MEET 2015
MULTIDISCIPLINARY EUROPEAN
ENDOVASCULAR THERAPY

Overlay and dose reduction during aortic procedures

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Disclosure

I do not have any potential conflict of interest

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Radiation doses from Imaging procedures

Type of Procedure	Average Adult Effective Dose (mSv)	Estimated Dose Equivalent (No. of Chest X-rays)
Dental X-ray	0.005-0.01 [6a]	0.25-0.5
Chest X-ray	0.02	1
Mammography	0.4	20
CT	2-16 [6b]	100-800
Nuclear Medicine	0.2-41 [6c]	10-2050
Interventional Fluoroscopy	5-70 [6d]	250-3500

Dose reported for IR EVAR

First author	Year	n	FT (min)	Median DAP (Gy.cm^2)
Dose reported for abdominal aortic endografting				
Geijier[77]	2005	24	21.4 (7.4–78.9)[a]	60.1 (16.6–195)[a]
Ho[78]	2007	30		
Weiss[79]	2008	12	20.6 (12.6–34.2)[b]	151.7 (52.1–245.4)[b]
Weerakkody[80]	2008	96	21 (16–31)	
Kalef-Ezra[63]	2009	62	18 (4.3–75)[a]	37.4 (9–139)[a]
Kuhelj[81]	2010	172	17 (2.9–97.8)[a]	153 (35–700)[a]
Jones[82]	2010	320	29.4 ± 23.3 [d]	46.9 ± 28.4 [d]
Howells[83]	2012	630	18 (2.4–161)	173 (109.4–3343.4)[a]
Walsh[84]	2012	111	18.5[c]	85.8[c]
Maurel[56]	2012	188	9.36 (1.76–67.1)[a]	30 (4.3–280)[a]
Peach[69]	2012	57	20.0 (4.8–49.3)[a]	69 (19.1–950)[a]
		65	16.2 (3.1–51.1)[a]	49 (12.5–133)[a]
Fossaceca[85]	2012	153		78 (27–370)
Patel[86]	2013	26	19.5 (14.4–31.5)	97.3 (55.4–167.9)
Blaszak[87]	2014	266		271 (37–1,760)[b]
	2014	31		276 (64–625)[b]
Hertault[45]	2014	44	10.6 (9.1–14.7)	12.2 (8.7–19.9)

DAP range
12-276 Gy.cm²

Mean DAP
105Gy.cm²

Hertault A, et al., Minimizing Radiation Exposure During Endovascular Procedures: Basic Knowledge, Literature Review, and Reporting Standards, European Journal of Vascular and Endovascular Surgery (2015), http://dx.doi.org/10.1016/j.ejvs.2015.01.014

Dose reported for FEVAR/BEVAR

First author	Year	n	FT (min)	Median DAP (Gy.cm^2)
Dose reported for complex aortic endografting				
Panuccio[89]	2011	18	140.7 ± 64.4 [d]	1,005.7 ± 627.8 [d]
		29	81.9 ± 45.8 [d]	642.5 ± 311.6 [d]
Howells[83]	2012	53	58 (6.7–212.0)[a]	320.6 (172.1–2133.2)
Maurel[56]	2012	54	27.2 (2.1–69.1)[a]	72.8 (11.0–290.0)[a]
		20	42.98 (2.38–95.5)[a]	159.5 (29.8–777.0)[a]
Tacher[90]	2013	9	82 ± 46[d]	1,188 ± 1,067[d]
		14	42 ± 22[d]	984 ± 581[d]
		14	80 ± 36[b]	656 ± 457[b]
Hertault[45]	2014	18	30.7 (20.2–40.5)	43.7 (24.7–57.5)
		20	39.5 (34.8–51.6)	47.4 (37.2–108.2)

DAP range 44-1188Gy.cm²

Mean DAP 511Gy.cm²

Hertault A, et al., Minimizing Radiation Exposure During Endovascular Procedures: Basic Knowledge, Literature Review, and Reporting Standards, European Journal of Vascular and Endovascular Surgery (2015), http://dx.doi.org/10.1016/j.ejvs.2015.01.014

Minimizing radiation Exposure

- ALARA Principles
  - Dedicated Radiation education
  - Low frame rate
  - Reduce time on Pedal
  - Low dose setting
  - Minimise DSA, store fluoroscopy loops

Minimizing radiation Exposure

- Collimation – reduce the field of view
- Minimise magnification – use large monitors
- Reduce Angulation – LAO/RAO
- Operator controlled imaging….30% Reduction
- Shields, Lead Garments and stand back!
- Advanced imaging - **FUSION**

