IM SE YOUNG

Heart Vascular Strock in Samsung Medical Center

Radiological Technologist & Radiographer

Radiation Hazard Protection

ALARA ; "As Low As Reasonably Achievable"


스파이더 맨
SPIDER-MAN

AN ACCIDENTAL BITE BY A RADIOACTIVE SPIDER HAS GIVEN TEENAGER PETER PARKER SUPER POWERS, AND TRANSFORMED HIM INTO--
the AMAZING SPIDER-MAN
STAN LEE + LARRY LIEBER

"AND THOUGH HE STOOD, LO MILES AWAY... HIS BODY ABSORBED THE GAMMA RAYS!"
"WHILE HELPLESS, THE LAD LOOKED ON IN VAIN, THE AIR WAS SHATTERED BY SCREAMS OF PAIN!"

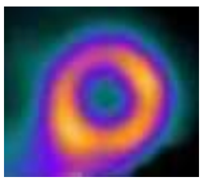
의학적 방사선 노출량과 자연 방사선 노출량

Annual, cumulative, or single exposure (mSv), appropriately

체르노빌 원전 사망자 *6000*

일본 후쿠시마 원전 최대값 (2011-03-15) *450*

Columbia Univ Medical Center 에서 2회 이상 SPECT 시행받은 환자의 3년간 누적 방사선량 * 121



USA CV imaging 환자의 3 년간 누적노출량** 23

USA AMI 환자 입원당 노출량*** 15

SPECT 관상동맥성형술 (PCI)

전신 CT 10

관상동맥조영술 (CAG)

6

흉부/복부 CT, 위장관조영술

심장 CT, 저선량 Lung CT 3

Mammography 0.5

Chest X-ray 0.1

* Einstein, JAMA 2010
** Chen, JACC 2010
*** Kaul, Circulation 2010

5000 사망률 50%

1000 급성 방사선 장해, 오심 및 구토

260 이란 Ramsar 연간 자연방사선

100 근로자의 5년간 또는 긴급작업 노출량 한계, 암 발생 증가 역치

50 근로자의 연간 노출량 한계

10 브라질 Guarapari 연간 자연방사선

4 항공기승무원의 연간 노출량

3 일반인의 연간 자연방사선 노출량

1 일반인의 연간 인위방사선 노출량 한계

0.2 서울 – 뉴욕 왕복비행

0.05 원자력발전소 연간노출량 한계

0.001 원자력발전소 연간 평균노출량

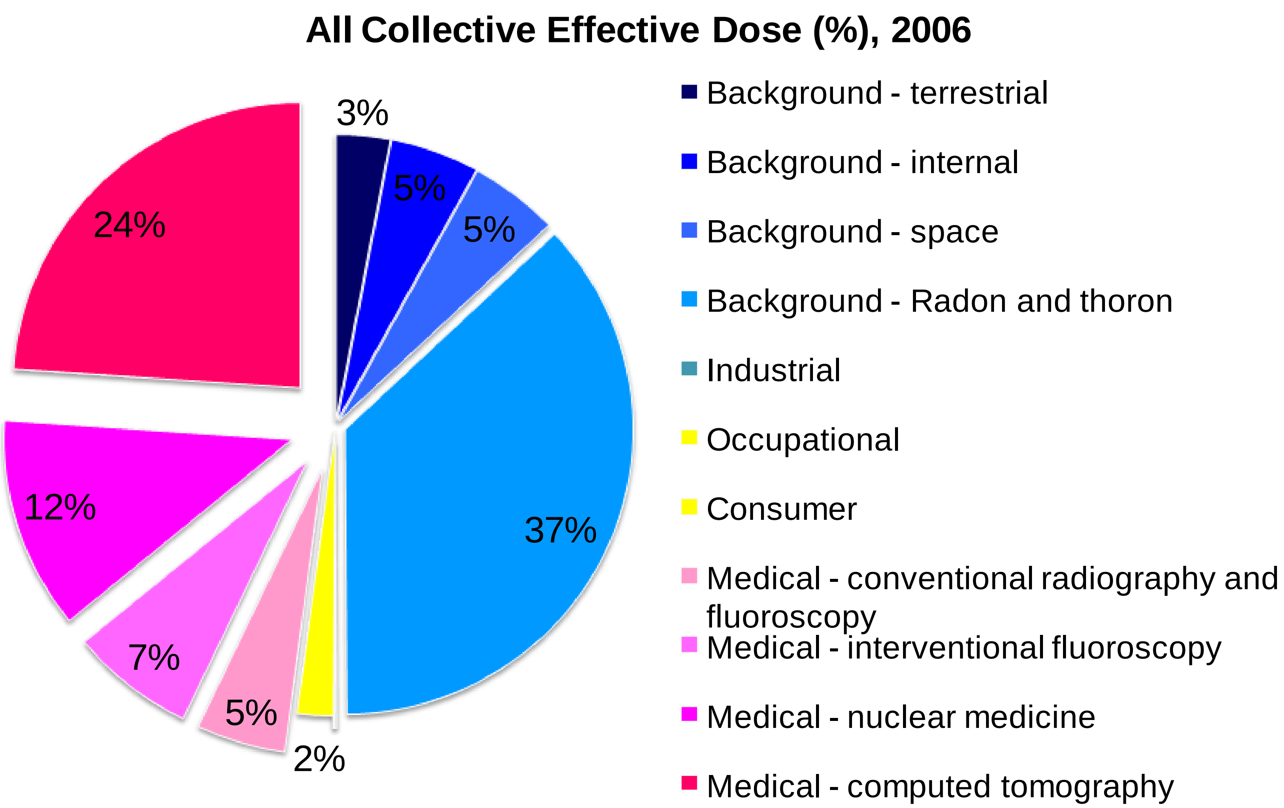
		작업 종사자	일반인
유효선량한도		연간 50mSv 넘지 않는 범위에서 5년간 100mSv	연간 1mSv
등가선량한도	수정체	연간 150mSv	연간 15mSv
	손, 발, 피부	연간 500mSv	연간 50mSv

