Safety considerations in fluoroscopy room for endoscopists

Dr Javad Shokri

Babol University of Medical Sciences.

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Fluoroscopy is an integral part of ERCP , endoluminal stent placement ,EUS-ERCP combination therapeutic interventions and some dilation procedure.

Fluoroscopy places patients, endoscopists and endoscopy personal at risk for radiation-induced deterministic and stochastic side effects.

ERCP prevalence : No data from Iran

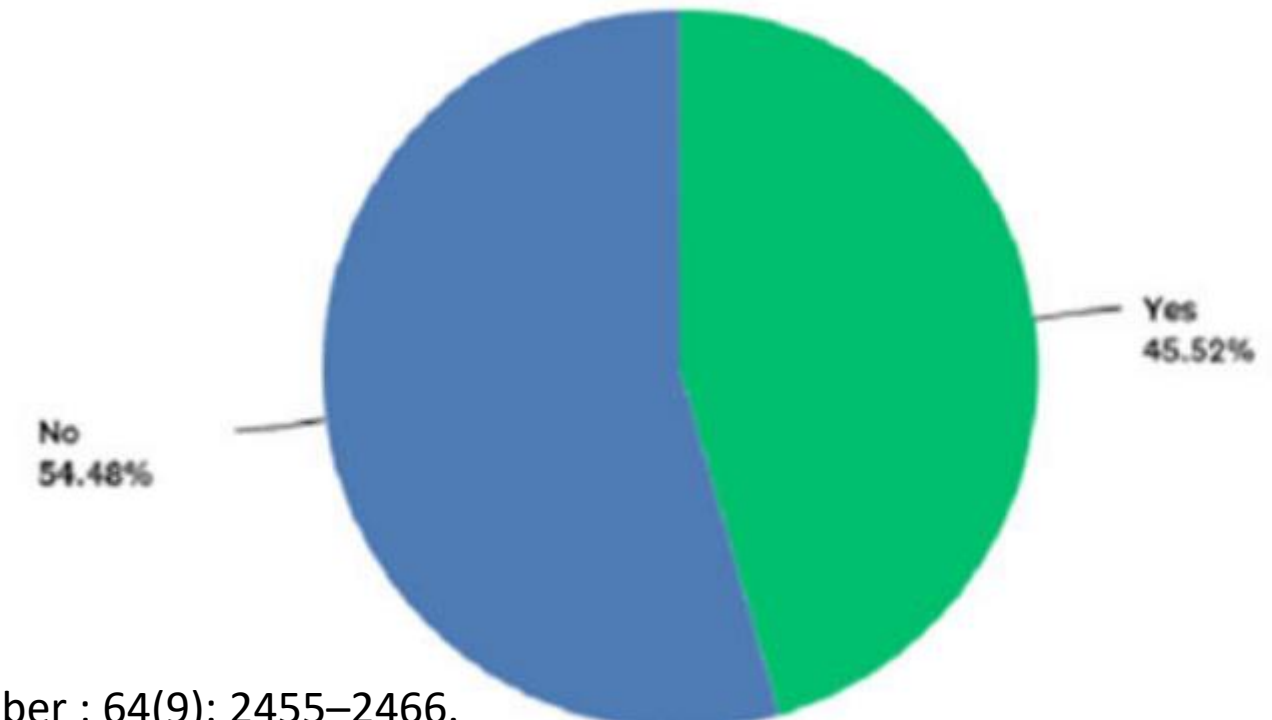
- Largest study from USA showed it is done in 160000 cases annually

- In our center(Rohani Hospital of Babol) 1325 patients underwent ERCP procedure last year
- It is estimated 30000-40000 ERCP is done yearly in Iran