The Steps of Fusion

1. Vessel marking on pre op CT Angio

2. Cone Beam CT

3. Registration of bone landmarks with CTA

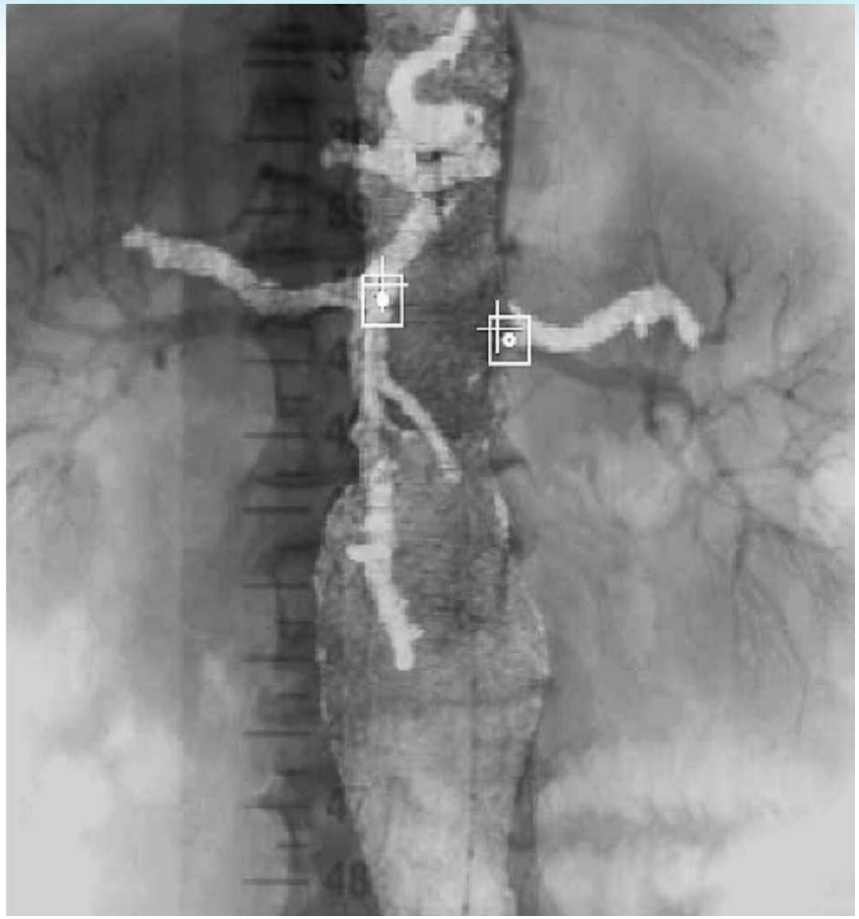
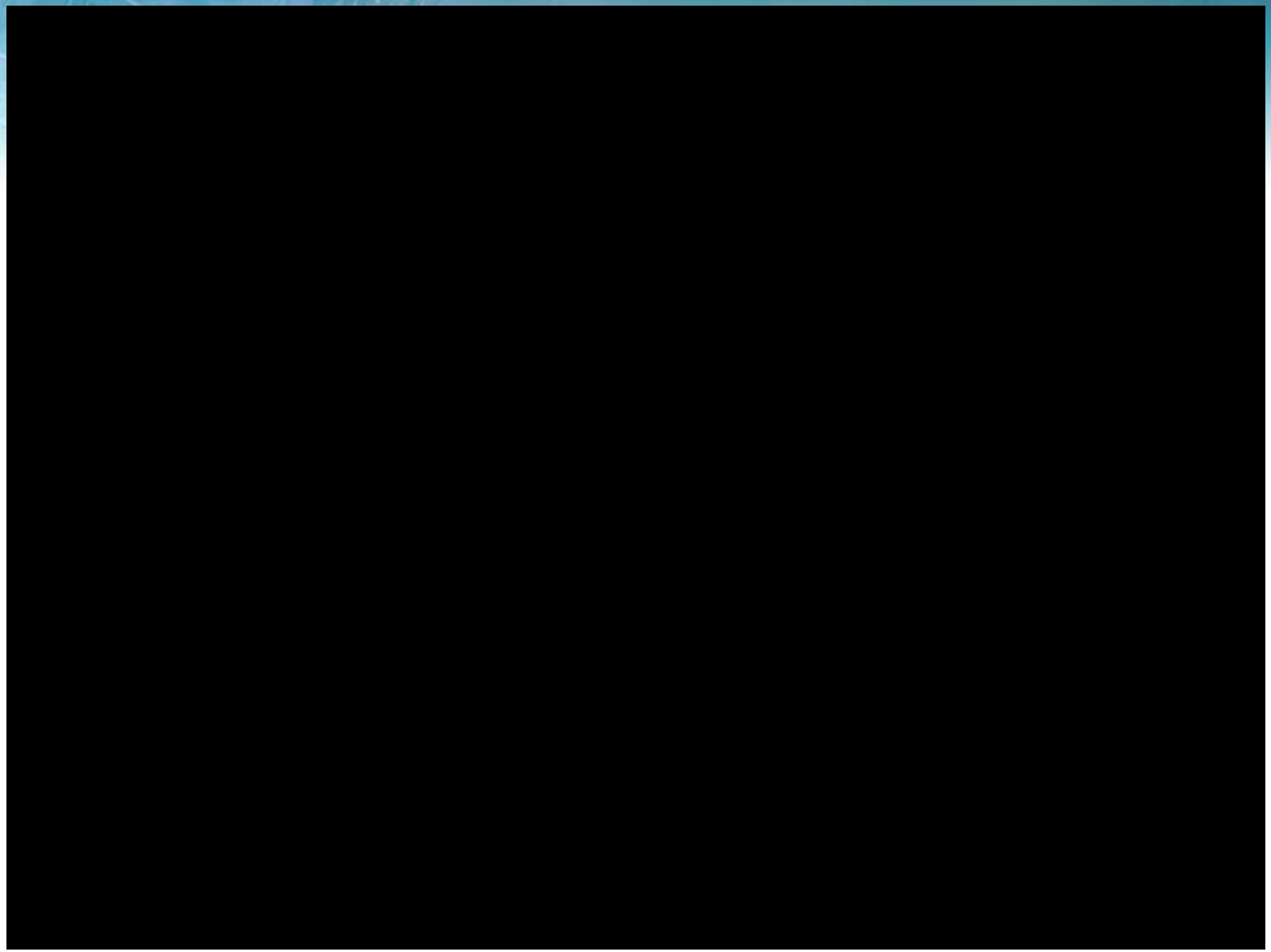