ICRP 103

Group	mSv/yr
Physicians	2 ~ 60
Nurse	8 ~ 16
Technologists	2

More

Medical radiation contributes the half of whole radiation exposure in USA



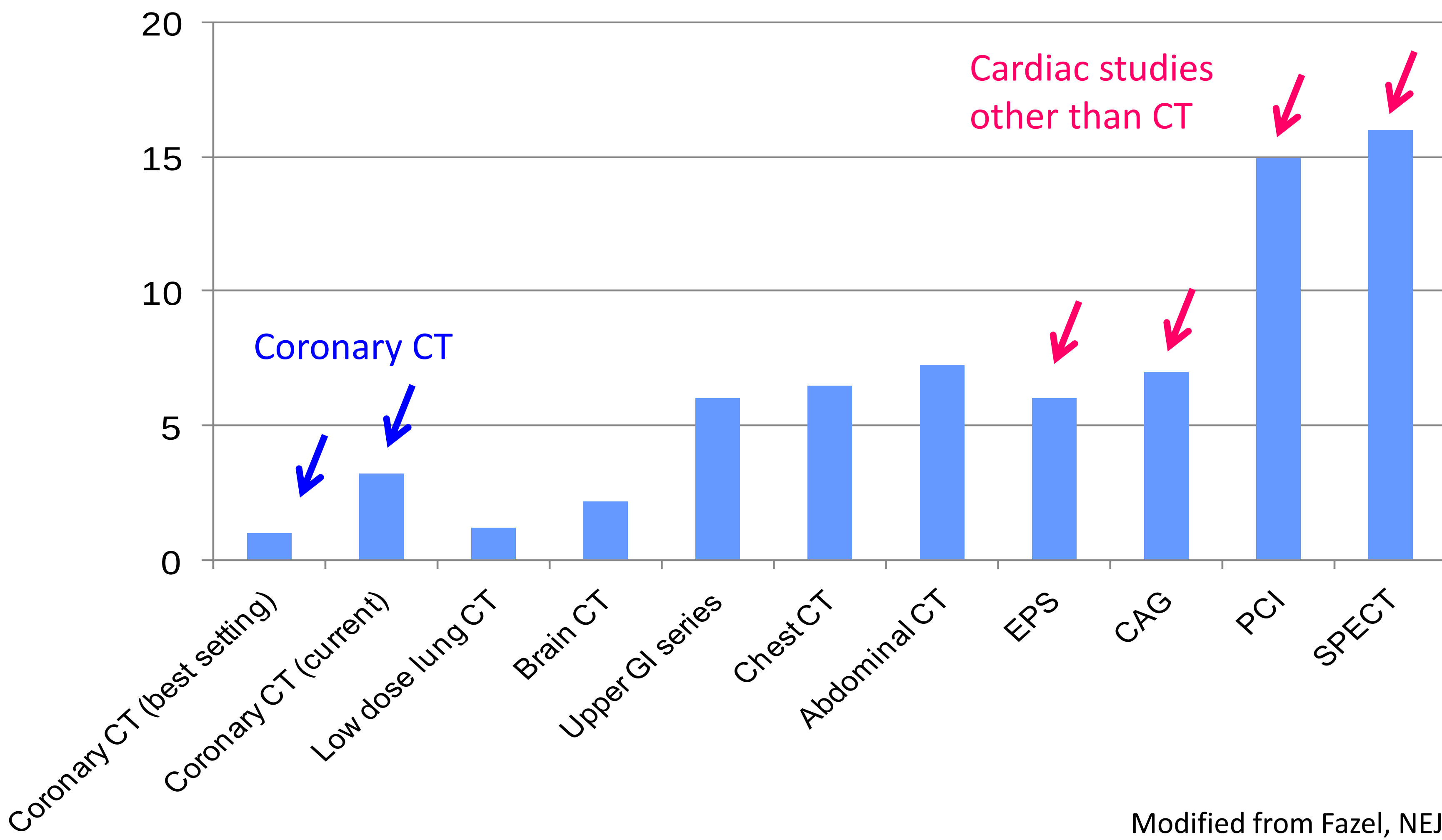
Natural source
3.6 mSv /year

If smoker, additional
2.8 mSv /year

Medical source
3.0 mSv /year

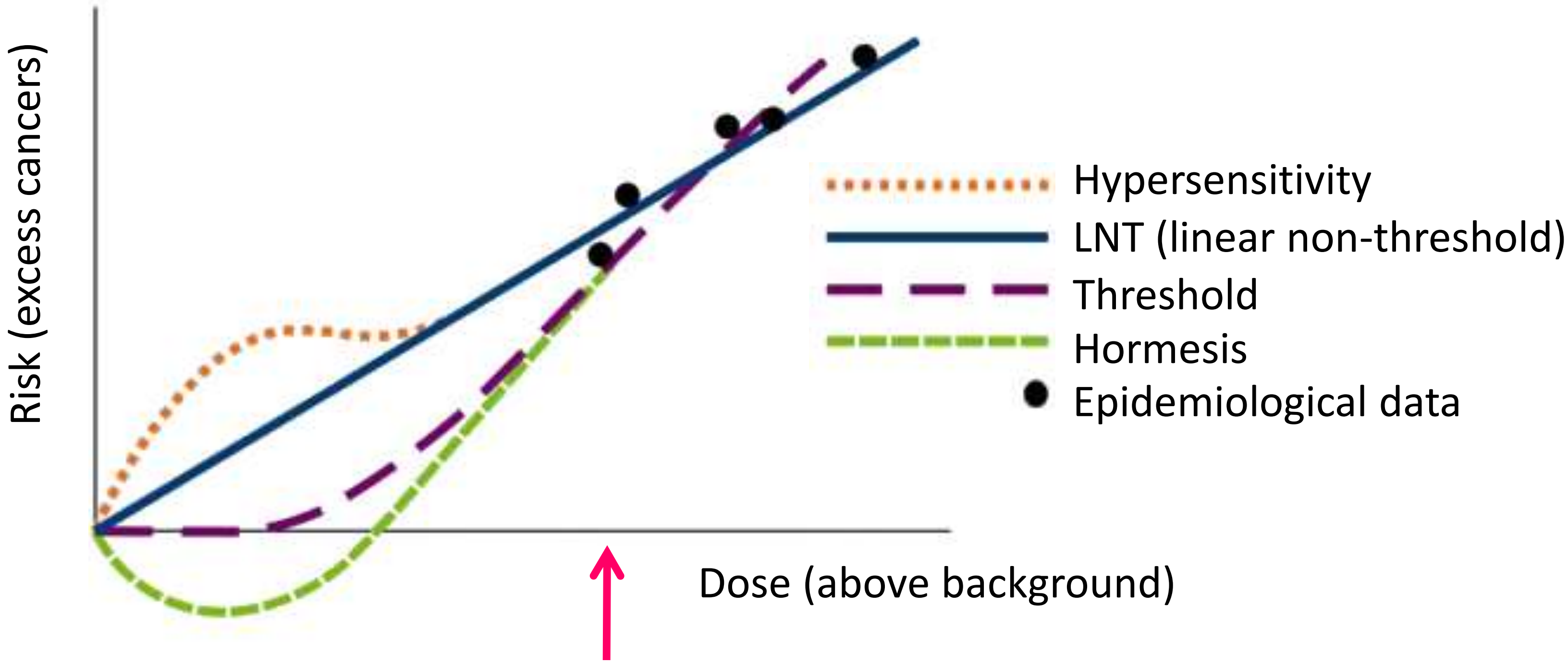
National Council on Radiation Protection and Measurements (NCRP), 2009-3-3, http://NCRPpublications.org
http://web.princeton.edu/sites/ehs/osradtraining/backgroundradiation/background.htm

Radiation dose (mSv)



Modified from Fazel, NEJM 2009

Models for the health risks from exposure to low levels of ionizing radiation

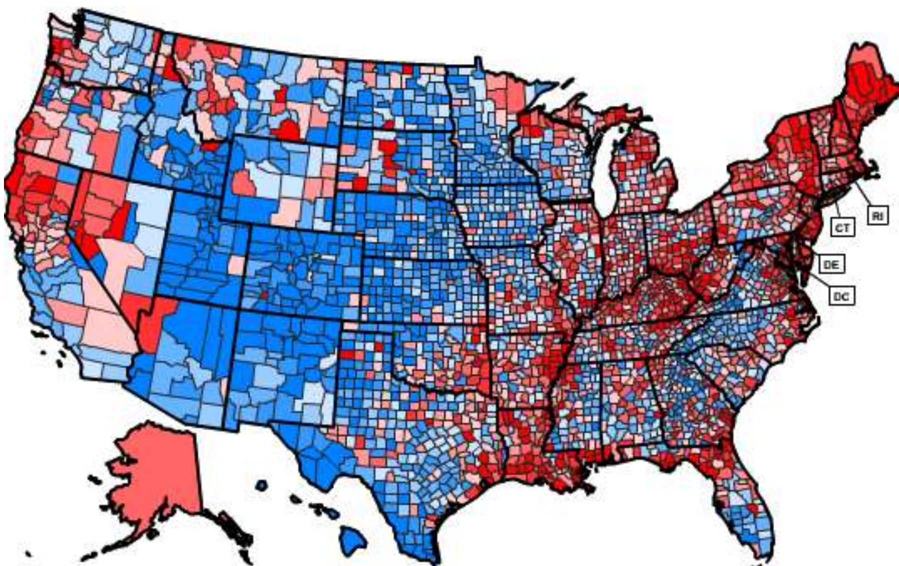


100 mSv = approximate the lowest acute dose known to cause cancer

Canadian Nuclear Safety Commission, http://nuclearsafety.gc.ca

Mismatch between US cancer rate and radon concentration

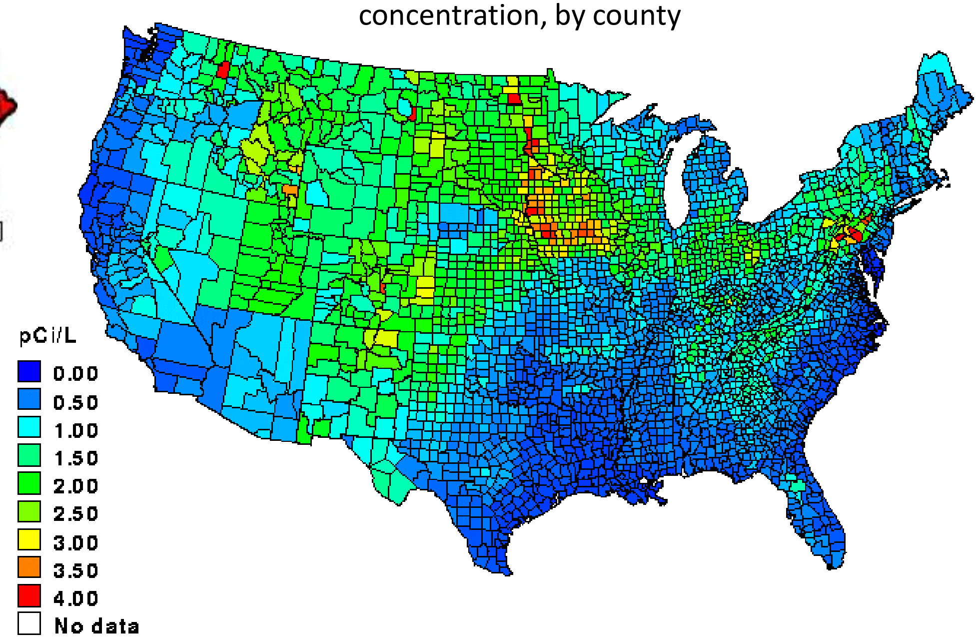
Cancer mortality rates
(county-basis, age-adjusted 2000 US population, all cancers, all ethnicity, all ages, both sexes, 1970 – 1994)



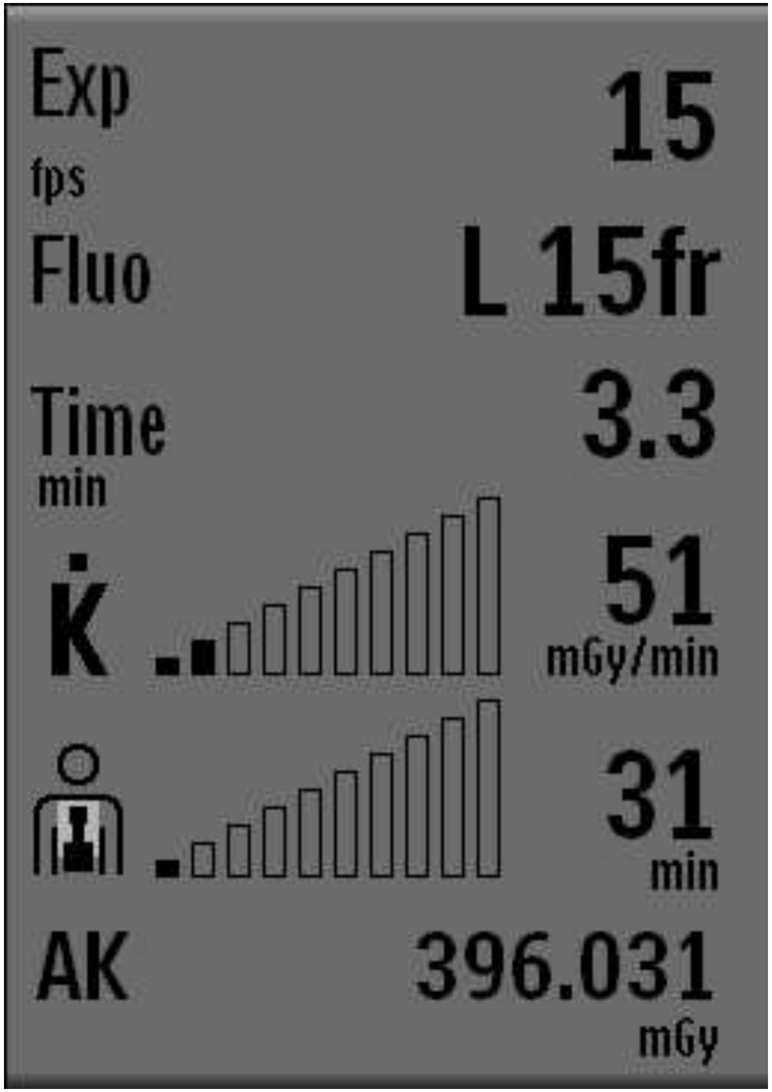
National Cancer Institute,
http://ratecalc.cancer.gov/

Mortality rate	Confidence interval	No. of deaths
US [illegible]	[illegible] - [illegible]	14,405,180

Radon concentration
Predicted median annual-average living-area concentration, by county



