03:09,830
Which and correct me
if I'm wrong, I mean,

100
00:03:09,830 --> 00:03:12,260
that's not quantifying
the blood flow.

101
00:03:12,260 --> 00:03:14,435
It's sort of a
comparison of flow,

102
00:03:14,435 --> 00:03:16,340
different regions
of the heart.

103
00:03:16,340 --> 00:03:18,290
So I think this
obviously is

104
00:03:18,290 --> 00:03:21,065
an important
distinction that

105
00:03:21,065 --> 00:03:24,935
you're measuring in
absolute terms. The

106
00:03:24,935 --> 00:03:27,785
The blood flow.

107
00:03:27,785 --> 00:03:30,290
So absolute
quantification of flow.

108
00:03:30,290 --> 00:03:31,700
So this, we
really don't have

109
00:03:31,700 --> 00:03:32,810
any other tools to

110
00:03:32,810 --> 00:03:34,760
do this
noninvasively, Do we?

111
00:03:34,760 --> 00:03:36,320
That's correct, right?
And you're right.

112
00:03:36,320 --> 00:03:37,865
It's, it's an advancement

113
00:03:37,865 --> 00:03:39,140
much beyond spec
where we are

114
00:03:39,140 --> 00:03:40,460
not able to do that at

115
00:03:40,460 --> 00:03:42,020
a much lower
radiation dose and

116
00:03:42,020 --> 00:03:43,640
inspect typically around
11 millisievert

117
00:03:43,640 --> 00:03:45,320
with our PET
imaging around two.

118
00:03:45,320 --> 00:03:46,730

And with this
new technique,

119
00:03:46,730 --> 00:03:47,825
we're not adding
more radiation

120
00:03:47,825 --> 00:03:48,995
time, or scan time.

121
00:03:48,995 --> 00:03:51,170
It's a software
technique that

122
00:03:51,170 --> 00:03:52,220
we're able to run on

123
00:03:52,220 --> 00:03:53,360
the patient, but
you're exactly right.

124
00:03:53,360 --> 00:03:55,850
This is the best
non-invasive way

125
00:03:55,850 --> 00:03:58,040
to measure to
quantifying blood flow.

126
00:03:58,040 --> 00:03:59,360
Yeah. And I think the, the

127
00:03:59,360 --> 00:04:00,815
lower radiation dose,

128
00:04:00,815 --> 00:04:02,255
I think really has to be

129
00:04:02,255 --> 00:04:05,000
a big attraction of
this technique as well.

130

00:04:05,000 --> 00:04:06,800
As you pointed out.

131
00:04:06,800 --> 00:04:08,600
With the quantification,

132
00:04:08,600 --> 00:04:10,730
is this done automatically?

133
00:04:10,730 --> 00:04:12,860
Is it your vendor

134
00:04:12,860 --> 00:04:14,300
specific or is it something

135
00:04:14,300 --> 00:04:16,160
that you have
to do manually?

136
00:04:16,160 --> 00:04:18,080
It's done
automatically. So it's

137
00:04:18,080 --> 00:04:19,340
mathematical modelling.

138
00:04:19,340 --> 00:04:20,600
We have means by which

139
00:04:20,600 --> 00:04:22,070
we do quality
control checks.

140
00:04:22,070 --> 00:04:24,440
It's very critical
for each patient to

141
00:04:24,440 --> 00:04:25,670
make sure that these

142
00:04:25,670 --> 00:04:27,245
time activity

curves are again,

143
00:04:27,245 --> 00:04:28,400
the video of the blood

144
00:04:28,400 --> 00:04:29,990
flowing to the
heart over time.

145
00:04:29,990 --> 00:04:32,450
Look like there,
up to par for

146
00:04:32,450 --> 00:04:34,550
the competition model.
So we look at that.

147
00:04:34,550 --> 00:04:35,795
We have a Ph.D.

148
00:04:35,795 --> 00:04:37,400
Nicu cardiologists
that works

149
00:04:37,400 --> 00:04:37,910
with us if we're

150
00:04:37,910 --> 00:04:40,145
ever have any concerns
with that is off.

151
00:04:40,145 --> 00:04:42,290
And it is per vendor.

152
00:04:42,290 --> 00:04:43,790
So the software vendor

153
00:04:43,790 --> 00:04:45,680
will give us a software

154
00:04:45,680 --> 00:04:46,835
to do that calculation.

155
00:04:46,835 --> 00:04:49,175
And that'll go to
something we speak to

156
00:04:49,175 --> 00:04:50,570
a bit towards the
end about if where

157
00:04:50,570 --> 00:04:51,920
we see the future
of this going.

158
00:04:51,920 --> 00:04:52,970
Because it's
important understand

159
00:04:52,970 --> 00:04:54,350
that different
vendors may have

160
00:04:54,350 --> 00:04:55,730
a little bit
different modeling

161
00:04:55,730 --> 00:04:57,260
techniques that they use.

162
00:04:57,260 --> 00:04:59,420
So we're still working
to standardize

163
00:04:59,420 --> 00:05:00,290
numbers across

164
00:05:00,290 --> 00:05:02,405
different techniques
and vendors.

165
00:05:02,405 --> 00:05:04,415
Yeah. And you
mentioned that

166
00:05:04,415 --> 00:05:07,010
you're using
pharmacologic stress.