Need for radiation safety education for gastroenterologists

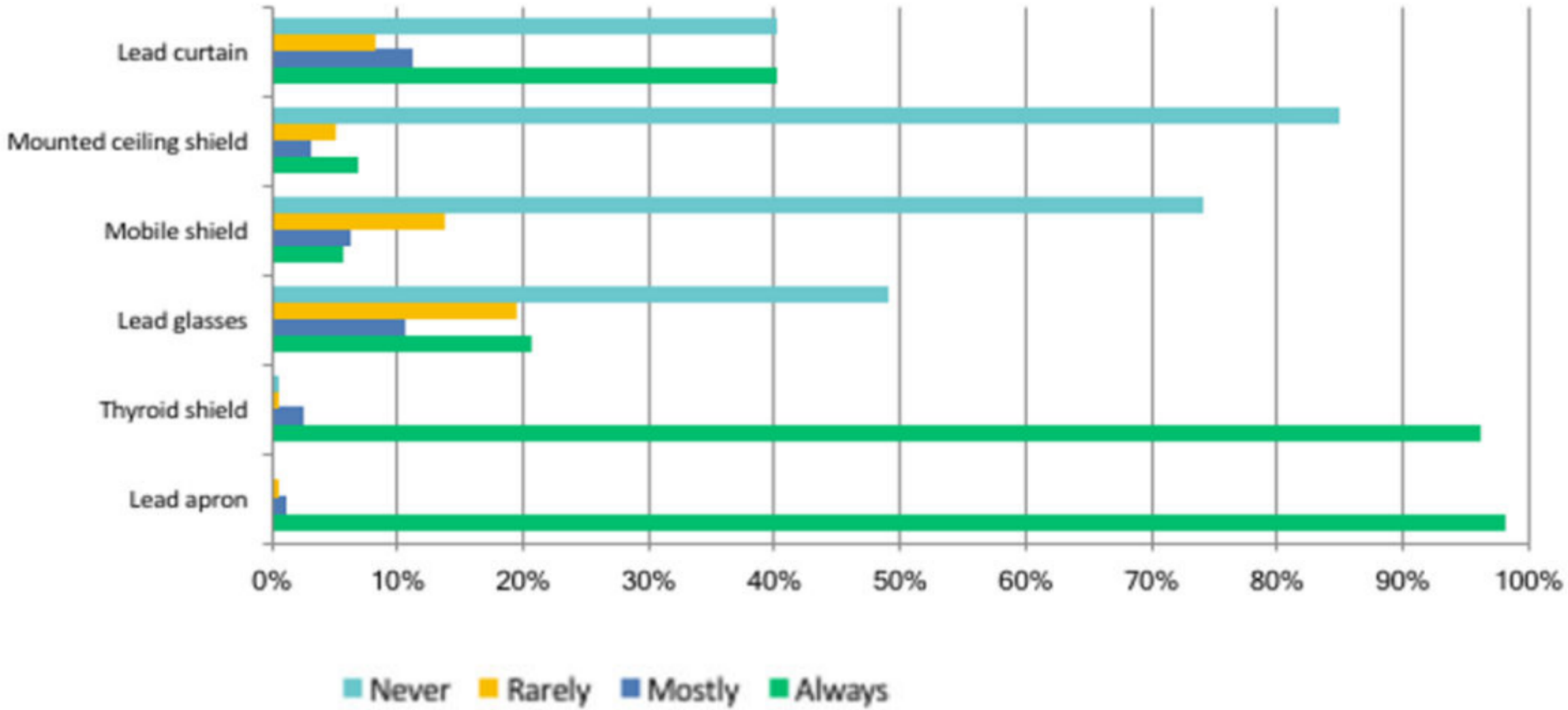
- Most gastroenterologists performing ERCP have not received formal training in operating their fluoroscopy system or in minimizing radiation exposure to themselves and to their personal and patients.
- training about fluoroscopy system and how to minimize radiation exposure should be included in all therapeutic endoscopy training programs
- there is no formal curriculum, and radiation protection is not typically emphasized during GI fellowship training.

A. Have you received any formal education/training from your hospital regarding operating your fluoroscopy machine?



Dig Dis Sci. 2019 September ; 64(9): 2455–2466.

A. How often do you use the following protective equipment?



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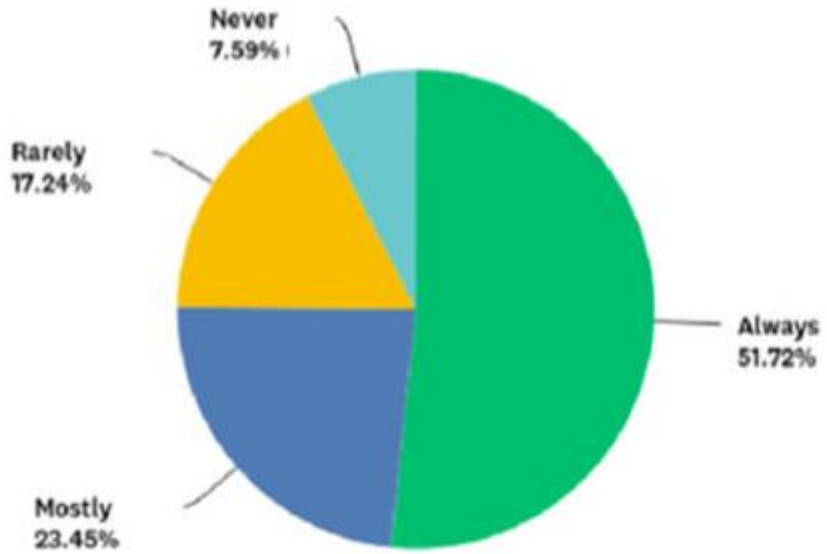
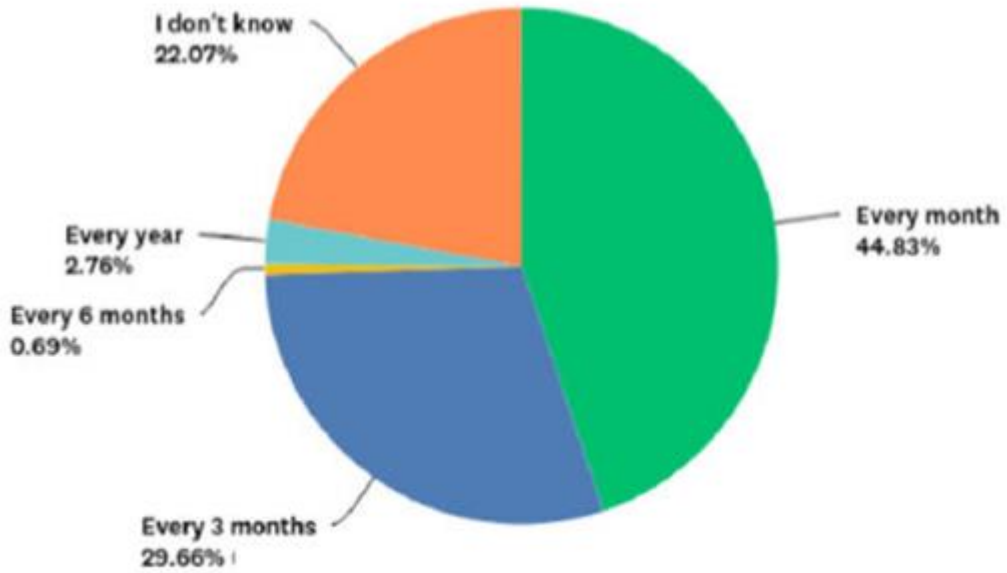
B. How often do you wear a radiation badge (dosimeter) during ERCP?



