19. APT Seminar und 3. Theo-Schmidt Symposium

Fallbeispiele bei deterministischen Schäden

R.Loose

Institut für Diagnostische und
Interventionelle Radiologie

PARACELSUS
Medical University Nuernberg

Materialiensammlung

der

Unfälle und Schäden in Röntgenbetrieben

Erstes Heft

Von

Privatdozent Dr. **Franz M. Groedel** (Frankfurt a. M. — Bad Nauheim),
Vorstand der Röntgenabteilung des Hospitals zum heiligen Geist, Frankfurt a. M.
Landesmedizinalrat a. D. Prof. Dr. **Hans Liniger** (Frankfurt a. M.),
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Hamburg
Lucas Gräfe & Sillem
(Edmund Sillem)
1925

Unfälle und Personenschäden in der Radiologie

publiziert 1925

82 Unfälle

21 Unfälle in der Diagnostik

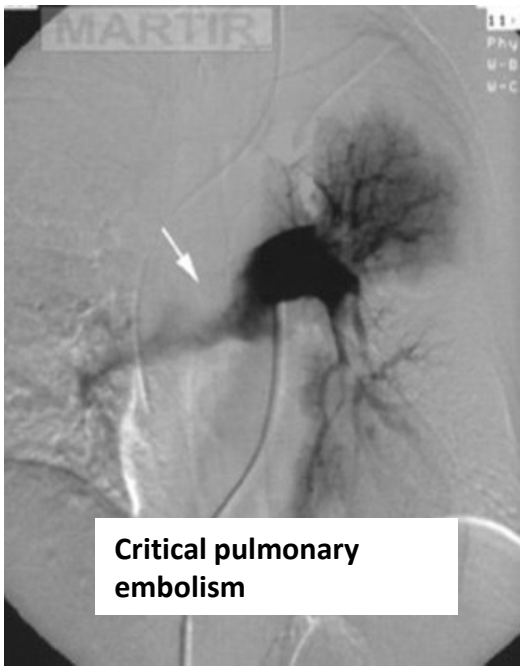
61 Unfälle in der Therapie

Fluoroscopic interventions in radiology and cardiology are the two most frequent procedures involving a significant radiation exposure of patients as well as an occupational exposure of the staff.

Frequency

1. Cardiology
2. Radiology
3. Others

- Vascular surgery
- Gastroenterology
- Urology
- Other applications in operating rooms



Critical pulmonary embolism

Emergency-interventions: The patient does not ask for the dose, but what about the staff?

ICRP BERICHT 85 (2001): Vermeidung von Strahlenschäden bei interventionellen Eingriffen

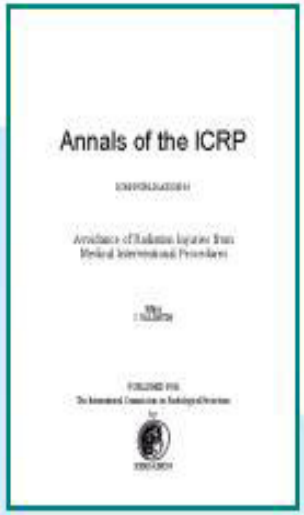
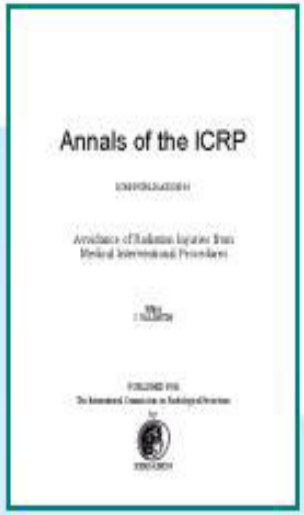


Photo des Rückens eines Patienten 21 Monate nach einer Koronarangiographie und zwei Angioplastien innerhalb von 3 Tagen. Die geschätzte kummulative Dosis betrug etwa 15 - 20 Gy (Photo F. Mettler).

MARTIR

ICRP BERICHT 85 (2001): Vermeidung von Strahlenschäden bei interventionellen Eingriffen



Deutschland 2011:
kardiologischer Herzklappeneingriff
BMI: 42 kg/m^2
Dauer Eingriff 6 Std.
DFP: 607000 cGy*cm^2
ESD: 75 Gy

Table 3. Surface dose in mGy and effective dose in mSv during neurointerventions

Author	Surface dose (mGy)	Effective dose (mSv)
Bergeron (1994)	615 (187 - 1,335)	1.67 (0.44 - 3.44)
Chopp (1980)	159 ± 45	-
Feygelman (1992)	-	16.6
Berthelsen (1991)	660 - 1,400	6 - 43
Huda (1994)	6,600 *	30 *
Habermaas (1995)	-	23.8 (8.5 - 61.2)
Norbash (1996)	1,510 ± 880 960 ± 640 **	-
Theodorakou (2003)	770 (pa) 780 (lat)	
Mooney (2000)	up to 4,000	
Struelens (2005)	up to 5,400	
O'Dea (1999)	up to 5,400	
Marshall (1995)		3.6 (diagn. 4-vessel angiography)