167
00:05:07,010 --> 00:05:09,335
Obviously, exercise

168
00:05:09,335 --> 00:05:11,960
information is also
really important.

169
00:05:11,960 --> 00:05:13,610
As we're assessing
patients.

170
00:05:13,610 --> 00:05:16,910
Something that can be
used with exercise,

171
00:05:16,910 --> 00:05:18,815
your treadmill or
bicycle testing?

172
00:05:18,815 --> 00:05:19,070
It?

173
00:05:19,070 --> 00:05:20,300
No, it has not yet. So it's

174
00:05:20,300 --> 00:05:21,350
only used with
pharmacologic.

175
00:05:21,350 --> 00:05:22,430
I think that's a
critical point

176
00:05:22,430 --> 00:05:23,210
because we're just speaking

177
00:05:23,210 --> 00:05:25,490
to SPECT imaging

and saying,

178
00:05:25,490 --> 00:05:25,850
you know, we have

179
00:05:25,850 --> 00:05:27,680
much lower radiation
five-fold with PET,

180
00:05:27,680 --> 00:05:29,375
we get this
additional data.

181
00:05:29,375 --> 00:05:31,730
But we aren't
doing it with exercise.

182
00:05:31,730 --> 00:05:32,810
And so I think that's

183
00:05:32,810 --> 00:05:33,935
a critical point at that.

184
00:05:33,935 --> 00:05:35,240
So that exercise
data can be very

185
00:05:35,240 --> 00:05:36,860
helpful to you in
certain scenarios.

186
00:05:36,860 --> 00:05:38,180
So you may default more toward

187
00:05:38,180 --> 00:05:41,510
a SPECT exercise test
in those scenarios.

188
00:05:41,510 --> 00:05:43,520
And then define a
question on technique.

189

00:05:43,520 --> 00:05:45,080
How long does it
take and is it

190
00:05:45,080 --> 00:05:46,790
all done in one setting?

191
00:05:46,790 --> 00:05:48,035
All done in one setting.

192
00:05:48,035 --> 00:05:49,700
So it's no additional time

193
00:05:49,700 --> 00:05:51,380
to the PET
imaging normative

194
00:05:51,380 --> 00:05:53,075
know about an hour or so.

195
00:05:53,075 --> 00:05:56,000
But it's It's an update

196
00:05:56,000 --> 00:05:57,230
to what's it already
was being done.

197
00:05:57,230 --> 00:05:58,580
We were injecting
these patients with

198
00:05:58,580 --> 00:06:01,610
perfusion imaging agents.
For many decades.

199
00:06:01,610 --> 00:06:02,810
We just didn't have
the capability to

200
00:06:02,810 --> 00:06:04,490
watch it live flow
into the heart.

201
00:06:04,490 --> 00:06:06,200
So we don't add any
additional time when we

202
00:06:06,200 --> 00:06:08,405
quantify and all
done in one setting.

203
00:06:08,405 --> 00:06:10,700
Okay, So let's move on to

204
00:06:10,700 --> 00:06:11,960
how do you use

205
00:06:11,960 --> 00:06:13,820
this in your
patient population?

206
00:06:13,820 --> 00:06:15,184
And as I mentioned,

207
00:06:15,184 --> 00:06:17,300
introducing early,
the co-director

208
00:06:17,300 --> 00:06:18,440
of the chest pain clinic,

209
00:06:18,440 --> 00:06:21,080
where you'd get to see

210
00:06:21,080 --> 00:06:23,360
really high proportion
of patients who do

211
00:06:23,360 --> 00:06:25,895
not have obstructive
coronary disease,

212
00:06:25,895 --> 00:06:27,710
who may have

213
00:06:27,710 --> 00:06:31,235
typical or atypical
chest pain angina.

214
00:06:31,235 --> 00:06:33,620
So how do you use it in

215
00:06:33,620 --> 00:06:34,820
those patients and but

216
00:06:34,820 --> 00:06:36,740
then also in the
patients who have

217
00:06:36,740 --> 00:06:38,060
Suspected or known

218
00:06:38,060 --> 00:06:39,620
obstructive coronary disease?

219
00:06:39,620 --> 00:06:39,980
Yes.

220
00:06:39,980 --> 00:06:41,840
I think that's a great
question and I think

221
00:06:41,840 --> 00:06:42,950
that break it
down to How can

222
00:06:42,950 --> 00:06:44,150
It help us diagnostically,

223
00:06:44,150 --> 00:06:46,460
prognostically and also
with general kind of

224
00:06:46,460 --> 00:06:47,870
quality control to
make sure that we've

225
00:06:47,870 --> 00:06:49,940
had good stress tests
for the patients.

226
00:06:49,940 --> 00:06:52,100
So in regards to diagnosis,

227
00:06:52,100 --> 00:06:53,300
when we look at epicardial,

228
00:06:53,300 --> 00:06:54,980
the traditional disease
that we think about,

229
00:06:54,980 --> 00:06:56,330
the lesions that you're
going to think about

230
00:06:56,330 --> 00:06:58,190
potentially stenting
or bypassing.

231
00:06:58,190 --> 00:07:01,280
One Achilles heel of
all nuclear imaging

232
00:07:01,280 --> 00:07:03,080
SPECT and PET is

233
00:07:03,080 --> 00:07:04,970
the concern for
balanced ischemia.