C. How often is the radiation badge (dosimeter) checked for radiation exposure at your center?



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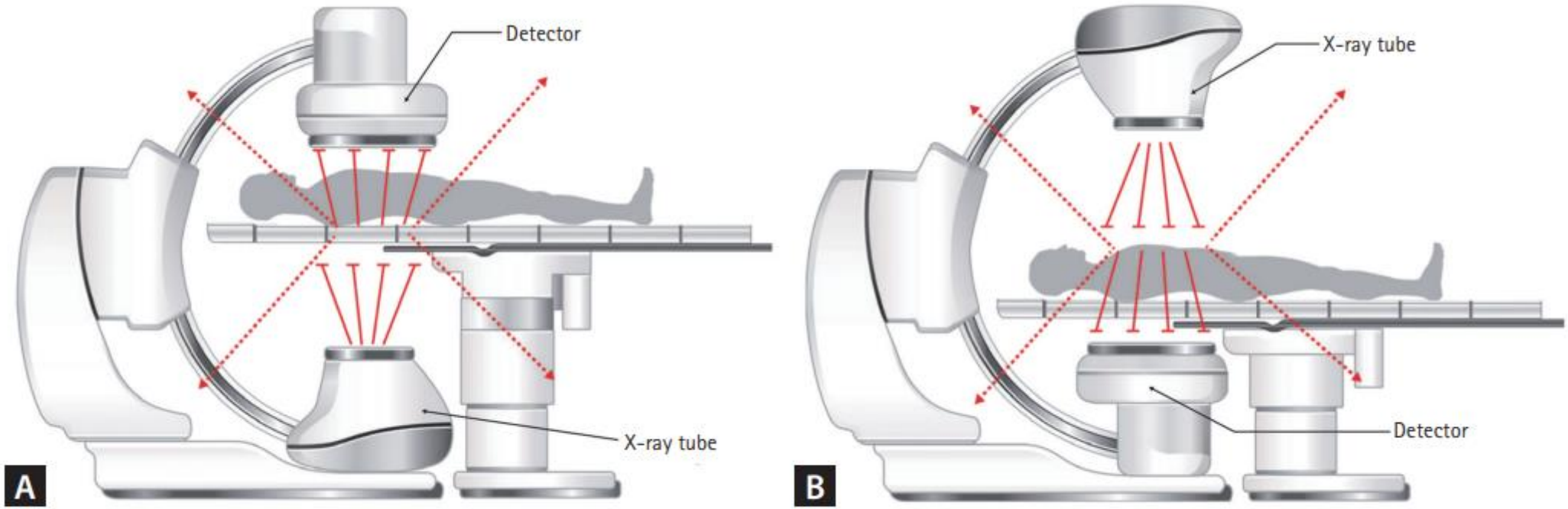
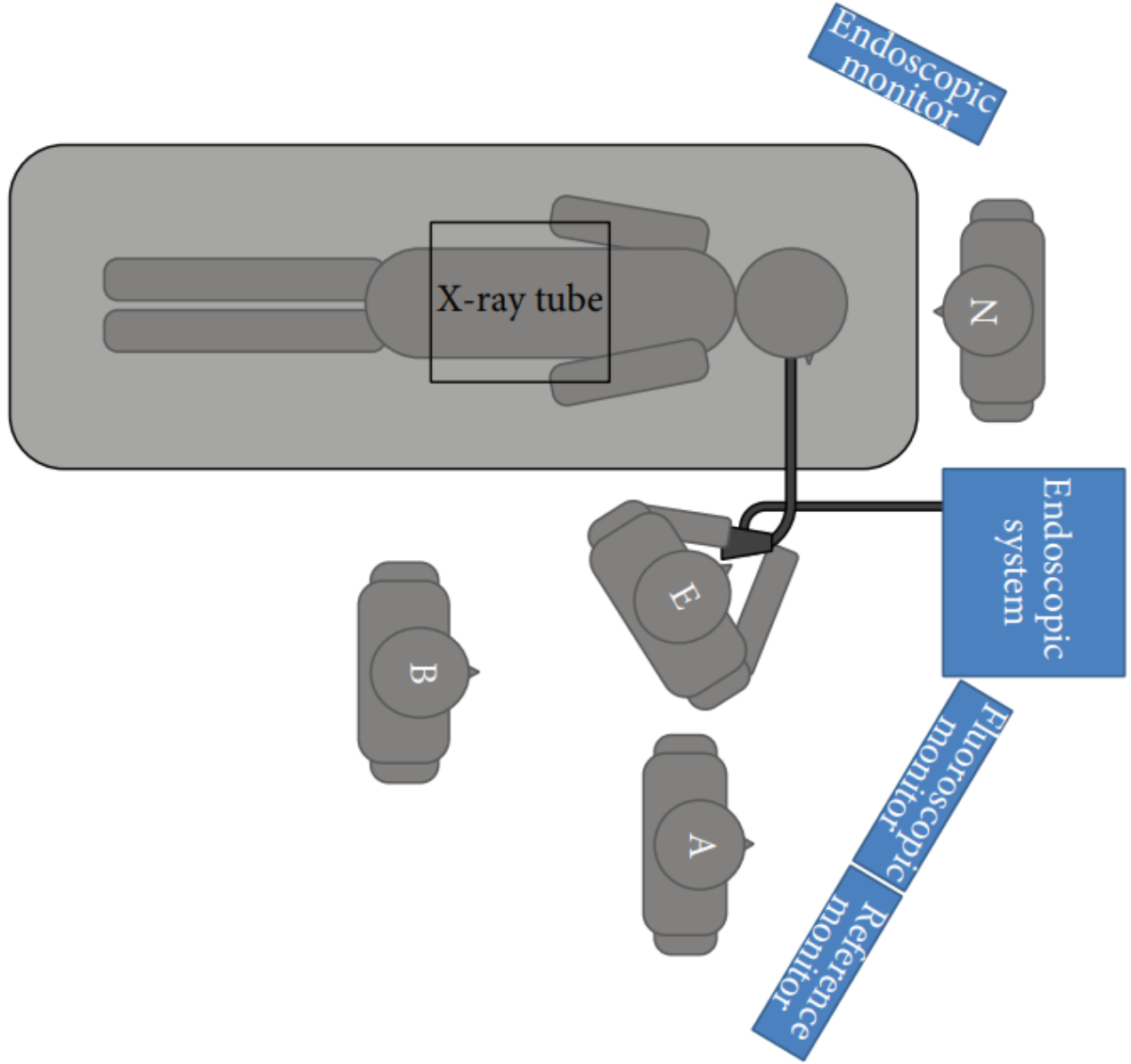