Lawrence Berkeley National Laboratory,
http://eetd.lbl.gov/



← Predicted Fluoro AK Rate

← Remaining time at predicted rate until **2Gy limit** is reached

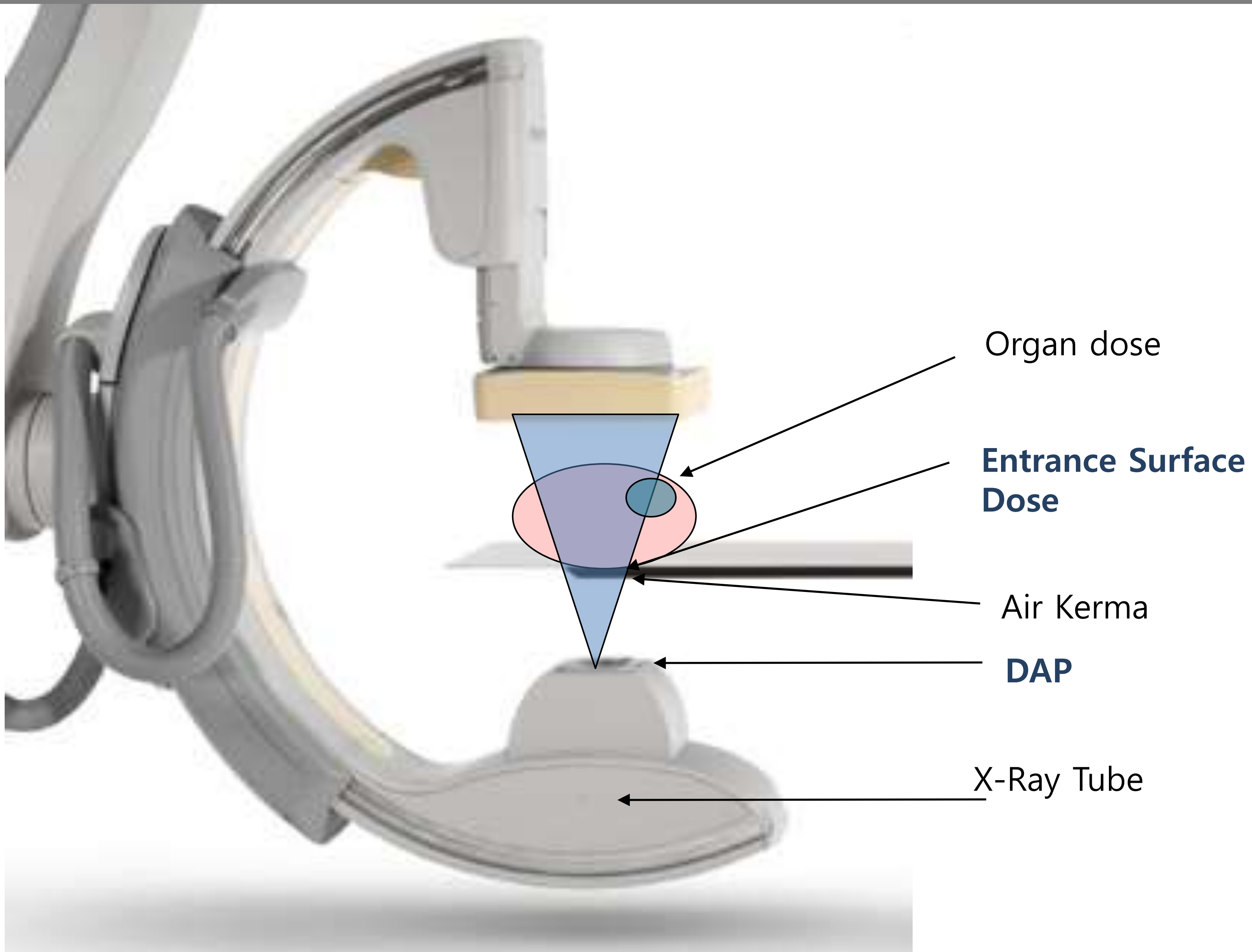
Note: Each bar is 10% of the 2Gy limit.

← Accumulated Total

What kind of Dose

- Dose Area Product (DAP – $Gycm^2$)
- Air Kerma (AK – Gy)
- Exposure dose (X – R or C/kg))
- Absorbed dose (D – Gy)

- Diagnostic radiology : Kerma and Absorbed dose (D) are equal.
- D [mGy]. = $f_{(air)}$. X R [$C\ kg^{-1}$]   f= 8.69
- Dose in soft tissue = 1.06 X Dose in air


Organ dose
Entrance Surface Dose
Air Kerma
DAP
X-Ray Tube

Brain and Neck Tumors Among Physicians Performing Interventional Procedures

Ariel Roguin, MD, PhD[a,*], Jacob Goldstein, MD[b], Olivier Bar, MD[c], and James A. Goldstein, MD[d]

Physicians performing interventional procedures are chronically exposed to ionizing radiation, which is known to pose increased cancer risks. We recently reported 9 cases of brain cancer in interventional cardiologists. Subsequently, we received 22 additional cases from around the world, comprising an expanded 31 case cohort. Data were transmitted to us

22 of 26 cases (85%)

interventional cardiologists, 2 electrophysiologists, and 6 interventional radiologists. All physicians had worked for prolonged periods (latency period 12 to 32 years, mean 23.5 ± 5.9) in active interventional practice with exposure to ionizing radiation in the catheterization laboratory. The tumors included 17 cases (55%) of glioblastoma multiforme (GBM), 2 astrocytomas (7%), and 5 meningiomas (16%). In 26 of 31 cases, data were available regarding the side of the brain involved. The malignancy was left sided in 22 (85%), midline in 1, and right sided in 3 operators. In conclusion, these results raise additional concerns regarding brain cancer developing in physicians performing interventional procedures. Given that the brain is relatively unprotected and the left side of the head is known to be more exposed to radiation than the right, these findings of disproportionate reports of left-sided tumors suggest the possibility of a causal relation to occupational radiation exposure. (Am J Cardiol 2013;111:1368–1372)

Table 1 Main epidemiological studies of low do... -induced cataracts

	Population size	Exposure age or	Eye examination age or period	Type of cataracts involved
Hiroshima and Naga...				
Otake et al				
Radiologists and radiological technologists				
Chodick et al. [18]	Cohort of 35 705 radiology technicians	Median = 28.1 mGy	Range = 24 - 44 yrs	Follow up between 1983 and 2004

PSC: posterior subcapsular cataract; PS: posterior subcapsular;

Cancer. 2006 Jun 15;106(12):2707-15.

Breast cancer incidence in U.S. radiologic t...

Doody MM[1], Freedman DM, Alexander BH, Hauptmann M, Miller JS, R...

Author information

Abstract

BACKGROUND: Studies of atomic bomb survivors and medi... associated with acute or protracted, intermediate-dose or hig... dose-rate (protracted) exposures are less certain.

METHODS: The authors evaluated incident breast cancer ri... proxy index for cumulative radiation exposure based on 2 m... from 1925 to 1980, adjusting for established breast cancer...

RESULTS: During follow-up, 1050 new breast cancer diag... working in 1970 or later, adjusted breast cancer risks for t... 1935 were 1.0 (95% confidence interval [CI], 0.8-1.2), 1.2... 1.3-6.2), respectively. The risk rose with the number of ye... among those who began working before age 17 years (r... worked in the 1940s or later. Compared with technologis... cancer risks were 1.0 (95% CI, 0.9-1.2), 1.0 (95% CI, 0.... Level 3, and Level 4 (highest) exposure.

CONCLUSIONS: Breast cancer risk was elevated signi... exposures over several years that potentially resulted i... 1940, but not later, was consistent with decreasing oc... stringent radiation protection standards over time.

Subclinical Carotid Atherosclerosis and Early Vascular Aging From Long-Term Low-Dose Ionizing Radiation Exposure

A Genetic, Telomere, and Vascular Ultrasound Study in Cardiac Catheterization Laboratory Staff

ABSTRACT

OBJECTIVES This study sought to assess the association between long-term radiation exposure in the catheterization laboratory (cath lab) and early signs of subclinical atherosclerosis.

BACKGROUND There is growing evidence of an excess risk of cardiovascular disease at low-dose levels of ionizing radiation exposure.

METHODS Left and right carotid intima-media thickness (CIMT) was measured in 223 cath lab personnel (141 male; age, 45 ± 8 years) and 222 unexposed subjects (113 male; age, 44 ± 10 years). Leukocyte telomere length (LTL) was evaluated by quantitative reverse transcriptase polymerase chain reaction. The DNA repair gene *XRCC3* Thr241Met polymorphism was also analyzed to explore the possible interaction with radiation exposure. The occupational radiological risk score (ORRS) was computed for each subject on the basis of the length of employment, individual caseload, and proximity to the radiation source. A complete lifetime effective dose (mSv) was recorded for 57 workers.

RESULTS Left, right, and averaged CIMTs were significantly increased in high-exposure workers compared with both control subjects and low-exposure workers (all p values <0.04). On the left side, but not on the right, there was a significant correlation between CIMT and ORRS (p = 0.001) as well as lifetime dose (p = 0.006). LTL was significantly reduced in exposed workers compared with control subjects (p = 0.008). There was a significant correlation between LTL and both ORRS (p = 0.002) and lifetime dose (p = 0.03). The *XRCC3* Met241 allele presented a significant interaction with high exposure for right side ($p_{interaction}$ = 0.002), left side ($p_{interaction}$ < 0.0001), and averaged ($p_{interaction}$ < 0.0001) CIMTs.

CONCLUSIONS Long-term radiation exposure in a cath lab may be associated with increased subclinical CIMT and telomere length shortening, suggesting evidence of accelerated vascular aging and early atherosclerosis. (J Am Coll Cardiol Intv 2015;8:616-27) © 2015 by the American College of Cardiology Foundation.

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Radiation Safety for the Interventional Cardiologist—A Practical Approach to Protecting Ourselves From the Dangers of Ionizing Radiation

Jan 04, 2016 | Gautam Kumar, MD, FACC; Syed Tanveer Rab, MBBS, FACC

Expert Analysis

Share via: Print

Font Size A A A

Precautions to Minimize Exposure to Paitent and Operator

Utilize radiation only when imaging is necessary to support clinical care. Avoid allowing the "heavy foot," to step on the fluoroscopy pedal while not looking at the image.

Minimize use of cine. "Fluoro-save" has a <10% radiation exposure of cineangiography.

If the intensity of kV increases by 15%, mA is doubled.

Minimize use of steep angles of X-ray beam. The left anterior oblique (LAO) cranial angulation has the highest degree of scatter exposure to the operator.