234
00:07:04,970 --> 00:07:06,470
And when we looked at
the traditional way

235
00:07:06,470 --> 00:07:07,910
that we did this imaging,

236
00:07:07,910 --> 00:07:09,590
we talked about it's a

photo before and after

237
00:07:09,590 --> 00:07:11,480
we're looking for relative
profusion defects.

238
00:07:11,480 --> 00:07:12,260
But if everything is

239
00:07:12,260 --> 00:07:14,090
suppressed as
far as flow from

240
00:07:14,090 --> 00:07:16,040
left main disease or
triple vessel disease,

241
00:07:16,040 --> 00:07:17,165
that can be missed.

242
00:07:17,165 --> 00:07:19,250
Now in the past, we've
tried to rely on

243
00:07:19,250 --> 00:07:20,885
imperfect techniques

244
00:07:20,885 --> 00:07:22,385
called transient ischemic,

245
00:07:22,385 --> 00:07:23,810
dilatation, that
sort of thing.

246
00:07:23,810 --> 00:07:25,940
But we still, I
think truly have

247
00:07:25,940 --> 00:07:27,020
the Achilles heel
of potentially

248

00:07:27,020 --> 00:07:28,820
missing severe disease.

249
00:07:28,820 --> 00:07:31,160
So how can quantitative
PET help us?

250
00:07:31,160 --> 00:07:32,240
Well, studies have shown

251
00:07:32,240 --> 00:07:33,080
that if you're looking for

252
00:07:33,080 --> 00:07:35,495
the epicardial classic
coronary disease,

253
00:07:35,495 --> 00:07:37,430
the accuracy of
PET in detecting

254
00:07:37,430 --> 00:07:40,280
that is really excellent,
about 89 percent.

255
00:07:40,280 --> 00:07:42,140
So probably one of the best

256
00:07:42,140 --> 00:07:44,450
that we can see as far
as non-invasively.

257
00:07:44,450 --> 00:07:46,685
And then when you add
on quantitative PET,

258
00:07:46,685 --> 00:07:48,830
you make a very good
test, even better.

259
00:07:48,830 --> 00:07:51,230
So that number, the
detection of ischemia and

260
00:07:51,230 --> 00:07:52,340
the epicardial
vessels goes from

261
00:07:52,340 --> 00:07:54,425
the high 80s to
about the mid 90s.

262
00:07:54,425 --> 00:07:55,455
And the people may say

263
00:07:55,455 --> 00:07:57,770
that's great, but
that's only 4 or 5%.

264
00:07:57,770 --> 00:07:59,390
But when you look at
the 4-5 percent of

265
00:07:59,390 --> 00:08:00,050
patients that we're

266
00:08:00,050 --> 00:08:01,410
adding that
we're detecting,

267
00:08:01,410 --> 00:08:02,470
those are the most severe,

268
00:08:02,470 --> 00:08:03,520
Those are the left domains.

269
00:08:03,520 --> 00:08:04,570
The bounce ischemias
is that we

270
00:08:04,570 --> 00:08:06,130
might have been
missing before.

271
00:08:06,130 --> 00:08:08,290

So I think really
critical as far as

272
00:08:08,290 --> 00:08:10,480
that diagnostic component

273
00:08:10,480 --> 00:08:12,025
for epicardial disease.

274
00:08:12,025 --> 00:08:13,690
And then the other
patient population

275
00:08:13,690 --> 00:08:15,130
you mentioned that
fits into that,

276
00:08:15,130 --> 00:08:17,260
that diagnostic
categories and

277
00:08:17,260 --> 00:08:17,950
ones that we often

278
00:08:17,950 --> 00:08:18,340
see here in

279
00:08:18,340 --> 00:08:20,710
our chest pain clinic
that are referred.

280
00:08:20,710 --> 00:08:22,120
And these are the
patients that don't meet

281
00:08:22,120 --> 00:08:23,320
the classic mold as far

282
00:08:23,320 --> 00:08:24,550
as you go through your
traditional testing,

283

00:08:24,550 --> 00:08:26,470
they go through
diagnostic Coronary angiogram

284
00:08:26,470 --> 00:08:27,910
that do not have
obstructive disease,

285
00:08:27,910 --> 00:08:29,545
but they still
have chest pain.

286
00:08:29,545 --> 00:08:31,795
And that is trying to
assess the endothelium.

287
00:08:31,795 --> 00:08:33,760
And when we teach
Endothelium

288
00:08:33,760 --> 00:08:34,630
of microvascular
and when we

289
00:08:34,630 --> 00:08:35,650
teach our fellows here,

290
00:08:35,650 --> 00:08:37,150
we try to remind
them that if you do

291
00:08:37,150 --> 00:08:38,725
a diagnostic
coronary angiogram,

292
00:08:38,725 --> 00:08:40,690
only, you know,
you're looking

293
00:08:40,690 --> 00:08:43,030
at vessels about 400
microns in diameter.

294

00:08:43,030 --> 00:08:46,250
You're missing the
microvascular tree

295
00:08:46,250 --> 00:08:48,515
That's four-fold lower,
about a 100 microns.

296
00:08:48,515 --> 00:08:49,895
And when we show them,

297
00:08:49,895 --> 00:08:51,290
pathologic
specimen is where

298
00:08:51,290 --> 00:08:52,100
we perfuse the heart.