Figure 1. Stationary fluoroscopy systems. (A) Under-couch system. (B) Over-couch system.



E: endoscopist
A: 1st assistant
B: 2nd assistant
N: nurse

Fluoroscopy and radiography create ionizing radiation that can lead to chemical and biological damage to patients and exposed personnel. The biological damage is divided into :

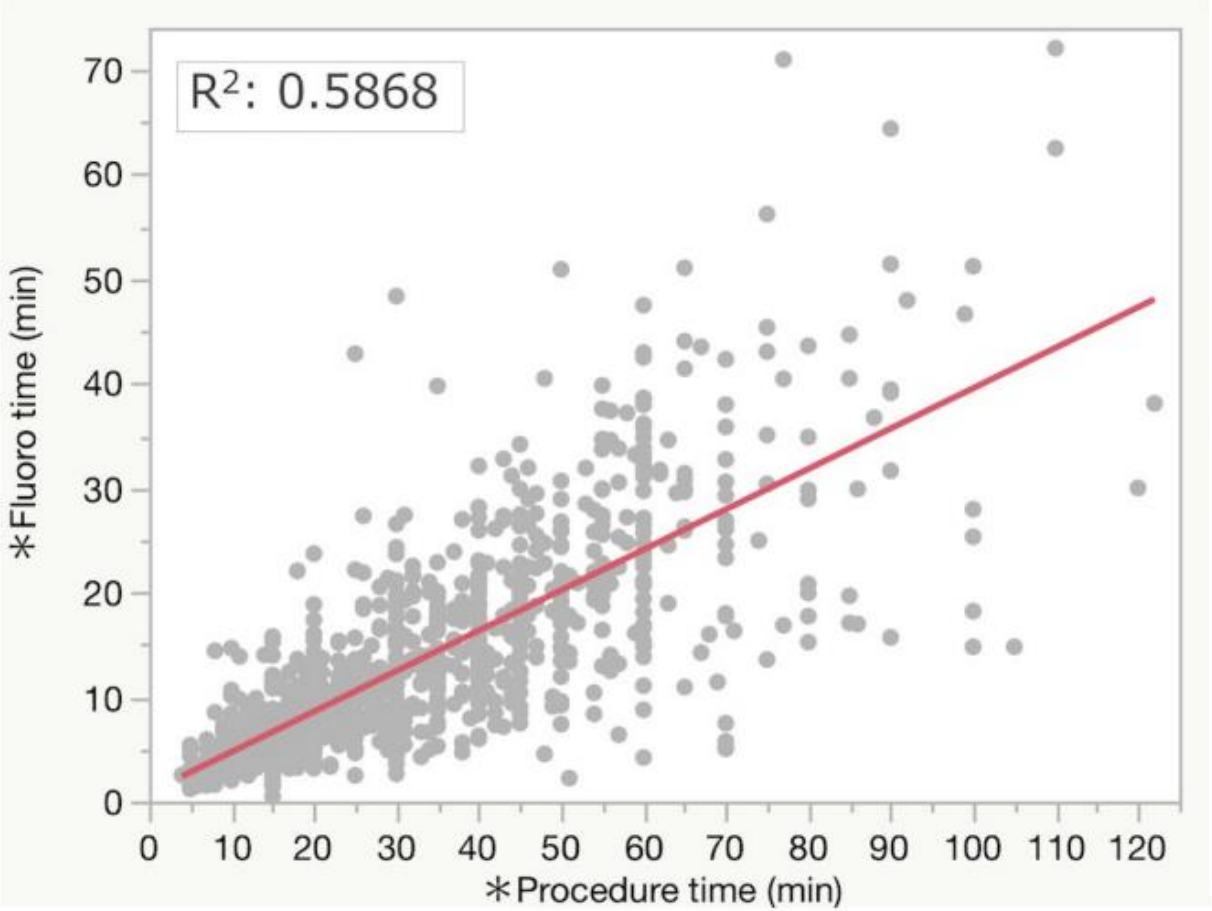
stochastic effect (i.e., assumed to have no dose threshold)