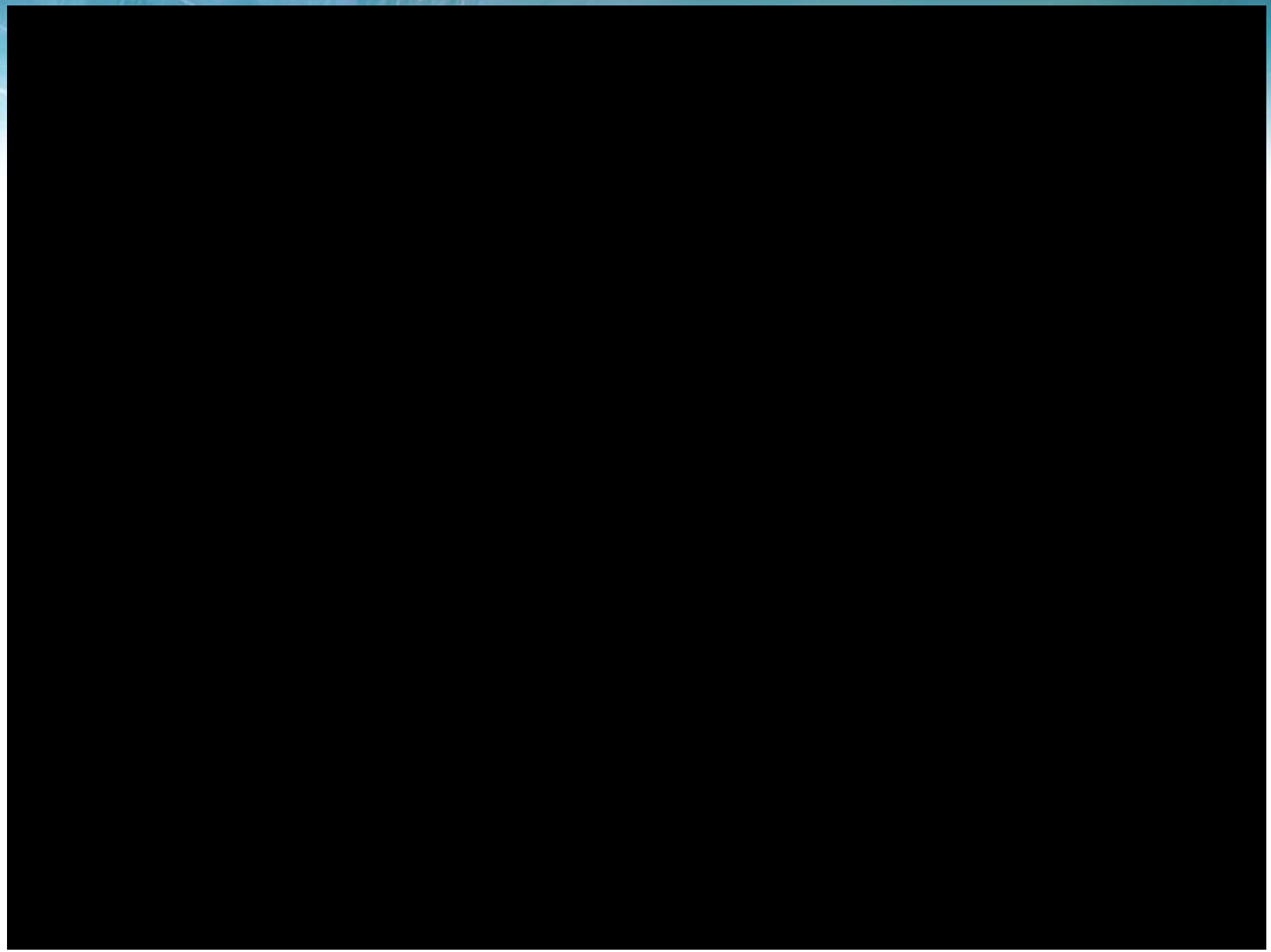
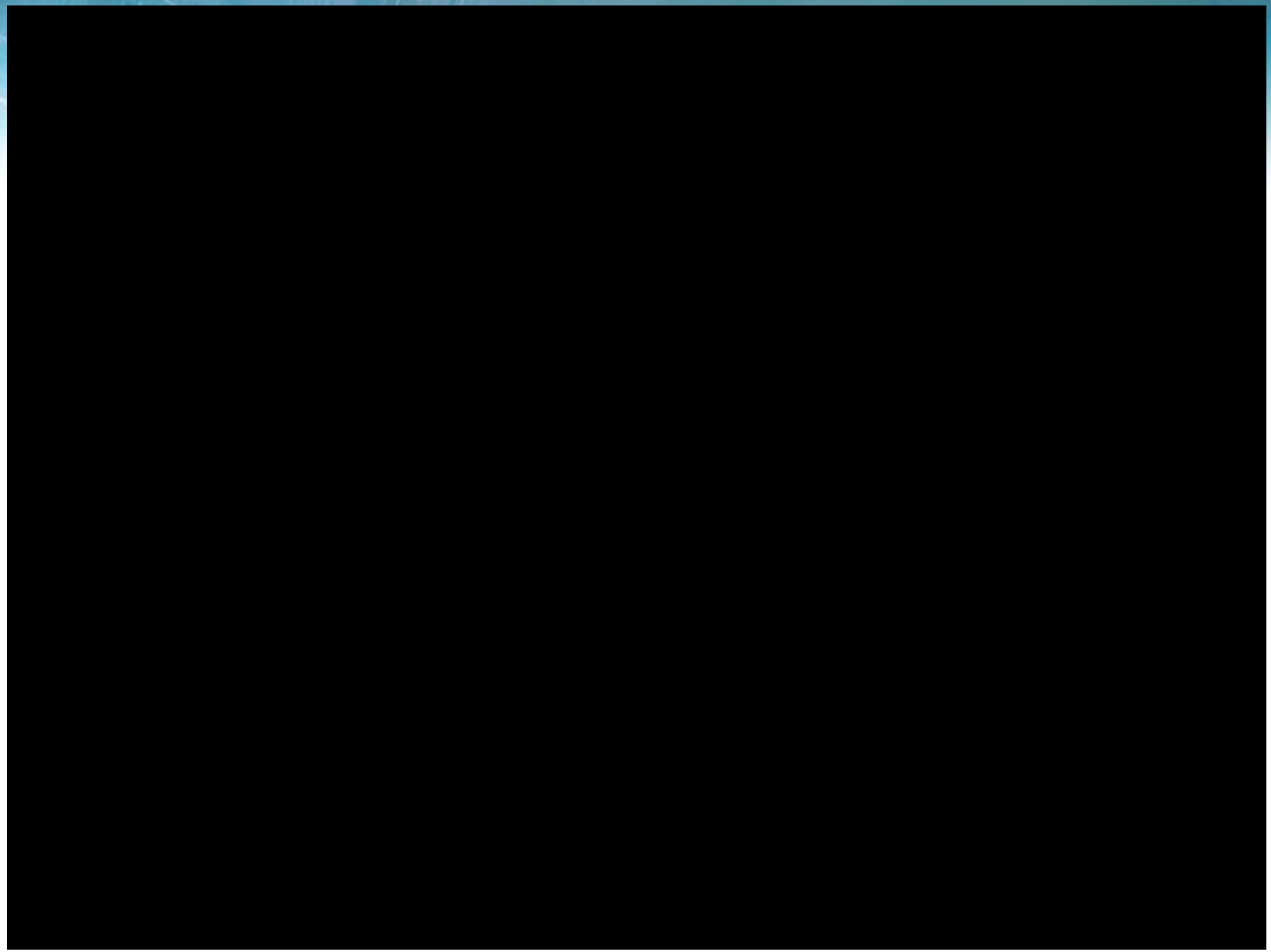
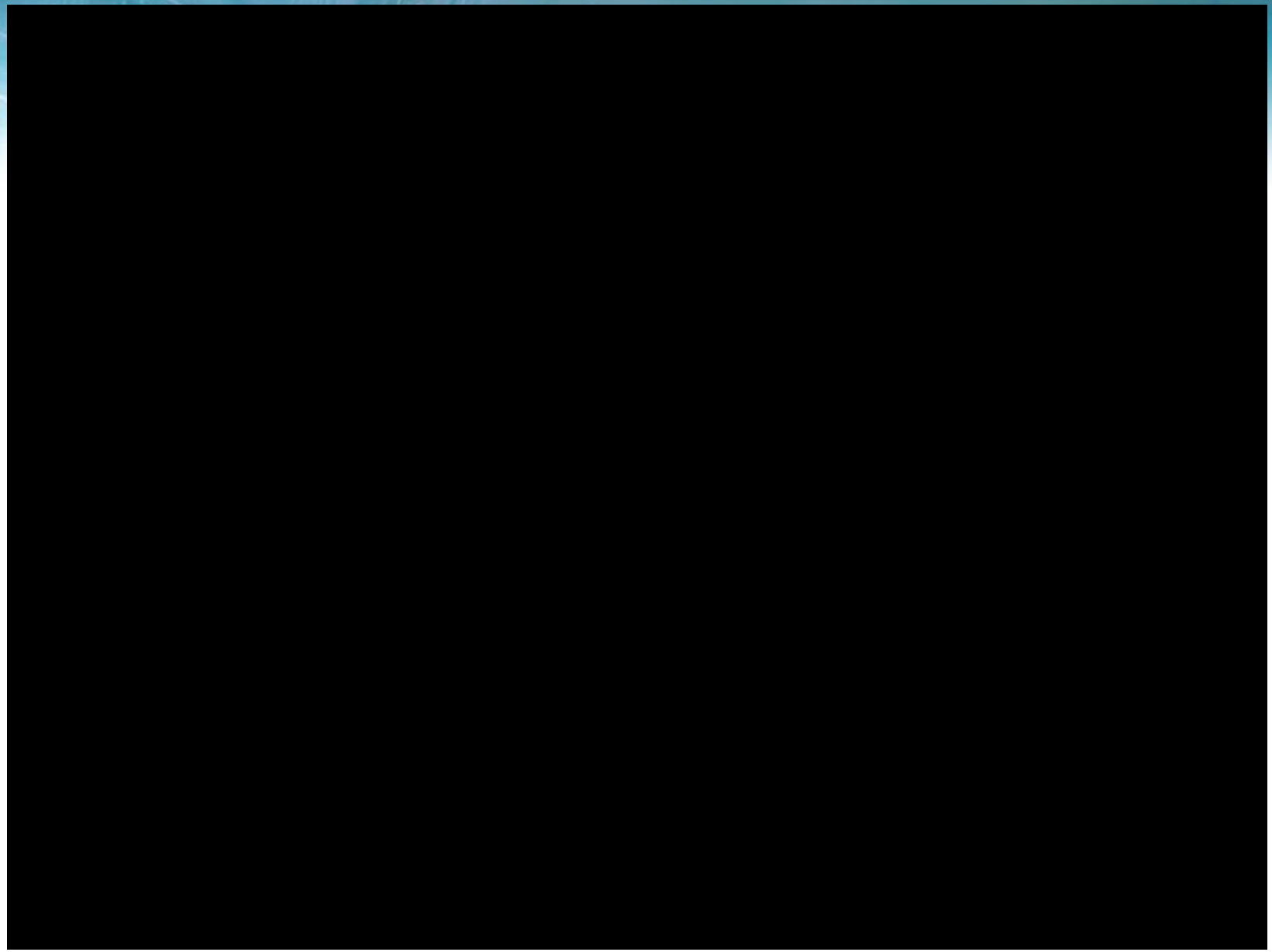