299
00:08:52,100 --> 00:08:54,620
It's really, really
overwhelming to look at

300
00:08:54,620 --> 00:08:56,000
the amount of vasculature

301
00:08:56,000 --> 00:08:56,720
that we don't see with

302
00:08:56,720 --> 00:08:58,940
our native eye in diagnostic
coronary angiogram.

303
00:08:58,940 --> 00:09:00,500
And in the chest
pain clinic,

304
00:09:00,500 --> 00:09:02,000
a lot of these patients
are presenting

305
00:09:02,000 --> 00:09:03,410
with chest pain and they

306
00:09:03,410 --> 00:09:05,254
ultimately have
endothelial dysfunction

307
00:09:05,254 --> 00:09:06,995
or microvascular disease.

308
00:09:06,995 --> 00:09:08,960
So the means by
which we get at that

309
00:09:08,960 --> 00:09:10,775
in our chest pain
clinic is we do do

310
00:09:10,775 --> 00:09:12,830
quantitative PET
imaging and we look for

311
00:09:12,830 --> 00:09:15,530
an abnormal myocardium
flow reserve value.

312
00:09:15,530 --> 00:09:16,970
And one may ask, well,

313
00:09:16,970 --> 00:09:18,860
what does that what
does an abnormal value

314
00:09:18,860 --> 00:09:21,260
and is typically
anything less than two.

315
00:09:21,260 --> 00:09:22,475
So you should be
able to at least

316
00:09:22,475 --> 00:09:23,510
double your blood flow.

317
00:09:23,510 --> 00:09:26,930

A stress compared to
rest, a normal rest,

318
00:09:26,930 --> 00:09:28,310
Blood flow is about one and a

319
00:09:28,310 --> 00:09:30,755
Stress is about two for
our quantitative PET.

320
00:09:30,755 --> 00:09:33,035
So if we see patients
that are below that,

321
00:09:33,035 --> 00:09:35,030
then we're suspicious of

322
00:09:35,030 --> 00:09:36,350
microvascular
disease and still in

323
00:09:36,350 --> 00:09:37,220
our chest pain clinic

324
00:09:37,220 --> 00:09:38,090
and we'll talk about this.

325
00:09:38,090 --> 00:09:39,500
I think I've been a
little bit. We also do

326
00:09:39,500 --> 00:09:41,270
the diagnostic cath with

327
00:09:41,270 --> 00:09:42,860
acetylcholine
testing up front.

328
00:09:42,860 --> 00:09:44,900
But as we follow these
patients over time,

329

00:09:44,900 --> 00:09:47,540
we don't have to repeat
the diagnostic cath.

330
00:09:47,540 --> 00:09:48,875
We can follow them with PET

331
00:09:48,875 --> 00:09:50,720
amfAR imaging to
see how they respond

332
00:09:50,720 --> 00:09:52,070
to our therapies for

333
00:09:52,070 --> 00:09:53,000
endothelial dysfunction

334
00:09:53,000 --> 00:09:54,020
and microvascular disease.

335
00:09:54,020 --> 00:09:55,910
And watch that
myocardial flow or

336
00:09:55,910 --> 00:09:58,520
a number just to see
if it's improving.

337
00:09:58,520 --> 00:10:00,890
So that's from the
diagnostic standpoint,

338
00:10:00,890 --> 00:10:03,170
I think has a role both
for epicardial disease

339
00:10:03,170 --> 00:10:04,790
predominantly try not to

340
00:10:04,790 --> 00:10:06,440
miss left Maine and
triple vessel disease.

341
00:10:06,440 --> 00:10:08,270
And I think a really
critical role for

342
00:10:08,270 --> 00:10:08,840
the endothelial

343
00:10:08,840 --> 00:10:10,865
dysfunction microvascular
population.

344
00:10:10,865 --> 00:10:12,410
So that's one
of the reasons

345
00:10:12,410 --> 00:10:14,510
I like this technique
for diagnostic.

346
00:10:14,510 --> 00:10:15,800
The second is prognostic.

347
00:10:15,800 --> 00:10:16,400
So if you want

348
00:10:16,400 --> 00:10:18,425
just kinda quick
take-home numbers.

349
00:10:18,425 --> 00:10:19,610
If your MFR, that

350
00:10:19,610 --> 00:10:20,915
flow reserve is
greater than two,

351
00:10:20,915 --> 00:10:21,140
you have

352
00:10:21,140 --> 00:10:23,270
a 97 percent negative
predictive value

353
00:10:23,270 --> 00:10:24,320
for any severe
coronary disease

354
00:10:24,320 --> 00:10:25,625
patients do quite well.

355
00:10:25,625 --> 00:10:27,560
If you're less
than 1.5 is high,

356
00:10:27,560 --> 00:10:29,105
high risk for major adverse

357
00:10:29,105 --> 00:10:30,740
cardiovascular events.

358
00:10:30,740 --> 00:10:32,330
And studies have shown that

359
00:10:32,330 --> 00:10:34,730
even with normal
perfusion imaging,

360
00:10:34,730 --> 00:10:36,785
if your MFR is abnormal,

361
00:10:36,785 --> 00:10:38,450
you have a sixfold
increase risk

362
00:10:38,450 --> 00:10:40,070
of major adverse
cardiovascular events.

363
00:10:40,070 --> 00:10:43,280
So add significant
prognostic value to me.