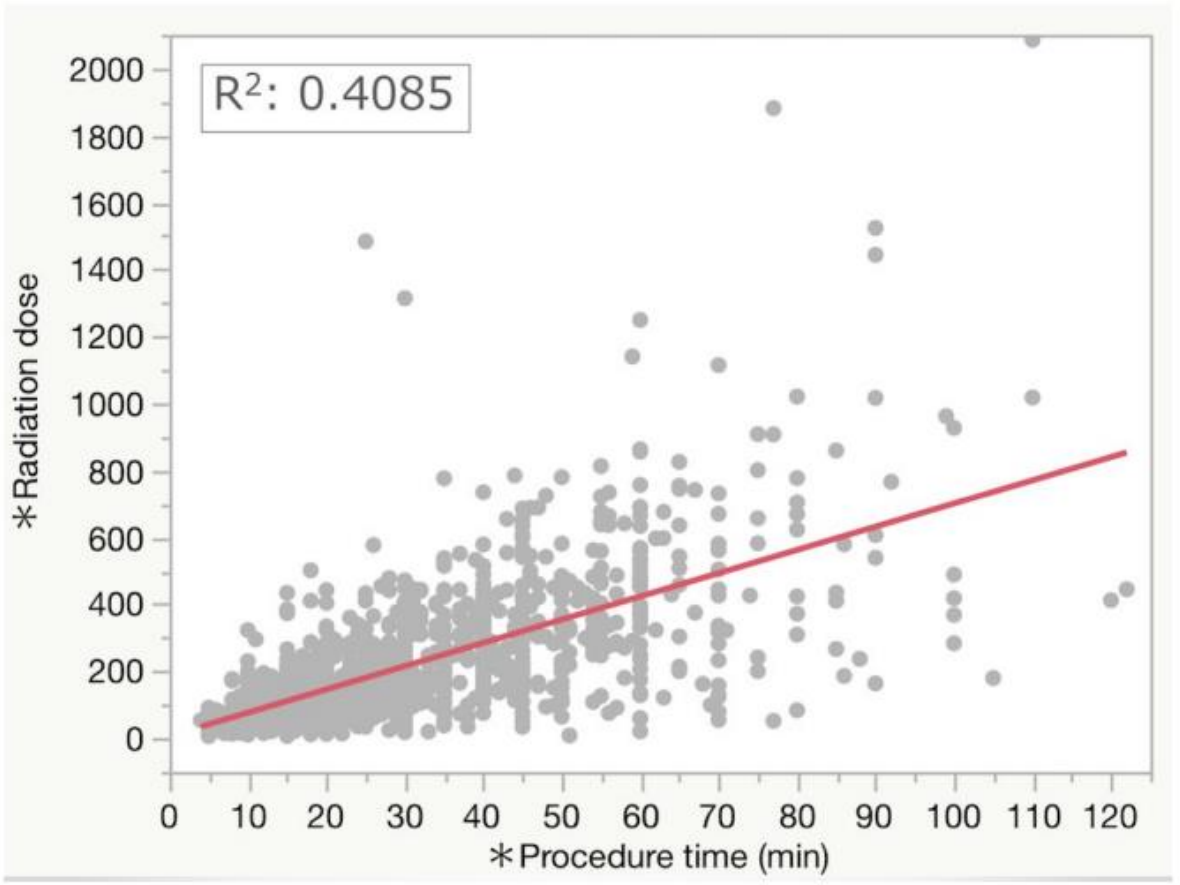
nonstochastic effect (somatic effect related to absorbed dose), depending on the dose of radiation.