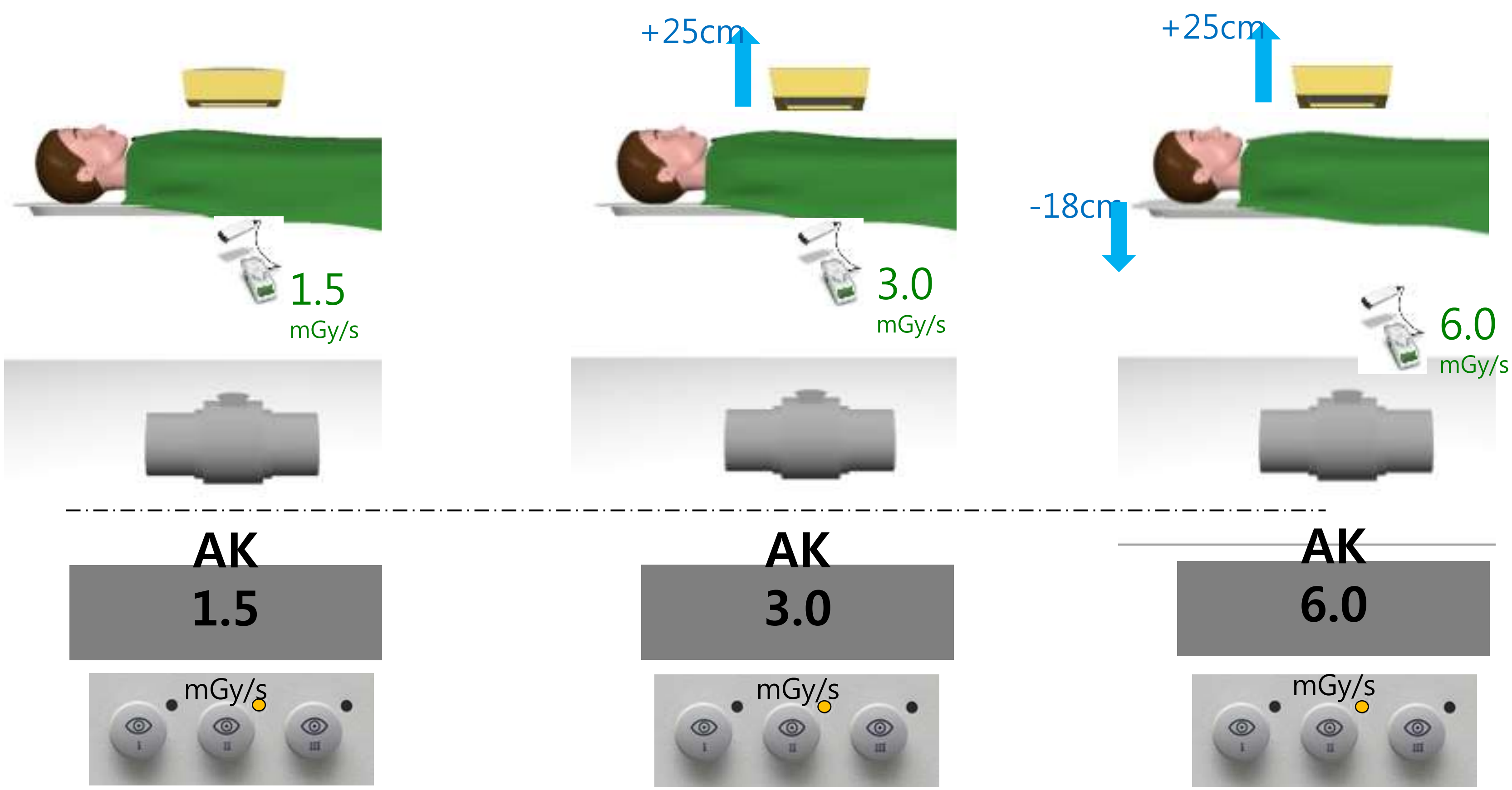
View	Dose(relative increase)
RAO 30~60°	1
LAO 30°	1
LAO 60°	3
LAO 90°	9

Minimize use of magnification modes. Most modern systems have software magnification algorithms that allow for magnification without additional radiation. In modern machines, there is a "Live Zoom" feature without significant degradation of the image. For example, in lieu of magnification, an 8-inch field of view with a zoom factor of 1.2 results in a 6.7-inch field of view without added radiation.

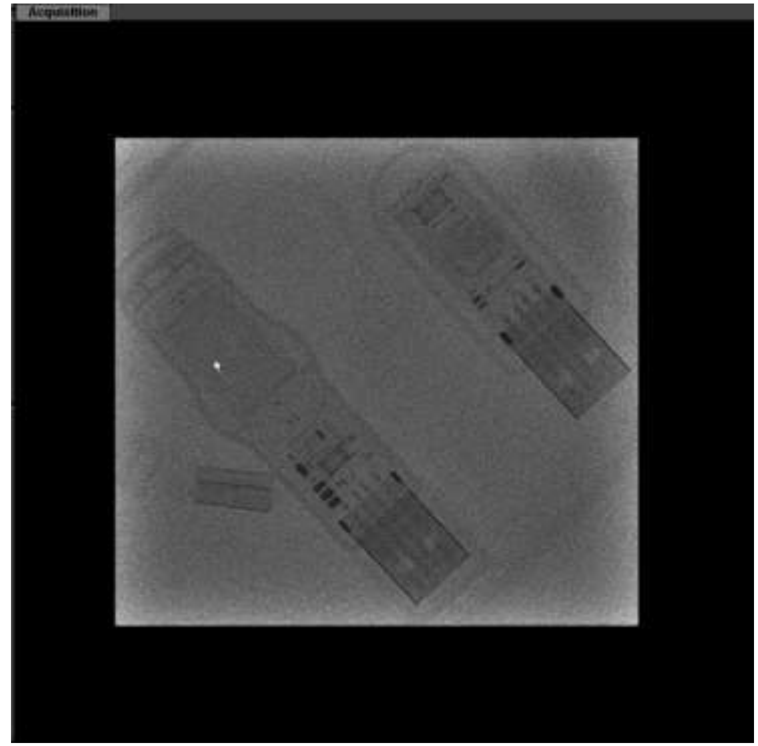
Minimize frame rate of fluoroscopy and cine.

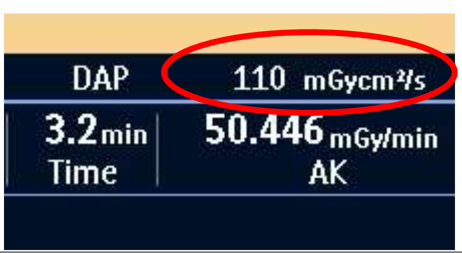
A reduction of the fluoroscopic pulse rate from 15frame/sec to 7.5 frames/sec reduces the radiation exposure by 67%.

Keep the image detector close to the patient (low subject-image distance).

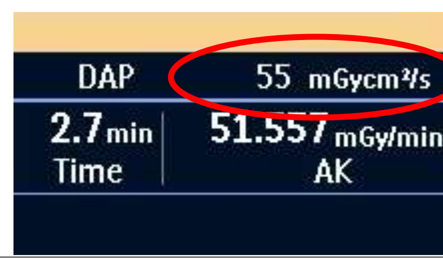


Utilize collimation to the fullest extent possible.





DAP cut in ½!!
Reduces statistical risk.



Precautions to specifically minimize Exposure to Operator

Use and maintain appropriate protective lead garments. We recommend a full protective suit with thyroid collar and additional head protection.

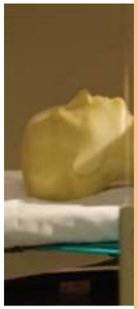
Maximize distance of operator from X-ray source and patient.

Keep above-table (hanging) and below-table shields in optimal position at all times. A larger ceiling-mounted shield with attached lamellae, used in combination with a drape, decreased exposure to the operator by half.[21]

Precautions to specifically minimize Exposure to Operator

Use additional disposable shielding material for protection from scatter radiation.

Keep all body parts out of the field of view at all times. When it is unavoidable that a body part would be exposed to radiation, consider usage of radiation attenuating gloves (for example, for an echocardiographer imaging during cardiac biopsies) or attenuating cream (for example, for an electrophysiologist attempting to perform device implantation).



Radiation Dose Reduction during Radial Cardiac Catheterization: Evaluation of a Dedicated Radial Angiography Absorption Shielding Drape

Andrew Ertel,[1] Jeffrey Nadelson,[2] Adhir R. Shroff,[1] Ranya Sweis,[3] Dean Ferrera,[1] and Mladen I. Vidovich[1]

[1] Division of Cardiology, University of Illinois at Chicago Medical Center, Chicago, IL 60612, USA
[2] Department of Medicine, Roger Williams Medical Center, Boston University School of Medicine, Providence, RI 02908, USA
[3] Department of Medicine and the Bluhm Cardiovascular Institute, Northwestern University Feinberg School of Medicine, Chicago, IL 60611, USA

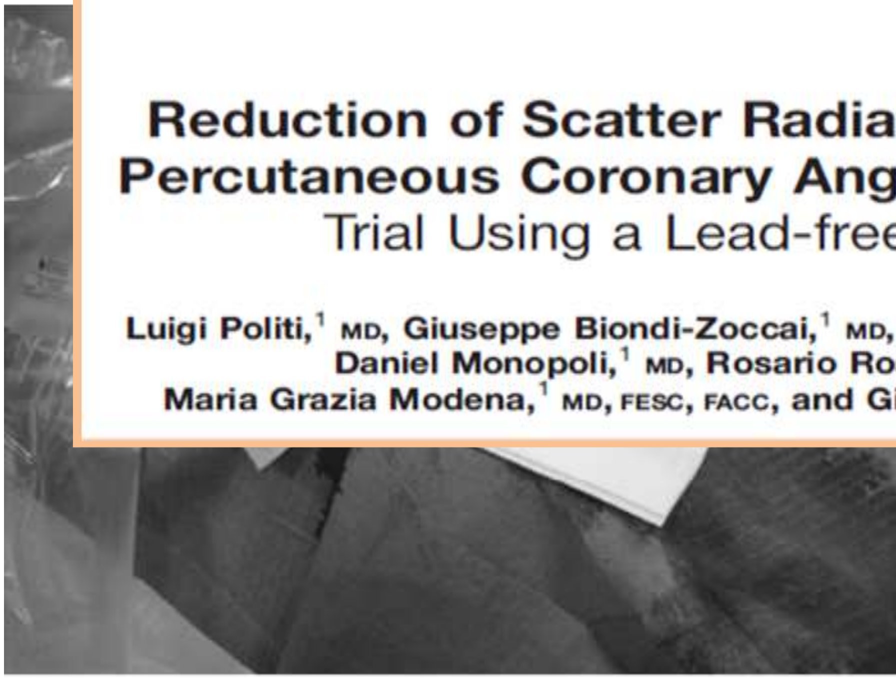
				rape 3 (mGy)
				211.05
				277.7
				357.65
				459.45
				525.4
				795.75
RAO 30 CRAN 30	2681	1122	746.8	927.9
Average dose reduction		58.14%	71.77%	65.39%

LAO: Left anterior oblique.
RAO: Right anterior oblique.
CAUD: Caudal.
CRAN: Cranial.