364
00:10:43,280 --> 00:10:44,690
And I think something

that's a good

365
00:10:44,690 --> 00:10:46,160
take home for

366
00:10:46,160 --> 00:10:47,480
physicians is how can I

367
00:10:47,480 --> 00:10:49,010
help me reclassify
patients?

368
00:10:49,010 --> 00:10:50,120
And we talk
about this often

369
00:10:50,120 --> 00:10:51,665
with our fellows here.

370
00:10:51,665 --> 00:10:53,000
And you see this is kind of

371
00:10:53,000 --> 00:10:54,380
a focus in the
literature when

372
00:10:54,380 --> 00:10:55,490
you're seeing a
patient in front of

373
00:10:55,490 --> 00:10:56,900
you with chest pain,

374
00:10:56,900 --> 00:10:58,100
all of us run
through our mind is

375
00:10:58,100 --> 00:10:59,990
this low intermediate
or high risk?

376
00:10:59,990 --> 00:11:01,880

And if it's high-risk,
classic angina,

377
00:11:01,880 --> 00:11:02,780
that's kind of
a no brainer.

378
00:11:02,780 --> 00:11:04,025
You're go into the lab.

379
00:11:04,025 --> 00:11:06,320
If it's walrus, non-cardiac
chest pain also,

380
00:11:06,320 --> 00:11:07,805
it's probably
pursuing other

381
00:11:07,805 --> 00:11:09,050
methods to help
that patient,

382
00:11:09,050 --> 00:11:10,865
other than pursuing
catheterization,

383
00:11:10,865 --> 00:11:12,080
what we often struggle

384
00:11:12,080 --> 00:11:13,235
with is the patient
in the middle.

385
00:11:13,235 --> 00:11:14,600
They have classic
risk factors,

386
00:11:14,600 --> 00:11:15,620
but their pain may be a bit

387
00:11:15,620 --> 00:11:17,570
atypical. What do
you do with that?

388
00:11:17,570 --> 00:11:18,980
And so the key
question with

389
00:11:18,980 --> 00:11:20,270
any new imaging
technique is how

390
00:11:20,270 --> 00:11:21,980
can it help you with
those difficult patients?

391
00:11:21,980 --> 00:11:23,480
And so this has
been studied.

392
00:11:23,480 --> 00:11:24,845
This was a
circulation patient

393
00:11:24,845 --> 00:11:27,155
by paper by Murthy
and colleagues.

394
00:11:27,155 --> 00:11:28,520
And they gave a series of

395
00:11:28,520 --> 00:11:30,995
cardiologists,
about 200 patients.

396
00:11:30,995 --> 00:11:33,140
They gave them the
qualitative PET data

397
00:11:33,140 --> 00:11:35,180
that perfusion imaging
at rest and stress.

398
00:11:35,180 --> 00:11:35,780
They gave him

399
00:11:35,780 --> 00:11:36,980
the clinical history
of the patient.

400
00:11:36,980 --> 00:11:38,060
So what they were
presenting with

401
00:11:38,060 --> 00:11:39,110
an their ejection fraction

402
00:11:39,110 --> 00:11:40,160
instead put them in a box,

403
00:11:40,160 --> 00:11:42,605
low, intermediate
or high risk.

404
00:11:42,605 --> 00:11:43,910
And then they said now that

405
00:11:43,910 --> 00:11:45,095
we give you
quantitative PET,

406
00:11:45,095 --> 00:11:46,910
How often are you
reclassifying

407
00:11:46,910 --> 00:11:48,169
patients specifically

408
00:11:48,169 --> 00:11:49,550
those patients are the
intermediate risk.

409
00:11:49,550 --> 00:11:51,380
We're not sure what
to do with them.

410
00:11:51,380 --> 00:11:52,610
And when we looked at that,

411
00:11:52,610 --> 00:11:53,720
and when these authors
looked at that,

412
00:11:53,720 --> 00:11:55,460
it was about 50%
of patients were

413
00:11:55,460 --> 00:11:56,510
reclassified to

414
00:11:56,510 --> 00:11:58,085
higher or lower
risk categories.

415
00:11:58,085 --> 00:11:59,600
And the high, high
majority were

416
00:11:59,600 --> 00:12:00,860
reclassified correctly when

417
00:12:00,860 --> 00:12:02,240
they followed
them long-term.

418
00:12:02,240 --> 00:12:05,570
So I think that's a
very powerful part

419
00:12:05,570 --> 00:12:07,070
of this test it’s a test
and that we don't

420
00:12:07,070 --> 00:12:09,020
have to use more
radiation more time.

421
00:12:09,020 --> 00:12:10,430
But those patients
that are difficult,

422
00:12:10,430 --> 00:12:12,380
it's helping you reclassify
them to higher or

423
00:12:12,380 --> 00:12:13,190
lower risk and then

424
00:12:13,190 --> 00:12:14,750
impacting your
decision-making.

425
00:12:14,750 --> 00:12:16,460
So for those reasons,

426
00:12:16,460 --> 00:12:17,960
diagnostic and
prognostic, I think

427
00:12:17,960 --> 00:12:20,705
it's a very
useful modality.

428
00:12:20,705 --> 00:12:22,130
Although there may be

429
00:12:22,130 --> 00:12:23,750
some clinical
characteristics

430
00:12:23,750 --> 00:12:26,555
that identify patients
at higher risk,

431
00:12:26,555 --> 00:12:28,535
having a test that

432
00:12:28,535 --> 00:12:31,400
really puts them
in that right?