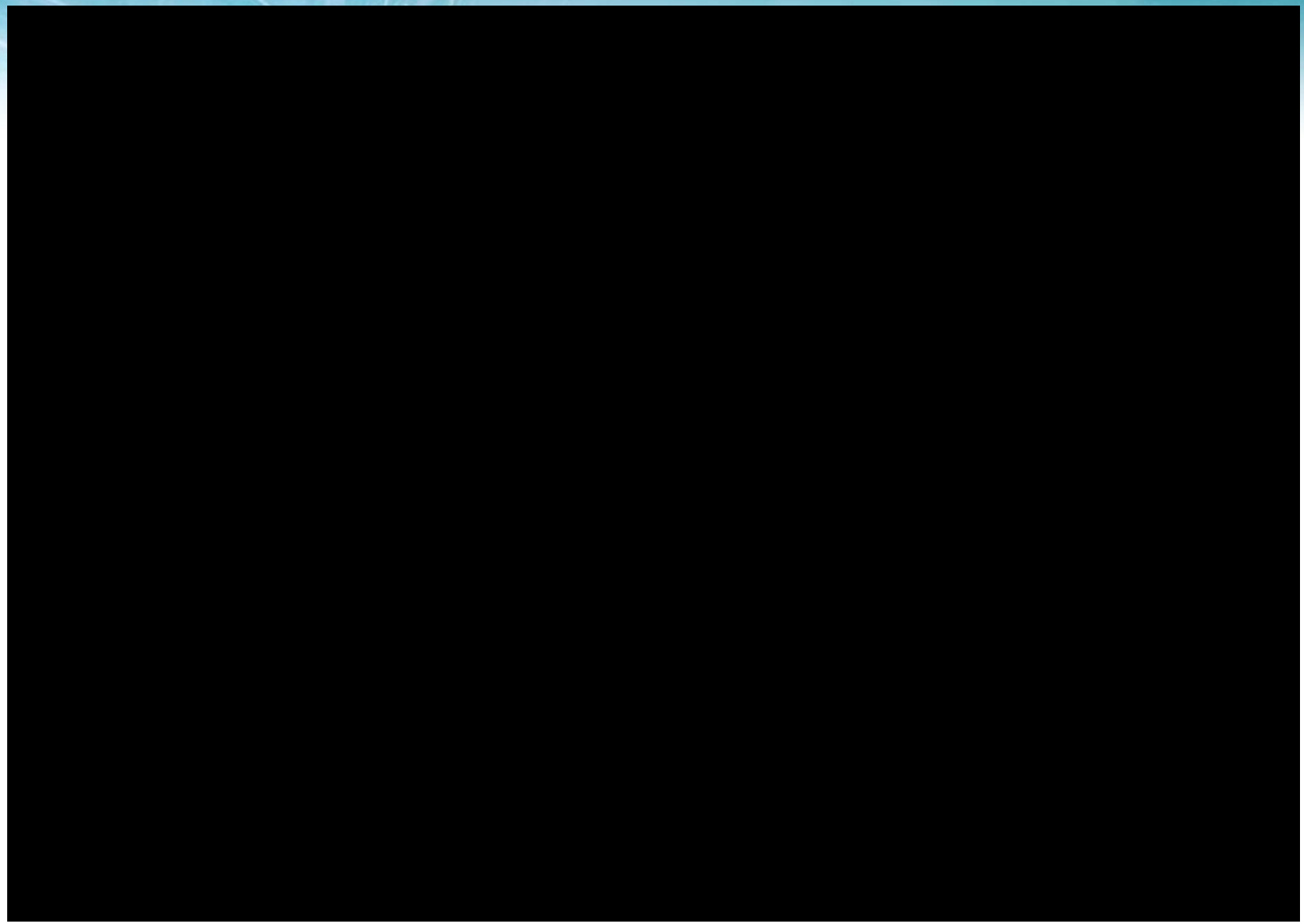
Image from Carrell et al, JEVT 2010









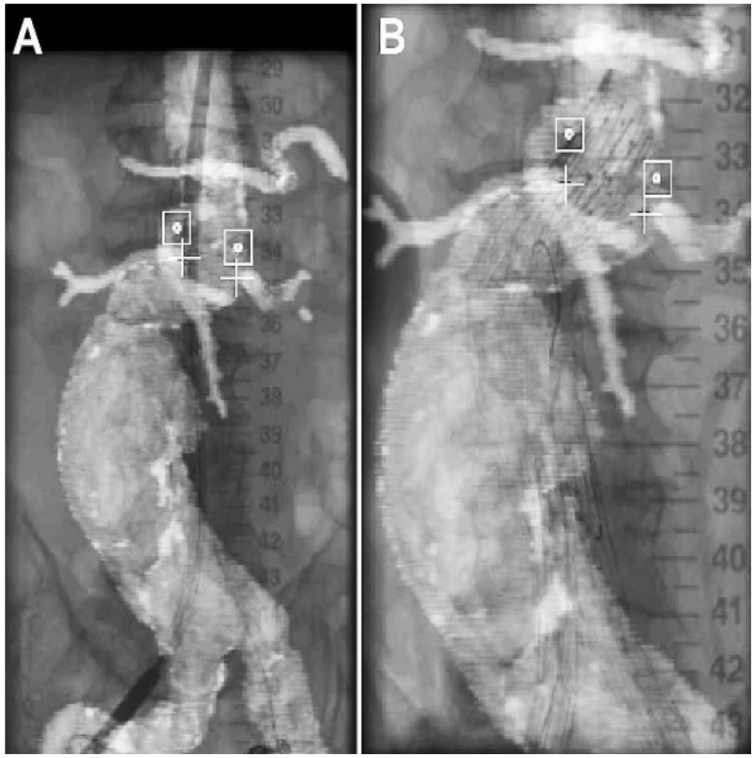


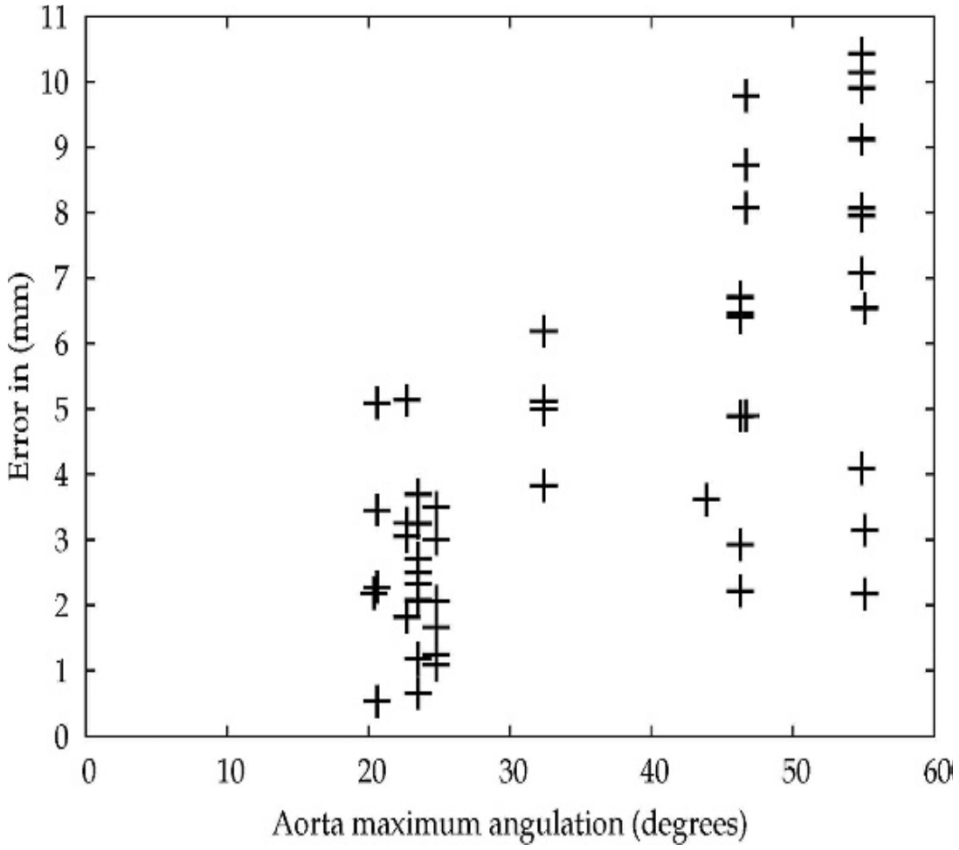
Inaccuracies of fusion

- Time lapse – pre op CT and procedure
- Pt was positioned differently for pre op CT angio
- Stiff wires and endograft delivery device

Deformation

- Severe angulation leads to errors of registration due to deformation as the SG is placed





Carrell et al, JEVT 2010

Reported Experience with Fusion

MEET 2015 MULTIDISCIPLINARY EUROPEAN ENDOVASCULAR THERAPY

Intraoperative C-arm cone-beam computed tomography in fenestrated/branched aortic endografting

Martijn L. Dijkstra, BA,[a] Matthew J. Eagleton, MD,[a,b] Roy K. Greenberg, MD,[a,b] Tara Mastracci, MD,[a] and Adrian Hernandez, MD, PhD,[c] *Cleveland, Ohio*

- N=40 patients
  - CBCT (Fusion) compared with No fusion
  - Average dose for fusion 0.18 to 0.29 Gy depending on the protocol used

	No Fusion	With 3D-3D fusion	P
N	49	40	
Radiation exposure (Gy)	7 (5-10)	7 (4-12)	0.782
Contrast (mL)	136 (96-199)	94 (72-131)	0.001

Dijkstra et al, JVS, 2011

Reported Experience with Fusion

MEET 2015 MULTIDISCIPLINARY EUROPEAN ENDOVASCULAR THERAPY

Three-dimensional fusion computed tomography decreases radiation exposure, procedure time, and contrast use during fenestrated endovascular aortic repair

Michael M. McNally, MD, Salvatore T. Scali, MD, Robert J. Feezor, MD, Daniel Neal, MS, Thomas S. Huber, MD, PhD, and Adam W. Beck, MD, *Gainesville, Fla*