Catheterization and Cardiovascular Interventions 79:97–102 (2012)

Reduction of Scatter Radiation During Transradial Percutaneous Coronary Angiography: A Randomized Trial Using a Lead-free Radiation Shield

Luigi Politi,[1] MD, Giuseppe Biondi-Zoccai,[1] MD, Luca Nocetti,[2] MSc, Tiziana Costi,[2] MSc, Daniel Monopoli,[1] MD, Rosario Rossi,[1] MD, Fabio Sgura,[1] MD, Maria Grazia Modena,[1] MD, FESC, FACC, and Giuseppe M. Sangiorgi,[1*] MD, FESC, FSCAI



JACC: CARDIOVASCULAR INTERVENTIONS
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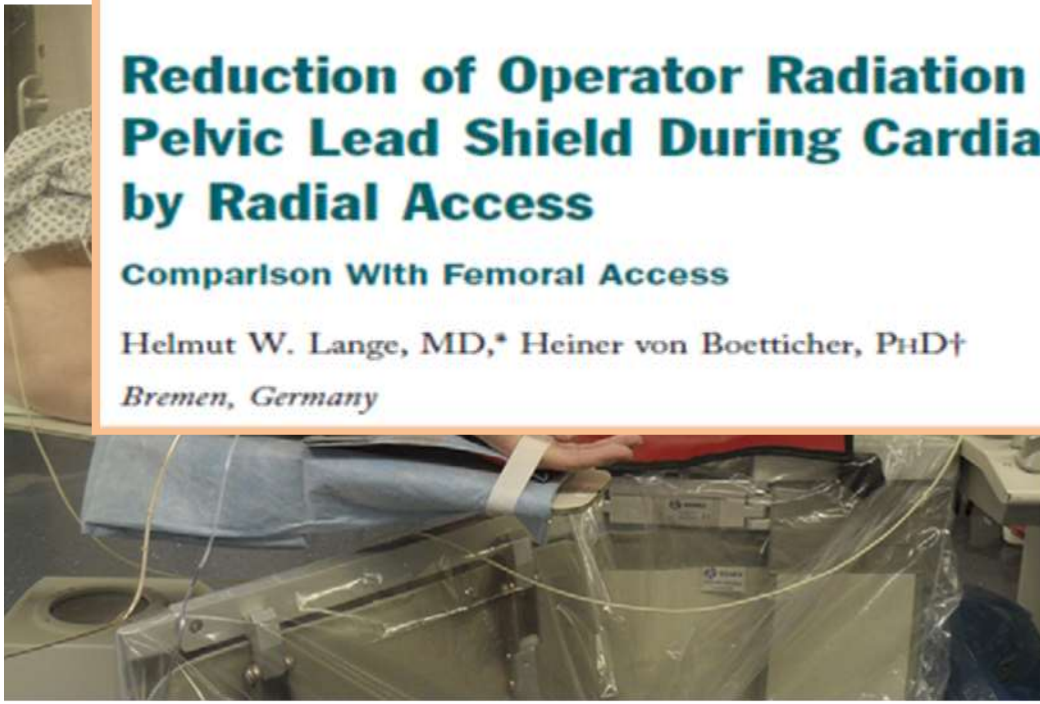
ISSN 1936-8798/$36.00
DOI: 10.1016/j.jcin.2011.12.013

Reduction of Operator Radiation Dose by a Pelvic Lead Shield During Cardiac Catheterization by Radial Access

Comparison With Femoral Access

Helmut W. Lange, MD,* Heiner von Boetticher, PHD†
Bremen, Germany



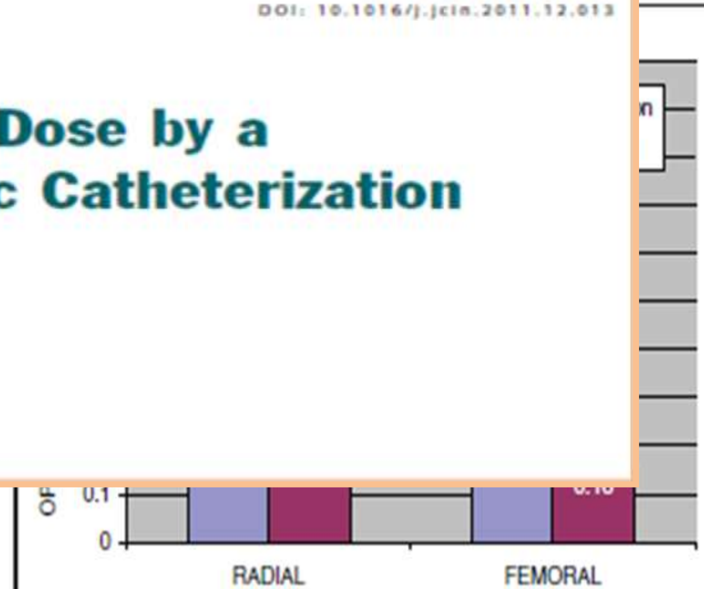


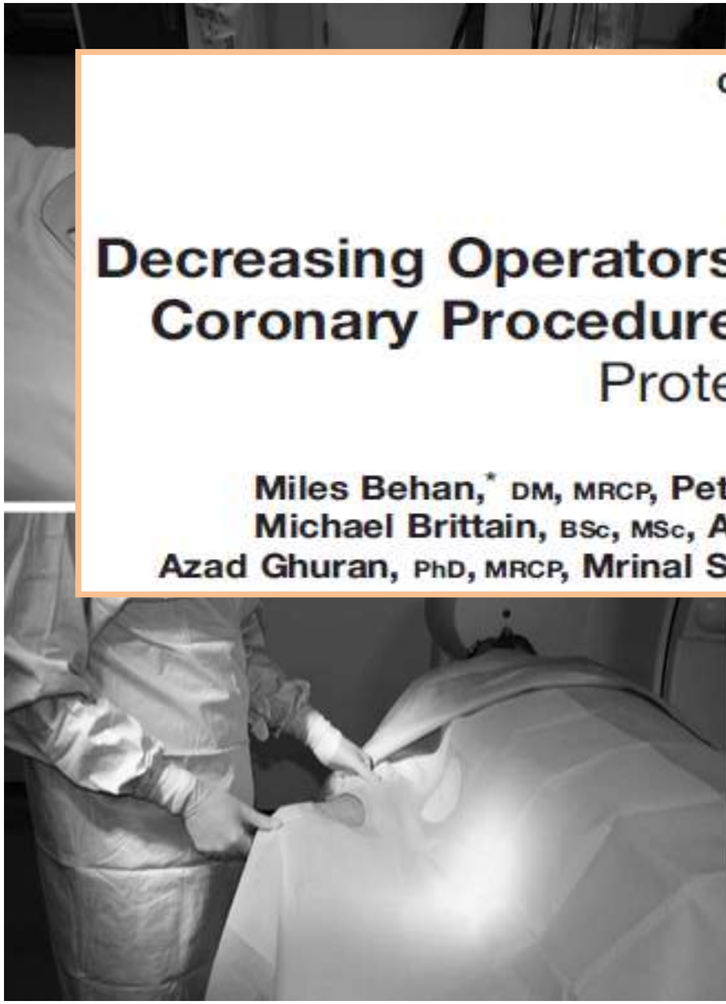
Figure 2. Effect of a Pelvic Lead Shield During Cardiac Catheterization

The dose-area product (DAP)-normalized radiation dose of the operator (µSv × Gy^{-1} × cm^{-2}) by radial access **(left)** and femoral access **(right)**. The amount of reduction is similar for both routes.

Catheterization and Cardiovascular Interventions 76:79–84 (2010)

Decreasing Operators' Radiation Exposure During Coronary Procedures: The Transradial Radiation Protection Board

Miles Behan,* DM, MRCP, **Peter Haworth,** MRCP, **Paul Colley,** BSc, MSc,
Michael Brittain, BSc, MSc, **Andrew Hince,** BSc, **Michael Clarke,** BSc,
Azad Ghuran, PhD, MRCP, **Mrinal Saha,** MRCP, and **David Hildick-Smith,** MD, FRCP



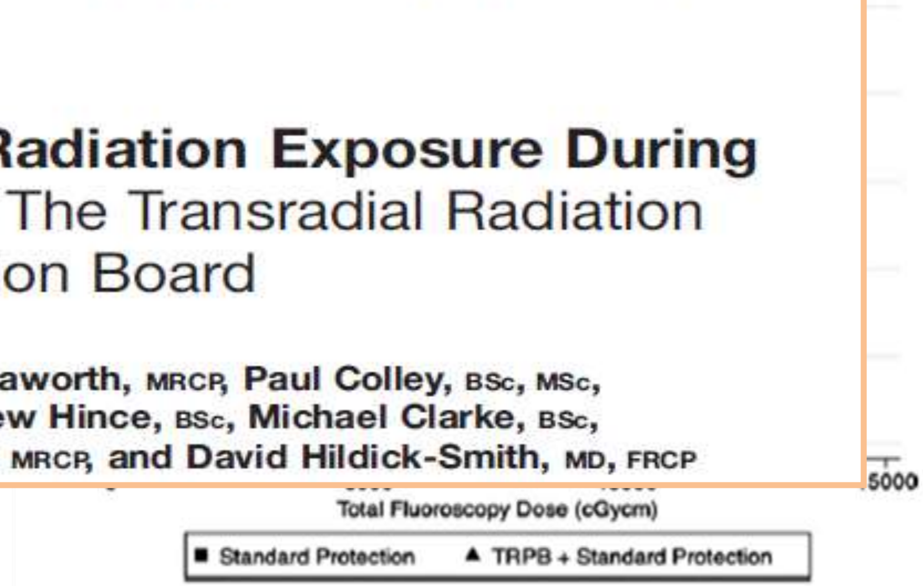


Fig. 3. The effect of the transradial protection board on operator radiation exposure. Linear regression model demonstrates the estimated effect of the TRPB on operator radiation exposure after adjusting for total fluoroscopy dose.

EURO PCR 2014년

Result

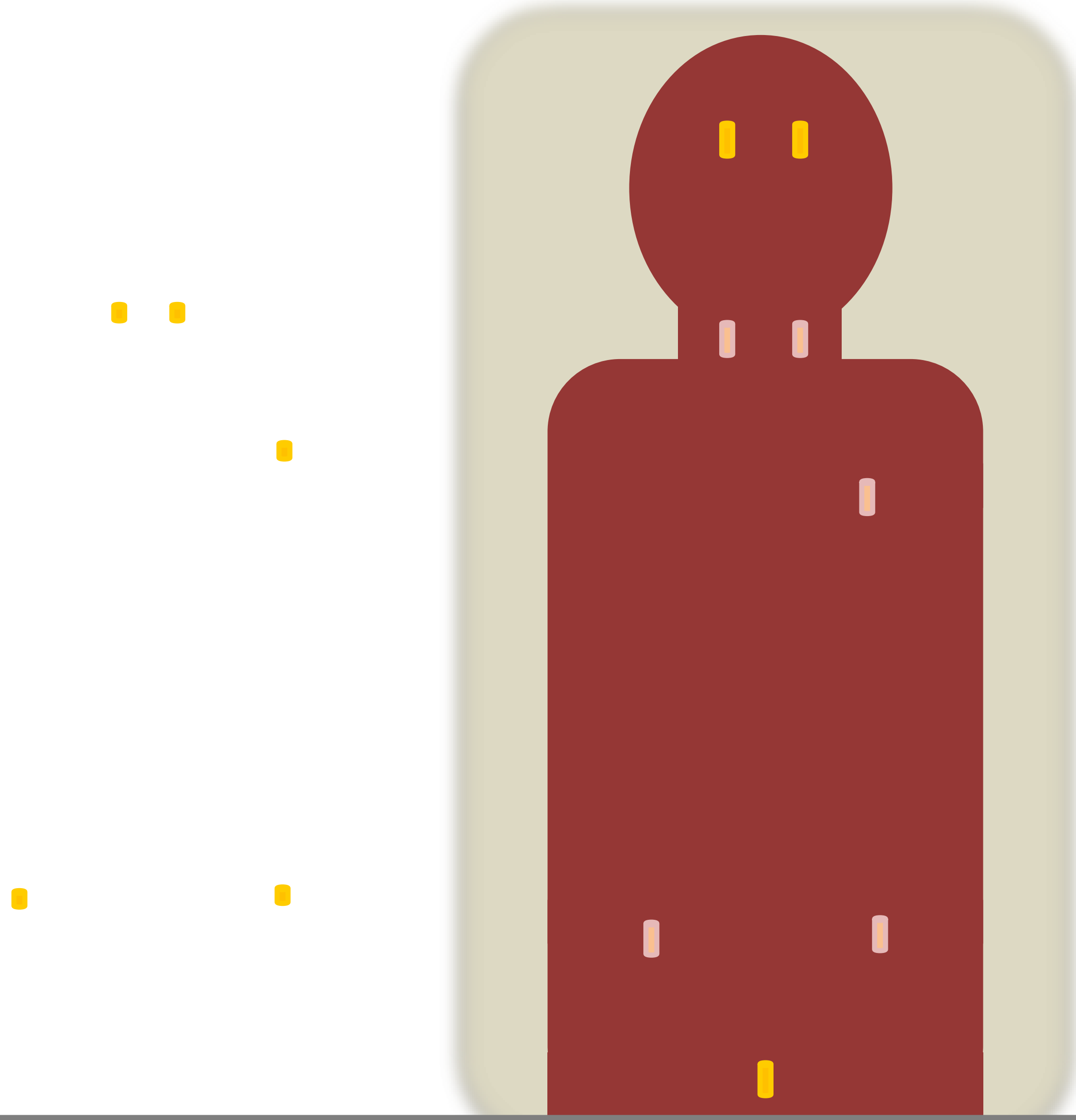
Exposure protocol

A median value of the fluoro time was obtained 180 seconds targeting from patients with 654 people