433
00:12:31,400 --> 00:12:33,050
Your box, your early

434
00:12:33,050 --> 00:12:34,865
on would be very helpful.

435
00:12:34,865 --> 00:12:37,250
Just with respect to
the patients with

436
00:12:37,250 --> 00:12:39,185
obstructive Coronary disease

437
00:12:39,185 --> 00:12:41,120
presenting with angina.

438
00:12:41,120 --> 00:12:44,690
Do you see this then as
potentially replacing

439
00:12:44,690 --> 00:12:46,940
our standard myocardial

440
00:12:46,940 --> 00:12:49,460
perfusion imaging tests

441
00:12:49,460 --> 00:12:52,040
and maybe even stress
echo, for example.

442
00:12:52,040 --> 00:12:54,650
I mean I mean, in
your own practice,

443
00:12:54,650 --> 00:12:57,380
is this what you're
going to first

444
00:12:57,380 --> 00:12:58,610
up or is it something that

445
00:12:58,610 --> 00:13:00,485
you're being more
selective in?

446
00:13:00,485 --> 00:13:02,660
I think it's more
selective right now.

447
00:13:02,660 --> 00:13:03,995
A lot of this, what

448
00:13:03,995 --> 00:13:05,090
I think you nicely
alluded to in

449
00:13:05,090 --> 00:13:06,800
the beginning is that

450
00:13:06,800 --> 00:13:07,879
we're doing this
pharmacologic.

451
00:13:07,879 --> 00:13:10,100
So if they can
still exercise

452
00:13:10,100 --> 00:13:11,660
to a point where you
think you can get

453
00:13:11,660 --> 00:13:13,265
a good stress
test out of them.

454
00:13:13,265 --> 00:13:14,750
The double product,
the heart rate

455
00:13:14,750 --> 00:13:16,010
times systolic
blood pressure

456
00:13:16,010 --> 00:13:17,299
greater than the 20,000.

457

00:13:17,299 --> 00:13:18,560
Then we get a lot of

458
00:13:18,560 --> 00:13:20,540
great info out of the
general exercise test.

459
00:13:20,540 --> 00:13:22,415
So we still do that
if we can exercise.

460
00:13:22,415 --> 00:13:23,990
In my practice and national

461
00:13:23,990 --> 00:13:25,490
guidelines put forward by

462
00:13:25,490 --> 00:13:27,260
American Society of
Nuclear cardiology is

463
00:13:27,260 --> 00:13:29,615
if they cannot exercise,

464
00:13:29,615 --> 00:13:31,010
then we would much prefer

465
00:13:31,010 --> 00:13:33,230
your PET imaging over

466
00:13:33,230 --> 00:13:34,160
SPECT imaging for some

467
00:13:34,160 --> 00:13:35,060
of the things
we've spoken to,

468
00:13:35,060 --> 00:13:36,110
some of the
traditional benefits

469
00:13:36,110 --> 00:13:37,190

of PET lower radiation,

470
00:13:37,190 --> 00:13:38,900
but also, now the
ability to quantitate.

471
00:13:38,900 --> 00:13:41,240
So, in my practice
where I can

472
00:13:41,240 --> 00:13:42,620
not have the
patient exercise,

473
00:13:42,620 --> 00:13:43,880
I default to this.

474
00:13:43,880 --> 00:13:45,290
And also, in the
practice where I'm

475
00:13:45,290 --> 00:13:46,160
specifically, worried

476
00:13:46,160 --> 00:13:47,525
about macrovascular
disease,

477
00:13:47,525 --> 00:13:50,060
even if they can't
exercise, I would default.

478
00:13:50,060 --> 00:13:50,960
It is specifically to

479
00:13:50,960 --> 00:13:52,685
look at the
microvasculature.

480
00:13:52,685 --> 00:13:54,365
And could you just
briefly tell us

481
00:13:54,365 --> 00:13:55,640
why you can't exercise

482
00:13:55,640 --> 00:13:58,805
a patient with
this approach.

483
00:13:58,805 --> 00:14:01,760
Yeah, So with
these with the

484
00:14:01,760 --> 00:14:03,680
rapidity of the imaging

485
00:14:03,680 --> 00:14:04,460
of the blood flowing

486
00:14:04,460 --> 00:14:05,450
into the heart over time,

487
00:14:05,450 --> 00:14:06,650
we need to be able
to do it with

488
00:14:06,650 --> 00:14:07,910
a pharmacologic agent like

489
00:14:07,910 --> 00:14:08,630
Regadenoson

490
00:14:08,630 --> 00:14:10,430
quickly get that accuracy

491
00:14:10,430 --> 00:14:11,765
by the time we were able

492
00:14:11,765 --> 00:14:13,370
to get the patient
on and off

493
00:14:13,370 --> 00:14:15,545

the treadmill and
into the scanner.

494
00:14:15,545 --> 00:14:17,150
We would not be
able to capture

495
00:14:17,150 --> 00:14:18,545
the blood flow to
the heart over time.

496
00:14:18,545 --> 00:14:19,625
So that makes sense.