The three principles of radiation protection are

- distance
- time
- shielding

Procedure time and fluoroscopy time





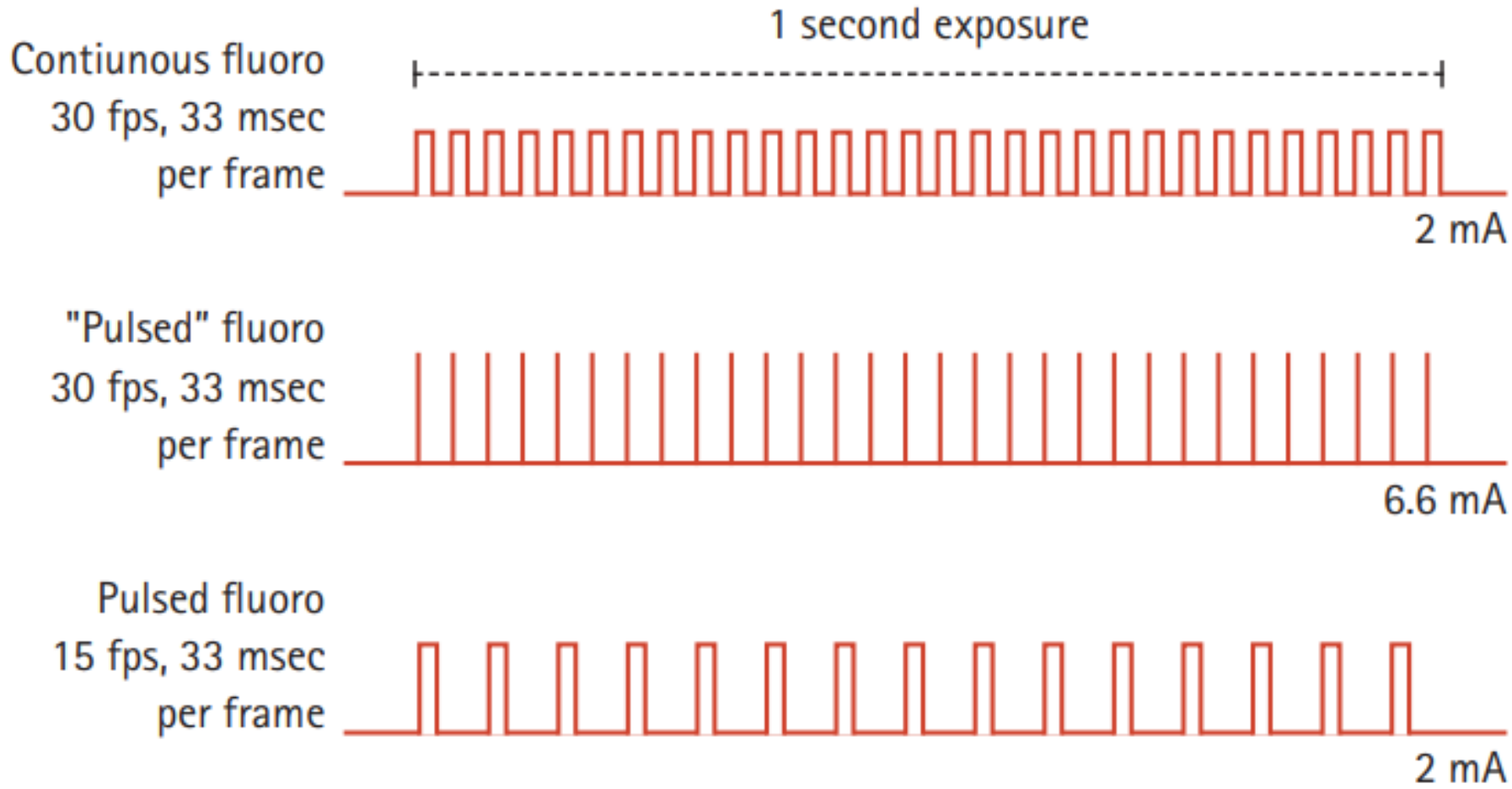
Radiation exposure dose during ERCP ; PLoS ONE 13(11): 2018 e0207539.


ARTIS pheno





X-ray fluoroscopy generator and protective lead shield. (a) Without protective lead shield. (b) With protective lead shield.



Continuous and pulsed fluoroscopy modes


A
B
C



Occupational radiation dose to medical staff members (μSv).

	Protective curtains (−)	Protective curtains (+)	*P* value
Endoscopist	340.9 ± 313.9	42.6 ± 54.7	<0.001
1st assistant	27.5 ± 48.5	4.2 ± 5.4	<0.001
2nd assistant	45.3 ± 81.3	13.1 ± 19.9	<0.001
Nurse	33.1 ± 43.7	10.6 ± 15.4	0.001

Values are presented as mean ± standard deviation.

Gastroenterology Research and Practice Volume 2014, Article ID 926876, 5 pages

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radiation dose to endoscopists was approximately ten times greater than that to any other member of the medical staff, which indicates that radiation is a much more substantial issue for endoscopists.

endoscopy and fluoroscopy screens next to each other was associated with a significantly lesser FT than when the screens were separated further (–1.4 min, $P = 0.026$).