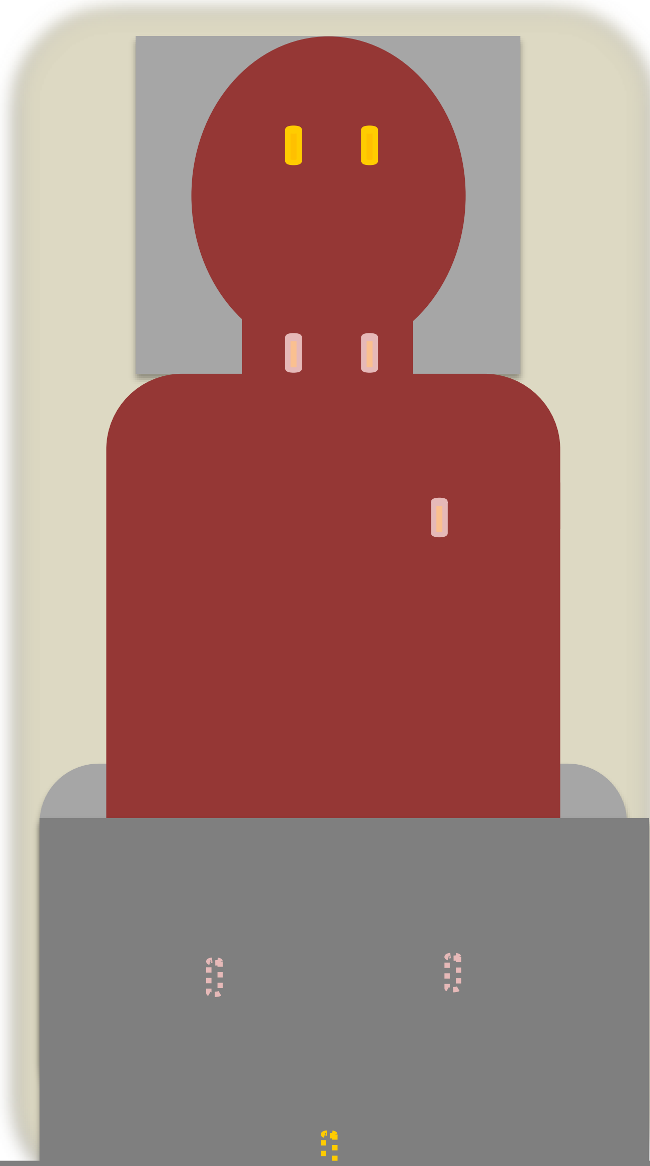
Result

Exposure protocol

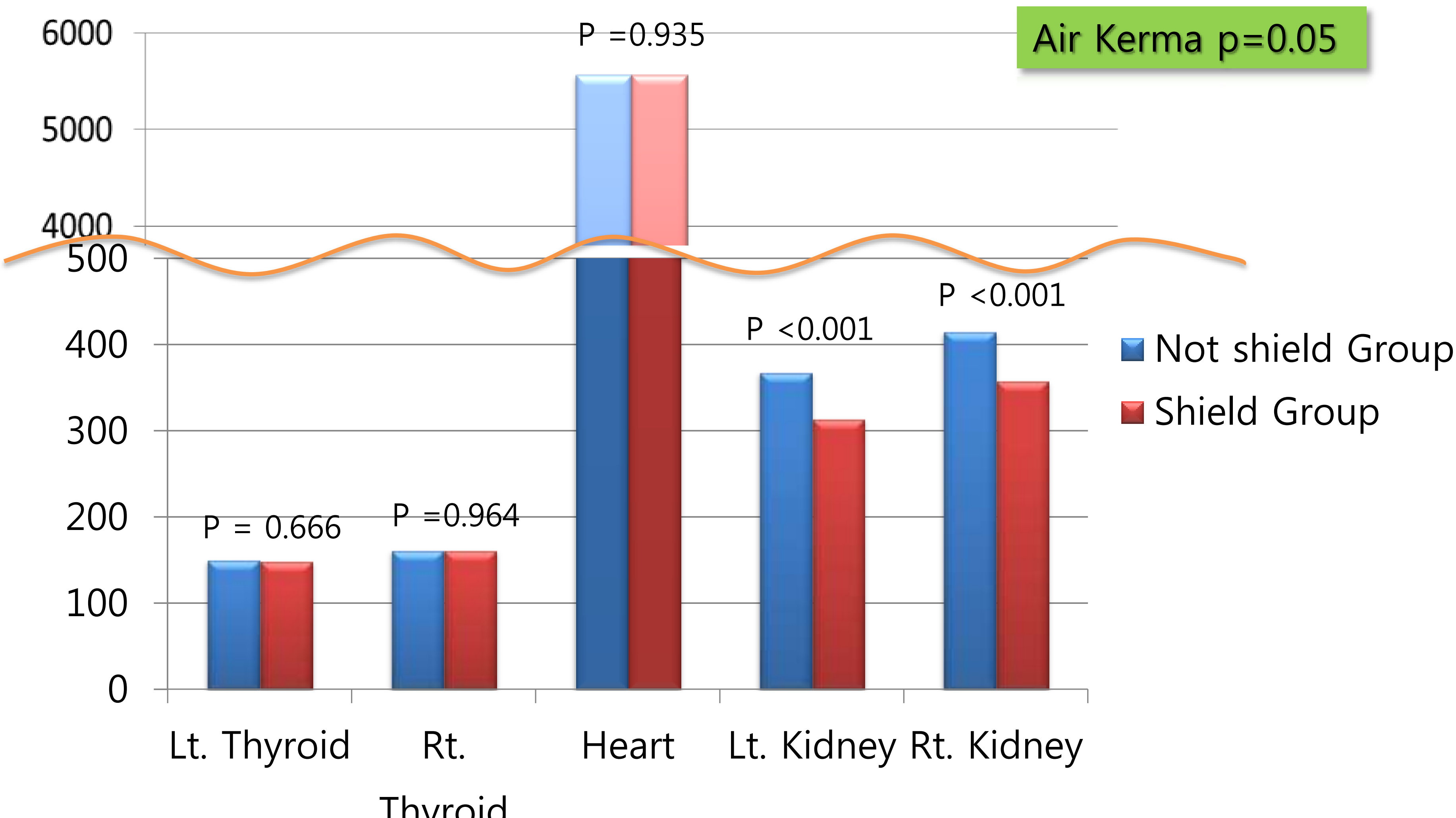
	Coronary	Angle	Time	SID
Fluoroscopy		LAO 40^0	180sec	100Cm
Cine Angiography	RCA	LAO 40^0 Cranial 10^0	5sec	100Cm
		RAO 30^0 Cranial 10^0	4sec	100Cm
	LCA	RAO 30^0 Cranial 20^0	5sec	100Cm
		RAO 30^0 Caudal 20^0	5sec	100Cm
		LAO 10^0 Cranial 40^0	6sec	110Cm
		LAO 45^0 Caudal 25^0	4sec	105Cm



Methods



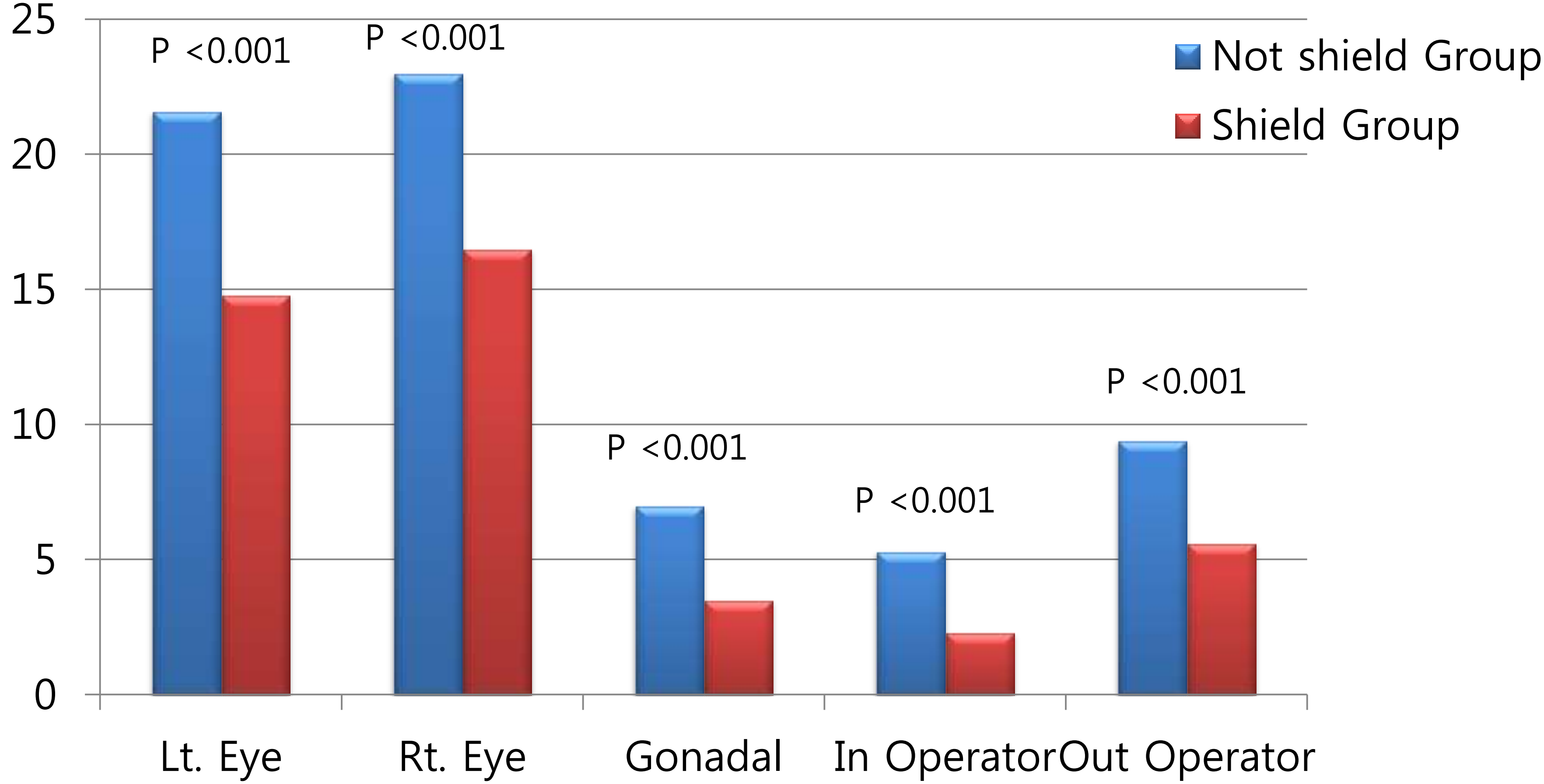
Result



Air Kerma p=0.05
6000
5000
4000
500
400
300
200
100
0
P = 0.666
P =0.964
P =0.935
P <0.001
P <0.001
Not shield Group
Shield Group
Lt. Thyroid
Rt. Thyroid
Heart
Lt. Kidney
Rt. Kidney