Objective: Endovascular surgery has revolutionized the
come at the cost of increased radiation and contra
dimensional (3D) fusion computed tomography (CT
The purpose of this analysis was to determine the eff
fenestrated endovascular aortic repair (FEVAR).
Methods: Our institutional database was reviewed to id
using 3D fusion CT were compared with patients trea
this technology when procedures were performed in a
Primary end points included patient radiation expo
contrast usage (mL), and procedure time (minutes). P
revascularized with a stent graft, and operative outcon
Results: A total of 72 patients (41 before vs 31 a

- N=72
  - 41 no fusion (fixed hybrid room)
  - 31 with fusion
    - Siemens, 3d-3d; noncontrast, 5s spin

	No Fusion	With 3D-3D fusion	P
N	41	31	
Radiation Exposure (Gy)	5 +/-0.28	2.2 +/- 1.3	0.0001
Contrast (mL)	86 +/- 25	34 +/- 15	0.0001

me (63 ± 29 vs 41 ± 11 minutes;
rative 3D fusion CT. Similarly, for
posure (5400 ± 2225 vs 2700 ±
), contrast usage (90 ± 25 vs 39 ±
.002) was noted. Estimated blood
ward being lower for all patients in

ing during FEVAR can significantly
ase the overall physiologic impact of

copy is an important radiation source
ctice, and an increasing focus on the
radiation exposure to patients and
n the literature.[4-14] Notably, a recent
l that FEVAR is one of the most
procedures that vascular specialists

McNally et al, JVS 2014

Reported Experience with Fusion

Impact of Hybrid Rooms with Image Fusion on Radiation Exposure during Endovascular Aortic Repair

A. Hertault [a], B. Maurel [a], J. Sobocinski [a], T. Martin Gonzalez [a], M. Le Roux [a], R. Azzaoui [a], M. Midulla [b], S. Haulon [a,*]

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WHAT THIS PAPER ADDS
Experience has shown that the
reduced the exposure of patients
without jeopardising the overall

- n=102
  - All patients had fusion guided procedures
  - 3d-2d fusion (GE system)

Objective: To evaluate exposure
intraoperative guidance by preop
Methods: All consecutive patients who underwent standard bifurcated (BIF) or thoracic (THO), and complex
ly enrolled. Indirect dose–area product (DAP),
corded. These data were compared with a previously
other literature. Direct DAP and peak skin dose were
s median (interquartile range).
derwent standard (56.8%) or complex (43.2%) EVAR.
9.9); THO 26.0 (11.9–34.9); FEN 43.7 (24.7–57.5);
10.6 (9.1–14.7); THO 8.9 (6.0–10.5); FEN 30.7
n volume (mL) was as follows: BIF 59.0 (50.0–75.0);
20.0 (100.0–170.0). When compared with a previous
FEN
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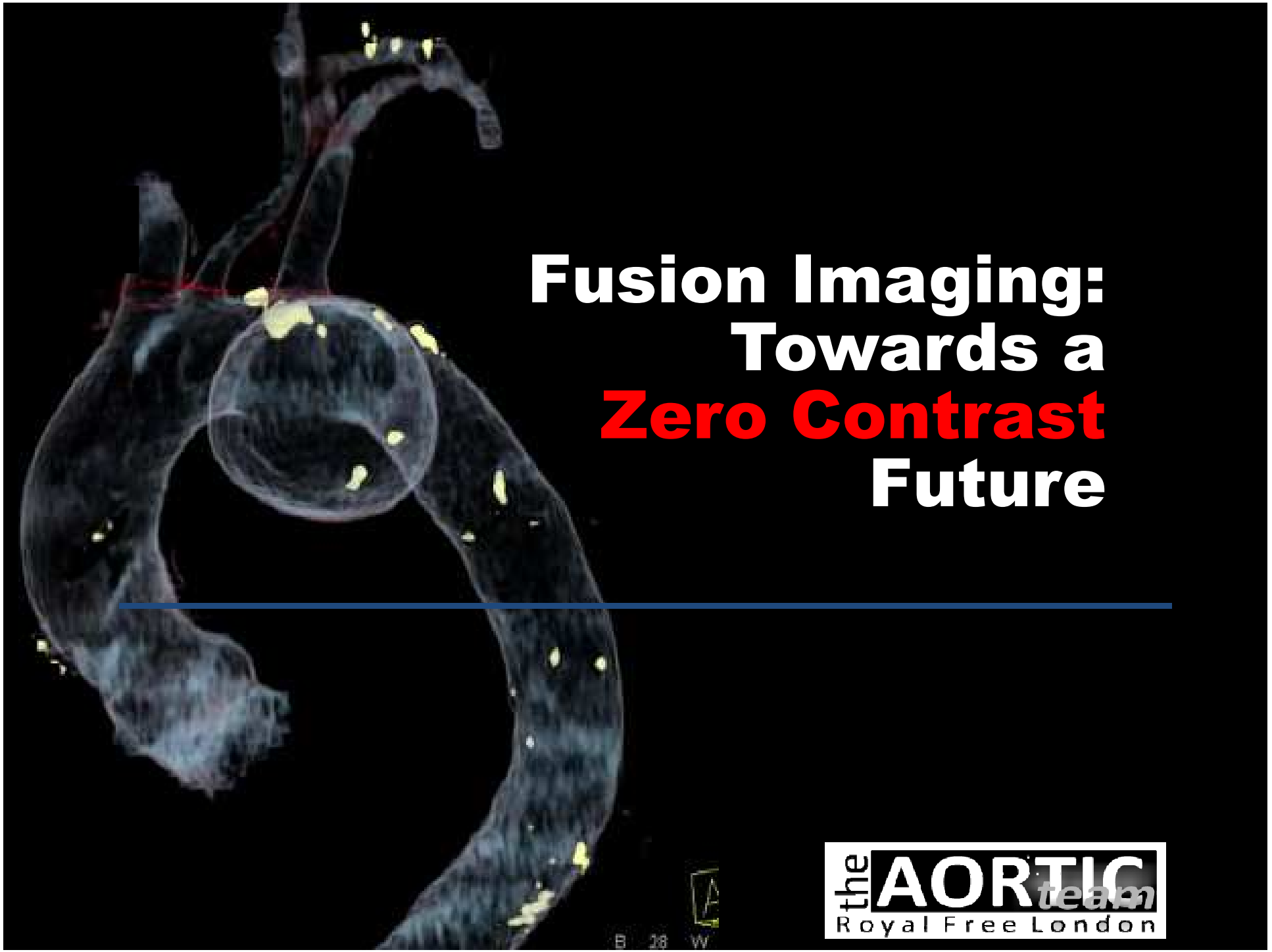
1). D
ation
y El
ay 2014, Available online 17 July 2014