497
00:14:19,625 --> 00:14:21,320
Just like you just go back

498
00:14:21,320 --> 00:14:24,770
briefly to that other
population very often,

499
00:14:24,770 --> 00:14:26,540
you know, young
patients who don't have

500
00:14:26,540 --> 00:14:27,620
obstructive
coronary disease that you

501
00:14:27,620 --> 00:14:29,660
talked about,
endothelial dysfunction.

502
00:14:29,660 --> 00:14:33,200
what is the
correlation between what

503
00:14:33,200 --> 00:14:34,505
you're measuring and what

504
00:14:34,505 --> 00:14:36,500
we might measure
in the cath lab.

505
00:14:36,500 --> 00:14:38,060
And you see this
as replacing

506
00:14:38,060 --> 00:14:40,040
the need for an
invasive procedure,

507
00:14:40,040 --> 00:14:41,510
which is really a big deal,

508
00:14:41,510 --> 00:14:42,920
I think, for
young patients,

509
00:14:42,920 --> 00:14:44,210
many of whom are in

510
00:14:44,210 --> 00:14:47,195
their second or
third decade.

511
00:14:47,195 --> 00:14:48,620
Yep, That's a
great question.

512
00:14:48,620 --> 00:14:51,200
So right now we
do not see it as

513
00:14:51,200 --> 00:14:52,640
replacing the cath is

514
00:14:52,640 --> 00:14:54,215
the gold standard
when we do our,

515
00:14:54,215 --> 00:14:55,490
our catheterization
studies here with

516

00:14:55,490 --> 00:14:56,300
acetylcholine to look

517
00:14:56,300 --> 00:14:57,830
at the microvasculature.

518
00:14:57,830 --> 00:15:00,470
We do it at the
beginning to get to

519
00:15:00,470 --> 00:15:03,260
establish a baseline of
coronary flow reserve.

520
00:15:03,260 --> 00:15:04,610
And right now we're
doing studies to see how

521
00:15:04,610 --> 00:15:06,080
well that correlates
with the gold standard,

522
00:15:06,080 --> 00:15:07,850
the cath acetylcholine
assessment

523
00:15:07,850 --> 00:15:10,085
of the microvasculature
and then using it,

524
00:15:10,085 --> 00:15:11,270
it's serial studies to

525
00:15:11,270 --> 00:15:12,995
follow up these patients,

526
00:15:12,995 --> 00:15:14,300
rather than
serially following

527
00:15:14,300 --> 00:15:15,140
them up with casts

528
00:15:15,140 --> 00:15:15,980
which obviously are

529
00:15:15,980 --> 00:15:17,690
invasive and
time-consuming.

530
00:15:17,690 --> 00:15:19,025
So it's not replacement of,

531
00:15:19,025 --> 00:15:20,960
as of yet, potentially
the future.

532
00:15:20,960 --> 00:15:22,520
If we see an excellent
correlation over time,

533
00:15:22,520 --> 00:15:23,780
it might be just a first go

534
00:15:23,780 --> 00:15:24,860
to rather than the cath,

535
00:15:24,860 --> 00:15:25,910
but at this point,

536
00:15:25,910 --> 00:15:27,635
caths still gold
standard for that,

537
00:15:27,635 --> 00:15:30,170
okay, So we're running
out of time here,

538
00:15:30,170 --> 00:15:31,280
but maybe just
the last question

539
00:15:31,280 --> 00:15:32,615
I'll ask you is,

540
00:15:32,615 --> 00:15:34,369
where do you see
this technology

541
00:15:34,369 --> 00:15:35,870
going in the future?

542
00:15:35,870 --> 00:15:38,630
And perhaps just
to maybe frame it

543
00:15:38,630 --> 00:15:41,150
alongside CTA
and particularly

544
00:15:41,150 --> 00:15:44,135
now with CT FFR
measurements.

545
00:15:44,135 --> 00:15:45,980
Yes, I think there's
three things that need

546
00:15:45,980 --> 00:15:47,630
to be looked at versus
standardization.

547
00:15:47,630 --> 00:15:48,800
And we alluded
to that briefly.

548
00:15:48,800 --> 00:15:50,825
You know, this is not a

549
00:15:50,825 --> 00:15:53,630
particularly fresh off
the press technique,

550
00:15:53,630 --> 00:15:54,740
what is relatively new

551
00:15:54,740 --> 00:15:56,285

and there's
different vendors,

552
00:15:56,285 --> 00:15:58,220
different ways that
patients are stressed

553
00:15:58,220 --> 00:15:58,520
as far as

554
00:15:58,520 --> 00:15:59,930
different pharmacologic
stress agents.

555
00:15:59,930 --> 00:16:01,820
So does myocardial flow reserve

556
00:16:01,820 --> 00:16:03,860
value of 2.5 and Mayo
Clinic compared to,

557
00:16:03,860 --> 00:16:05,210
you know, 2.2
at your practice

558
00:16:05,210 --> 00:16:06,590
is that a significant
difference?

559
00:16:06,590 --> 00:16:08,120
So we don't know that yet,

560
00:16:08,120 --> 00:16:09,379
so we have to see
standardization

561
00:16:09,379 --> 00:16:11,375
across the practices
in the US.

562
00:16:11,375 --> 00:16:13,340
And once that follows,
which I think it will,

563
00:16:13,340 --> 00:16:14,480
well as more and
more people use

564
00:16:14,480 --> 00:16:15,530
this technique that

565
00:16:15,530 --> 00:16:16,610
allow us to perform more

566
00:16:16,610 --> 00:16:17,720
kind of long-term studies.