Result

Air Kerma p=0.05



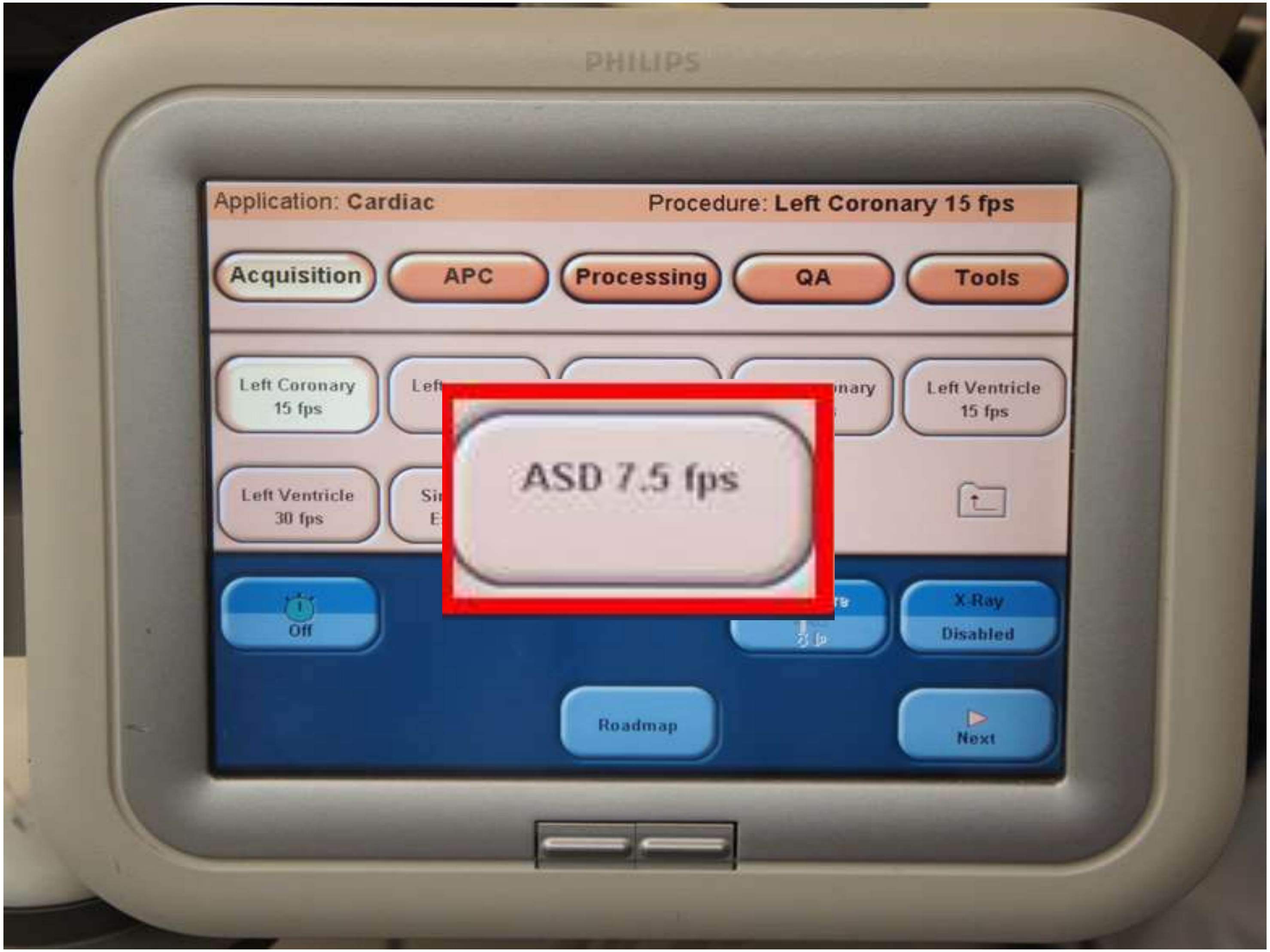
ECR 2017년 (VIEN)

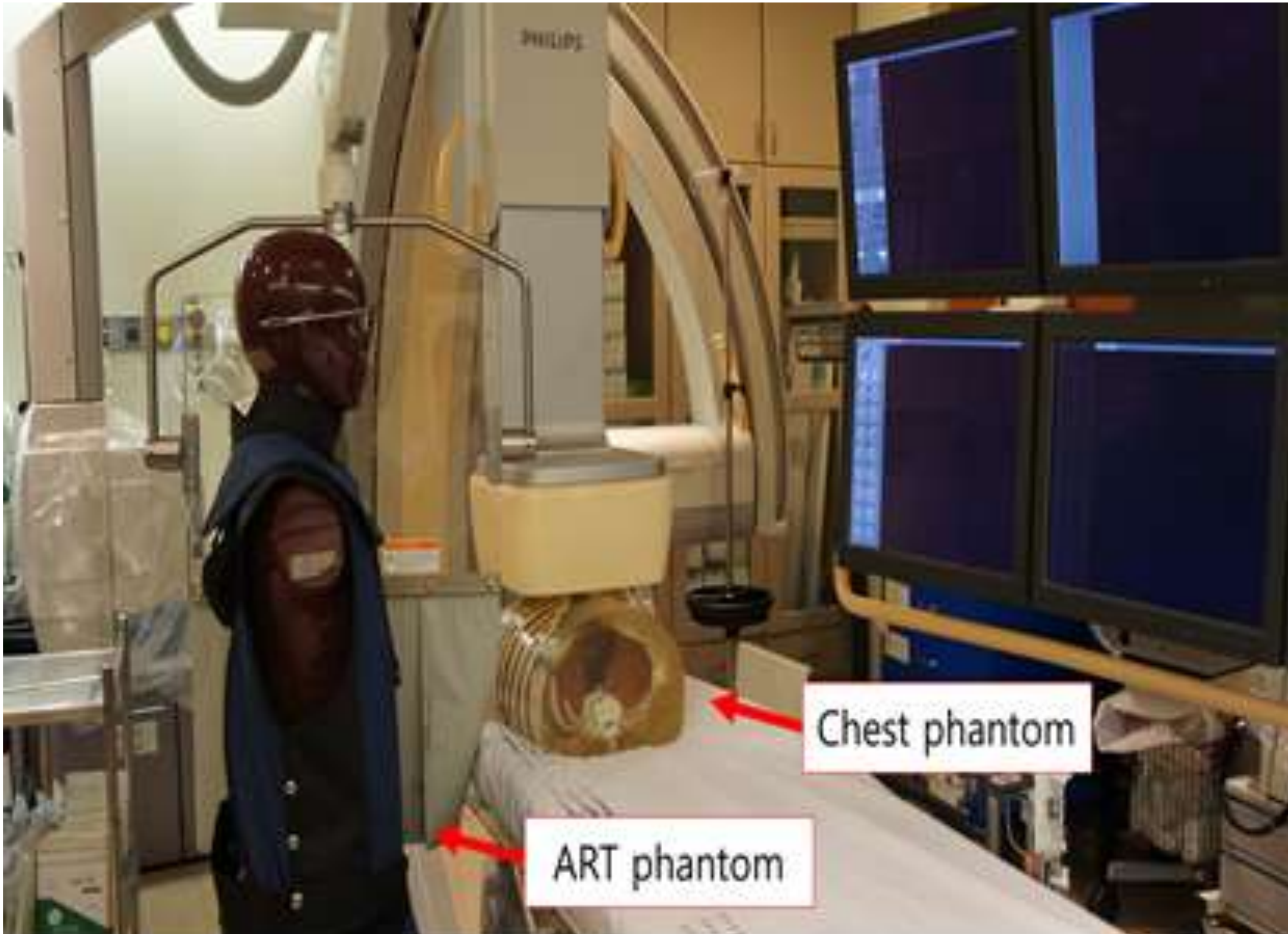
ISRRT Announcements

"Radiographer of the Year 2016"

The ISRRT and Philips are delighted to announce that the winner of DoseWise Radiography of the Year 2016 is Mr.IM Seyoung

who is currently a Radiological Technologist at the Samsung Medical Center in Seoul, South Korea.