A simple ergonomic measure … Endoscopy International Open 2017; 05: E172–E178

ERCP suite with endoscopy/fluoroscopy screens away and near




1,080 × 675

Factors affecting radiation dose: Multiple linear regression analysis

Variable	T value	P value
Age	0.3	0.7
Female	-1.8	0.08
Distal MBO*	-2.1	0.04
Proximal MBO	3.9	0.0001
CBDS†	0.5	0.6
Native papilla	-0.3	0.80
HVE‡	-1.2	0.3
NS1§	-7.2	<0.0001

MBO: Malignant biliary obstruction † CBDS: Common bile duct stones ‡ HVE: High-volume endoscopist
§ NS1: New Stage 1 (a novel processing engine of the 'EXAVISTA' fluoroscope unit)

Variable	No. of ERCPs (%)	Mean FT ± SD (min.)	*P* value
Fellow involved			
▪ Yes	172 (57.5)	7.26 ± 6.67	0.046
▪ No	127 (42.5)	5.92 ± 4.10	
Patient position			
▪ Left semi-prone	285 (95.3)	6.66 ± 5.75	0.749
▪ Left lateral decubitus	14 (4.7)	7.17 ± 6.02	
Instruments used			
▪ Balloon (extraction)			
– Yes	182 (60.9)	6.93 ± 5.80	0.369
– No	117 (39.1)	6.23 ± 5.67	
▪ Basket			
– Yes	33 (11)	12.56 ± 7.92	<0.001
– No	266 (89)	5.92 ± 4.98	
▪ Stone-crusher			
– Yes	19 (6.4)	14.97 ± 9.88	<0.001
– No	280 (93.6)	6.09 ± 4.90	
▪ Dilator (balloon/rigid)			
– Yes	28 (9.4)	10.26 ± 5.92	<0.001
– No	271 (90.6)	6.32 ± 5.62	
Sphincterotomies			
▪ Yes	167 (55.9)	6.09 ± 4.39	0.042
▪ No	132 (44.1)	7.45 ± 7.06	

ERCP without fluoroscopy ???

The cannulation rates in the no fluoroscopy (96.35%) and ERCP (100%) groups were similar ($P = .243$).
the stone clearance rate in the without F group (85.5%) vs the ERCP group (100%) ($P = .002$).

randomized trial of EUS-assisted ERCP without fluoroscopy versus ERCP in common bile duct stones

Gastrointestinal Endoscopy
Volume 86, Issue 6, December 2017, Pages 1059-1065

ERCP without fluoroscopy ???

The stone clearance rate based on the number of stones matched the number by EUS was correct in 94%. More than 2 stones may increase the failure rate in without fluroscopy.
The adverse event rates and the total procedure times were not different between the groups.

Gastrointestinal Endoscopy
Volume 86, Issue 6, December 2017, Pages 1059-1065

Occupational radiation dose to each medical staff member with or without patient movement (without the use of protective curtains) (μSv).

	Patient movement (−)	Patient movement (+)	P value
Endoscopist	332.3 ± 336.0	375.3 ± 217.3	0.367
1st assistant	27.1 ± 52.4	29.0 ± 31.0	0.046
2nd assistant	16.2 ± 15.6	161.4 ± 128.4	<0.01
Nurse	25.5 ± 34.2	63.5 ± 64.5	0.013

Values are presented as mean ± standard deviation.

Table 4: Occupational radiation dose to each medical staff member with or without patient movement (with the use of protective curtains) (μSv).

	Patient movement (−)	Patient movement (+)	P value
Endoscopist	27.1 ± 21.3	78.7 ± 86.4	<0.01
1st assistant	3.1 ± 4.4	6.8 ± 6.7	0.044
2nd assistant	3.4 ± 2.9	35.7 ± 24.1	<0.01
Nurse	6.2 ± 6.0	20.8 ± 24.2	0.033

Values are presented as mean ± standard deviation.

Gastroenterology Research and Practice Volume 2014, Article ID 926876, 5 pages

Other significant factors associated with a prolonged FT included having a prior ERCP (+1.4 min, $P = 0.031$),

more difficult procedures (+4.2 min for each level of difficulty, $P < 0.001$).

ERCPs performed by high-volume endoscopists used lesser FT vs. low-volume endoscopists (–1.82, $P = 0.015$).

Endoscopy International Open 2017; 05: E172–E178

In a prospective study, the ocular lens equivalent doses of ERCP personnel were reduced by 37.5% and 59.0%, respectively, by changing the patient position from LLD to prone.