567
00:16:17,720 --> 00:16:18,860
Because a lot of the
studies right now are

568
00:16:18,860 --> 00:16:20,585
mostly observational.

569
00:16:20,585 --> 00:16:22,460
So those are two things
that need to happen.

570
00:16:22,460 --> 00:16:23,600
Standardization followed

571
00:16:23,600 --> 00:16:25,790
by kinda
multi-institutional studies

572
00:16:25,790 --> 00:16:27,560
of the utility of
this technique.

573
00:16:27,560 --> 00:16:29,480
As far as the
future, I think,

574
00:16:29,480 --> 00:16:32,000
particularly with CTA

and the rise of FFR

575
00:16:32,000 --> 00:16:34,610
CT would be hybridization,

576
00:16:34,610 --> 00:16:36,260
I think that would be
ideal right now we do

577
00:16:36,260 --> 00:16:38,420
our PET scans
with CT scanning.

578
00:16:38,420 --> 00:16:40,760
It's a low-dose,
so limited CT scan

579
00:16:40,760 --> 00:16:41,780
lets us look for
coronary

580
00:16:41,780 --> 00:16:43,010
calcifications incidental,

581
00:16:43,010 --> 00:16:45,530
it is not the
0.6 millimeter

582
00:16:45,530 --> 00:16:46,730
or less resolution you

583
00:16:46,730 --> 00:16:48,380
get with the coronary CTA,

584
00:16:48,380 --> 00:16:50,150
and the FFR CT that we do

585
00:16:50,150 --> 00:16:51,860
here separately at
our practice in Mayo,

586
00:16:51,860 --> 00:16:54,080

however, in the future,

587
00:16:54,080 --> 00:16:55,190
you can envision where we

588
00:16:55,190 --> 00:16:56,390
could potentially marry

589
00:16:56,390 --> 00:16:57,890
those two techniques
where we're doing

590
00:16:57,890 --> 00:16:59,659
PET imaging with
quantitation,

591
00:16:59,659 --> 00:17:00,920
as well as the

592
00:17:00,920 --> 00:17:04,310
high quality CT scan
at the same time.

593
00:17:04,310 --> 00:17:05,510
So you're getting a

594
00:17:05,510 --> 00:17:07,580
beautiful anatomic
picture of the arteries.

595
00:17:07,580 --> 00:17:10,235
You're getting FFR CT
of specific lesions.

596
00:17:10,235 --> 00:17:11,810
But then you're getting the

597
00:17:11,810 --> 00:17:12,890
Myocardial flow reserve

598
00:17:12,890 --> 00:17:14,450
which helps you look

599
00:17:14,450 --> 00:17:16,190
at the total circulation,

600
00:17:16,190 --> 00:17:18,935
not just the specific
FFR of each lesions.

601
00:17:18,935 --> 00:17:20,330
So that's one interests.

602
00:17:20,330 --> 00:17:21,635
In other words, be
potentially even

603
00:17:21,635 --> 00:17:23,300
PET MR. where the

604
00:17:23,300 --> 00:17:24,830
MR techniques we
can let you look

605
00:17:24,830 --> 00:17:26,855
at viability tissue
characterizations.

606
00:17:26,855 --> 00:17:28,790
And the PET techniques
will let you

607
00:17:28,790 --> 00:17:29,780
look at the blood flow

608
00:17:29,780 --> 00:17:30,800
throughout the,
MR time.

609
00:17:30,800 --> 00:17:31,865
So I think
hybridization would

610
00:17:31,865 --> 00:17:34,190

be of interest
in the future.

611
00:17:34,190 --> 00:17:36,200
Well, John, thank
you very much.

612
00:17:36,200 --> 00:17:38,975
I mean, it's really
fascinating here.

613
00:17:38,975 --> 00:17:41,645
Four decades or so,

614
00:17:41,645 --> 00:17:43,725
maybe five decades or so.

615
00:17:43,725 --> 00:17:45,560
Mel Marcus, one of

616
00:17:45,560 --> 00:17:47,240
the really finest
with coronary physiology.

617
00:17:47,240 --> 00:17:48,830
The University
of Iowa lamented

618
00:17:48,830 --> 00:17:50,270
the fact that
we didn't have

619
00:17:50,270 --> 00:17:52,295
really precise
measurements of

620
00:17:52,295 --> 00:17:53,540
absolute blood flow in

621
00:17:53,540 --> 00:17:57,665
humans and we do in
animals for many years.

622
00:17:57,665 --> 00:17:59,510
And we finally sort
of getting there.

623
00:17:59,510 --> 00:18:00,695
So thank you very much

624
00:18:00,695 --> 00:18:03,230
for sharing this
information.

625
00:18:03,230 --> 00:18:05,690
Very exciting and
good luck with

626
00:18:05,690 --> 00:18:08,210
the further development
of this technique.

627
00:18:08,210 --> 00:18:10,670
And thank you to
viewers for,

628
00:18:10,670 --> 00:18:12,380
for joining us here today.

629
00:18:12,380 --> 00:18:14,090
Thank you Malcolm, and
it's an exciting time

630
00:18:14,090 --> 00:18:16,170
for sure in
cardiac imaging.