Keywords: Aorta, Endovascular procedures, Fusion imaging, Hybrid room, Radiation, Radiation protection

Procedure	N	DAP (Gy.cm2)	Contrast (mL)
IR EVAR	44	12.2	59
BEVAR	20	47.4	120
FEVAR	18	43.7	105
TEVAR	14	26.0	80

- Significant reduction in DAP and Contrast volume


Fusion Imaging:
Towards a
Zero Contrast
Future
the AORTIC team
Royal Free London

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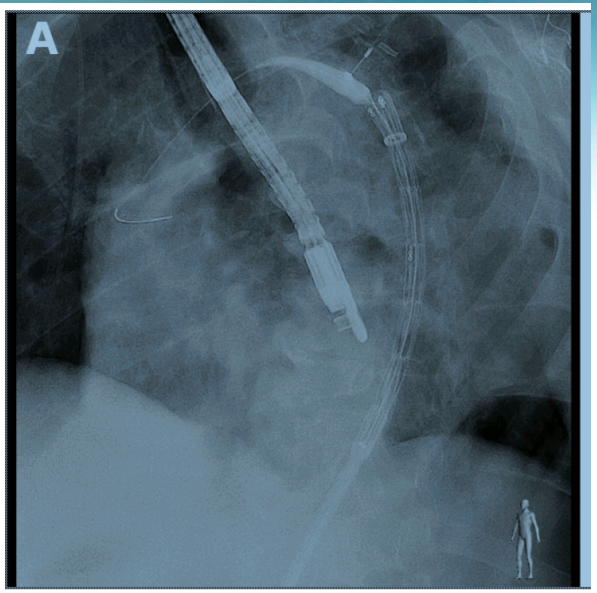
Images in Cardiovascular Medicine

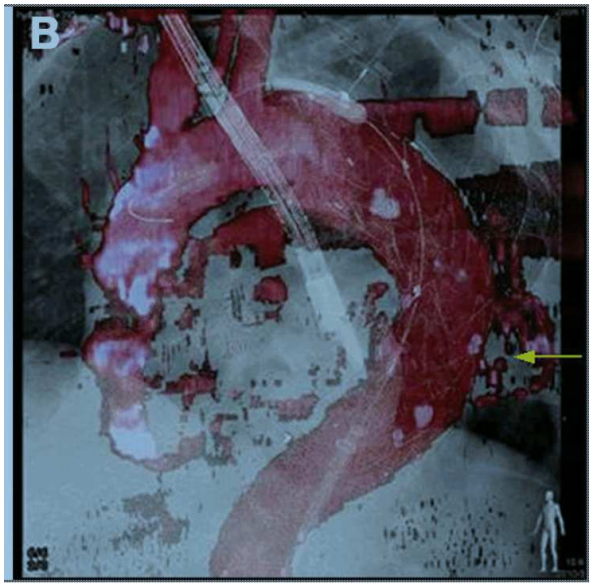
Zero-Contrast Thoracic Endovascular Aortic Repair Using Image Fusion

Hicham Kobeiter, MD; Julien Nahum, MD; Jean-Pierre Becquemin, MD

In recent years, thoracic endovascular aortic repair (TEVAR) has been established as a reliable alternative to conventional surgical repair.[1] The success of endovascular repair is critically dependent on adequate stent-graft deployment. Catheter-based 2-dimensional angiography is routinely performed before, during, and after stent-graft placement to ensure accurate positioning and confirm the absence of complications such as perigraft endoleaks. Computed tomography angiography (CTA) is also used to plan stent-graft deployment before intervention. Recent advances in imaging technology allow reusing the diagnostic volumetric data sets during intervention by overlying live fluoroscopy over the preacquired CTA.[2] This article describes the first case of TEVAR under guidance of CTA superimposed on live fluoroscopy without the use of iodinated contrast agent before, during, and after deployment.

An 82-year-old man was admitted to the hospital with an asymptomatic thoracic aneurysm of 65-mm diameter on the





- CBCT pre and post
- No gain in DAP (55Gy.cm²)
- NO CONTRAST

Imaging and the Vascular Surgeon

- Advances in technology and improvement in hybrid theatres has resulted in a decrease in radiation and contrast dose for the patient

- Strict application to ALARA principles - vital

- Future developments will get us closer to the holy grail of a zero radiation and zero contrast procedure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