PHILIPS
Application: Cardiac
Procedure: Left Coronary 15 fps
Acquisition
APC
Processing
QA
Tools
Left Coronary
15 fps
Left Ventricle
15 fps
Left Ventricle
30 fps
ASD 7.5 fps
Off
X-Ray
Disabled
Roadmap
Next


PHILIPS
Chest phantom
ART phantom

Characteristics	7.5 frames/sec (n=40)	15 frames/sec (n=40)	p value
Sex(male)	17 (42.5%)	8 (20%)	0.03*
Age(year)	44.8±12.3	46.5±11.2	0.51
Weight(kg)	63.5±9.1	59.3±10.9	0.06
Height(cm)	164.3±7.7	161.4±7.0	0.08
BSA(m^2)	1.69±0.15	1.62±0.16	0.05

**Chi-square tet for nominal variables*

Characteristics	7.5 frames/sec (n=40)	15 frames/sec (n=40)	p value
Qp/Qs	2.72±0.9	2.58±0.7	0.44
Device (㎜)	17.7±5.5	18.6±5.2	0.46
‡ICE guided	38명 (95%)	38명 (95%)	1.0*
Balloon assist	1명 (2.5%)	2명 (5%)	1.0*

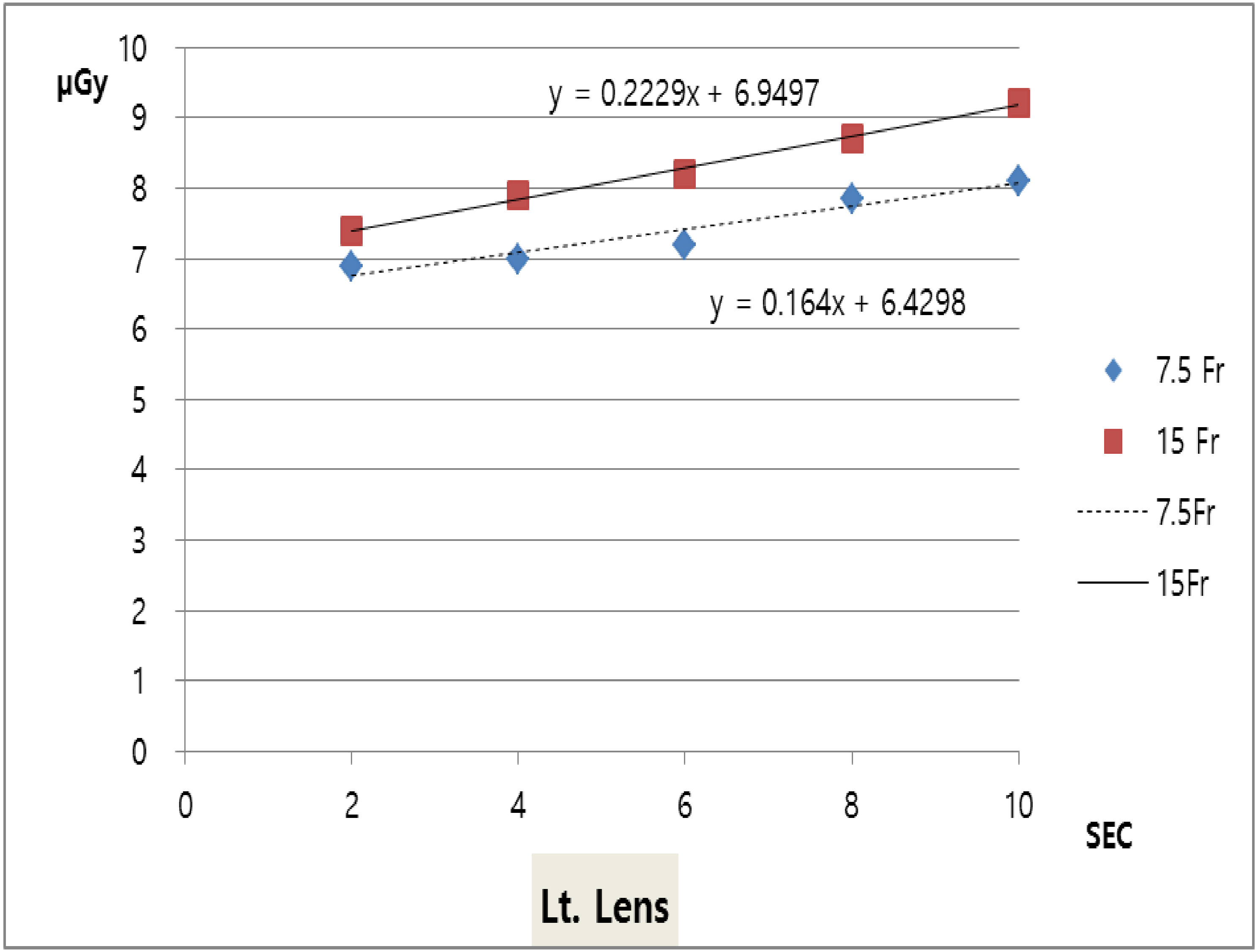
‡ICE : Intra cardiac echography
**Fisher's exact test*

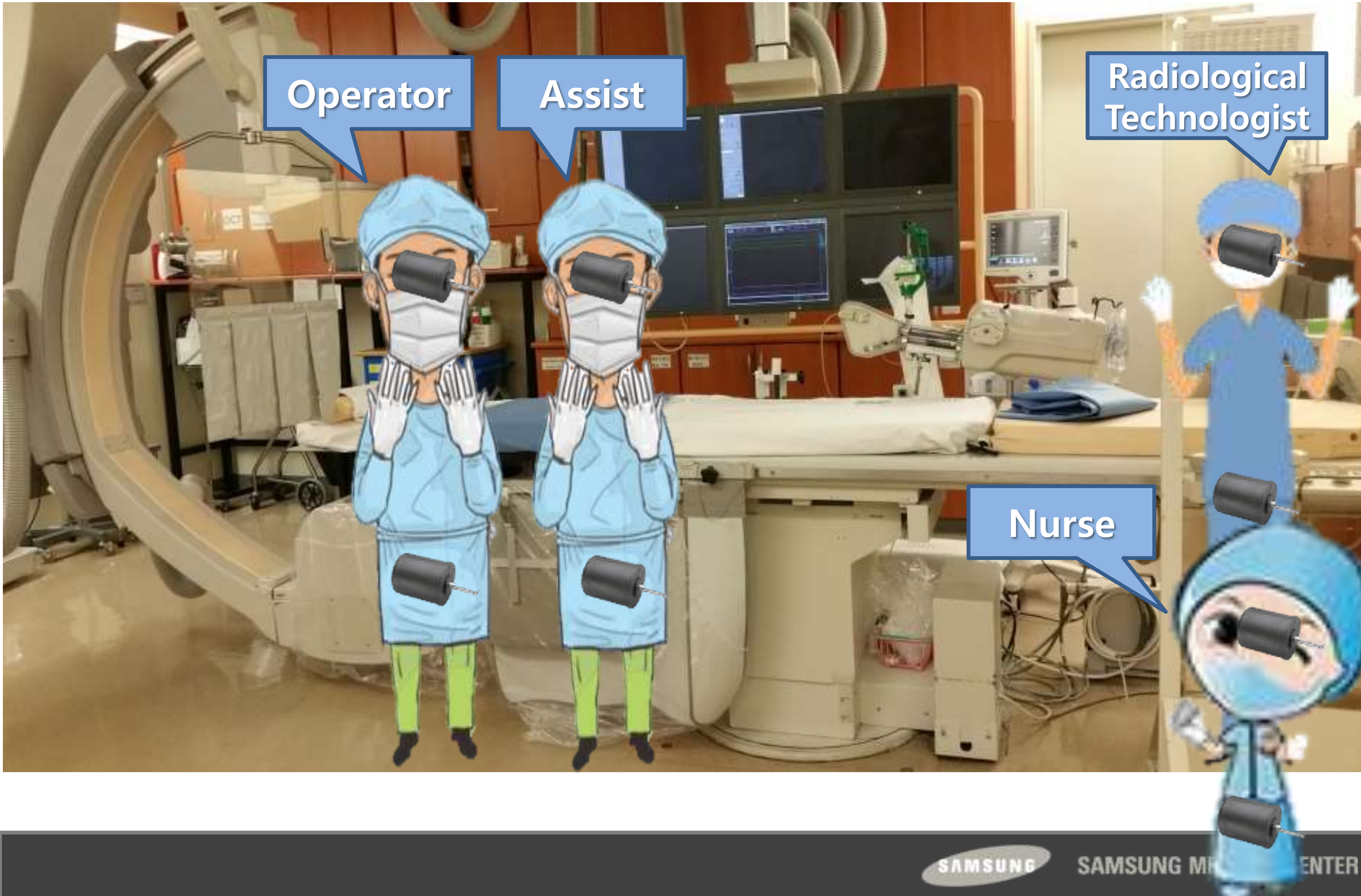
Variable	7.5 frames/sec (n=40)	15 frames/sec (n=40)	p value
Fluoro time (sec)	557.4±231.7	607.7±170.8	0.27
Cumulative fluoro DAP (mGy㎠)	7757.3±2802.4	7579.8±2874.9	0.78
Cumulative cinefluoroscopy DAP (mGy㎠)	1428.7±896.45	4518.5±4173.4	0.000
Total DAP(mGy㎠)	9186.0±3097.4	12098.32±4843.1	0.000
Total number of acquired images	52.2±24.5	161.2±124.8	0.000
Exposure time (sec)	6.9±3.3	10.7±8.3	0.08

단위 : μGy

sec	frames/sec	Lt. Lens	Rt. Lens	Lt. Thyroid	Rt. Thyroid	Chest	p value
2	7.5	6.75 ± 1.138	6.50 ± 0.904	6.25 ± 0.452	6.25 ± 0.866	6.00 ± 0.738	0.264
	15	7.50 ± 0.522	6.50 ± 0.522	6.50 ± 0.522	6.66 ± 0.492	6.25 ± 1.356	0.002
4	7.5	7.00 ± 1.044	6.75 ± 0.452	6.16 ± 0.577	6.25 ± 0.621	6.25 ± 0.753	0.020
	15	7.91 ± 0.668	7.75 ± 0.452	6.91 ± 0.288	6.75 ± 0.452	6.50 ± 0.522	0.000
6	7.5	7.25 ± 1.544	7.00 ± 0.738	6.25 ± 0.452	6.25 ± 0.866	6.33 ± 0.492	0.018
	15	8.25 ± 0.452	8.25 ± 1.138	7.33 ± 0.492	7.08 ± 0.514	6.75 ± 0.452	0.000
8	7.5	7.75 ± 0.452	7.33 ± 0.492	6.75 ± 0.452	6.50 ± 0.674	6.75 ± 0.621	0.000
	15	8.75 ± 1.138	8.25 ± 0.866	7.33 ± 0.651	7.08 ± 0.514	7.08 ± 0.668	0.000
10	7.5	8.16 ± 0.452	7.66 ± 0.651	6.50 ± 1.167	6.50 ± 0.522	6.58 ± 0.514	0.000
	15	9.00 ± 0.738	8.75 ± 0.866	7.25 ± 0.452	7.25 ± 0.452	6.83 ± 0.389	0.000

Data was analysed by ANOVA. Scheffe multiple comparision test.


μGy
10
9
8
7
6
5
4
3
2
1
0
y = 0.2229x + 6.9497
y = 0.164x + 6.4298
0
2
4
6
8
10
SEC
7.5 Fr
15 Fr
7.5Fr
15Fr
Lt. Lens


Operator
Assist
Radiological Technologist
Nurse

	operator				assist				radiological technologist				nurse			
	AK	DAP	mR/min	mGy	AK	DAP	mR/min	mGy	AK	DAP	mR/min	mGy	AK	DAP	mR/min	mGy
100Cm	37	6120	15.55	**0.135**	37	6110	2.95	**0.025**	37	6121	0.365	**0.003**	37	6114	0.305	**0.002**

	AK	DAP	mR/min	mGy	AK	DAP	mR/min	mGy	AK	DAP	mR/min	mGy	AK	DAP	mR/min	mGy
165Cm	37	6109	4.03	**0.035**	37	6107	2.73	**0.023**	38	6101	0.528	**0.004**	37	6091	0.375	**0.003**

Thank you for your attention!