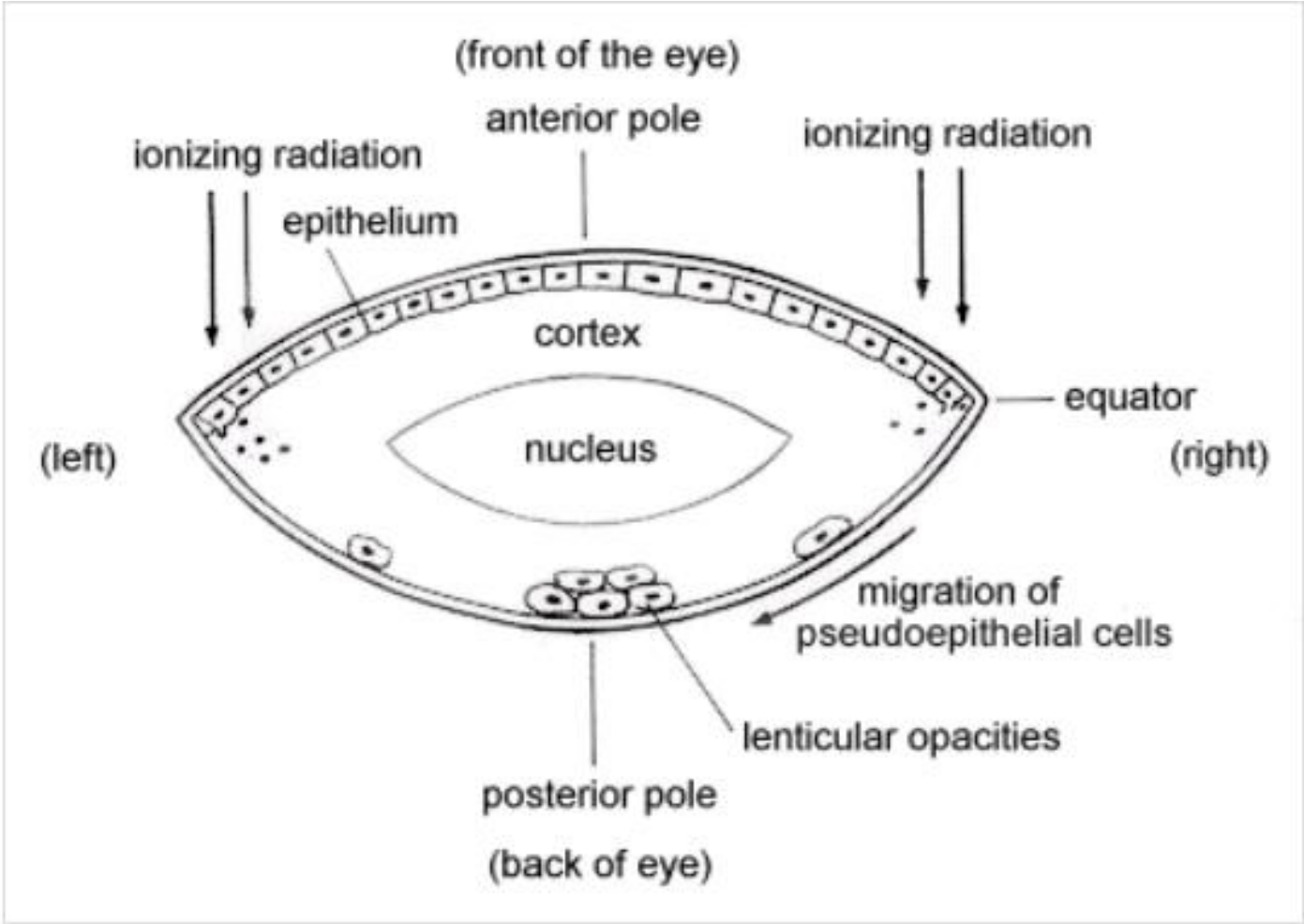
Endosc Int Open 2018;6:E969-E974.

Recommendations to reduce the radiation exposure of patients nurses and endoscopists during ERCP

Sielding	1	Be sure to wear thyroid shields, led glasses, and lead aprons.
	2	Use radiation shield protectors (lower protector, sealing type protector, mobile shield protector, etc.) protect from scattered radiation.
Distance	3	During the procedure, direct the operator as far as possible from the patient to minimize exposure from scattered radiation.
	4	Adjust the equipment, including the table, to position the patient as far as possible from the X-ray generator and as close as possible to the image detector.
Time	5	Try to minimize the fluoroscopy time
Fluoroscopy	6	Use under-couch type fluoroscopic equipment and C-arm type angiography equipment, where the X-ray generator (X-ray tube) is located below.

Recommendations to reduce the radiation exposure of patients nurses and endoscopists during ERCP

	7	Use “pulsed fluoroscope mode.”
	8	Use the “last-image-hold method.”
	9	If possible, do not magnify the image.
	10	Use the “collimator.”
Education	11	Share relevant knowledge with all team members participating in ERCP procedures using systematic education programs on X-ray generation devices, radiation exposure, and management.
Others	12	Measure and manage the radiation dose by wearing a thermology dosimeter.
	13	If the radiation dose is expected to be high, such as in complex procedures or procedures for obese patients, pay more attention to the management of the radiation dose.



Lens opacity at the posterior subcapsular region caused by radiation

Cataracts induced by **ionizing radiation (e.g., X-rays and gamma rays**) usually are often in the form of a posterior subcapsular cataract

lead glasses will prevent a majority of damaging radiation. Many study: **leaded glasses decreased the radiation dose rate on the eye lens by as much as 5-10 times**.


THANK YOU,,