** selected case*

*** with added filtration*

Avoiding Radiation Injuries Informed consent and records

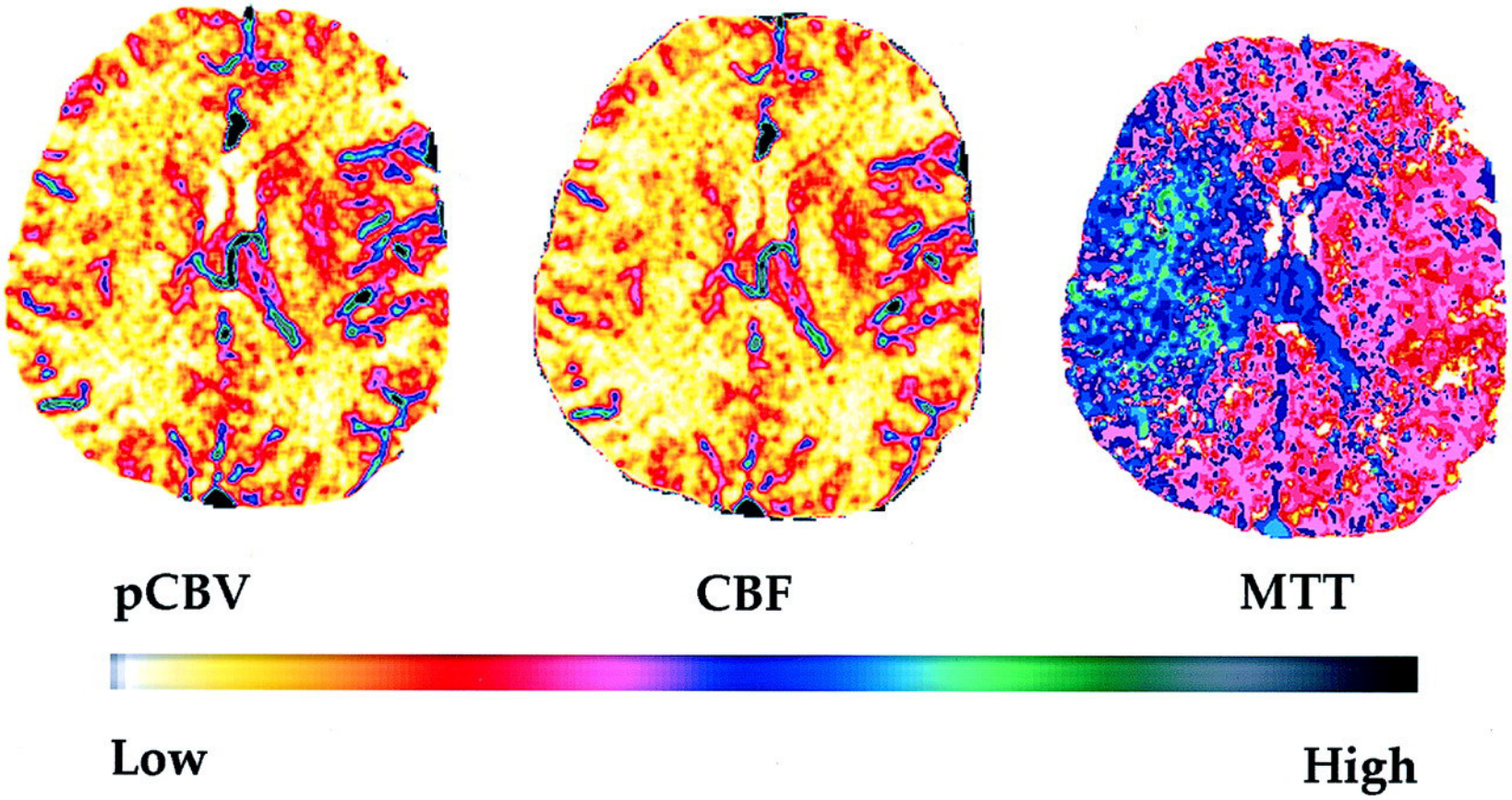
- Patients are entitled to know the risks of radiation injury if likely to be high
- A written record should be kept if skin doses are estimated to be >3 Gy (1 Gy for repeated procedures)
- Not all skin reactions are due to radiation; e.g. contrast medium allergy

Information abstracted from ICRP *Publication 85*
www.icrp.org

Follow-up

- Radiation skin injury may present late and the association not considered if no documentation
- All patients with estimated skin doses of 3 Gy should be followed up 10-14 days after exposure
- A system to identify repeat procedures should be set up

Figure 3. CT Perfusion study.



Richard E. Latchaw et al. Stroke. 2003;34:1084-1104

American Heart Association

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How much radiation dose they received?

- Instead of receiving the expected dose of 0.5 Gy to the head (depend on patient size, age, condition and scanner design, etc.), these patients received 3-4 Gy (approximately eight times) which is in some cases resulted in hair loss and erythema.

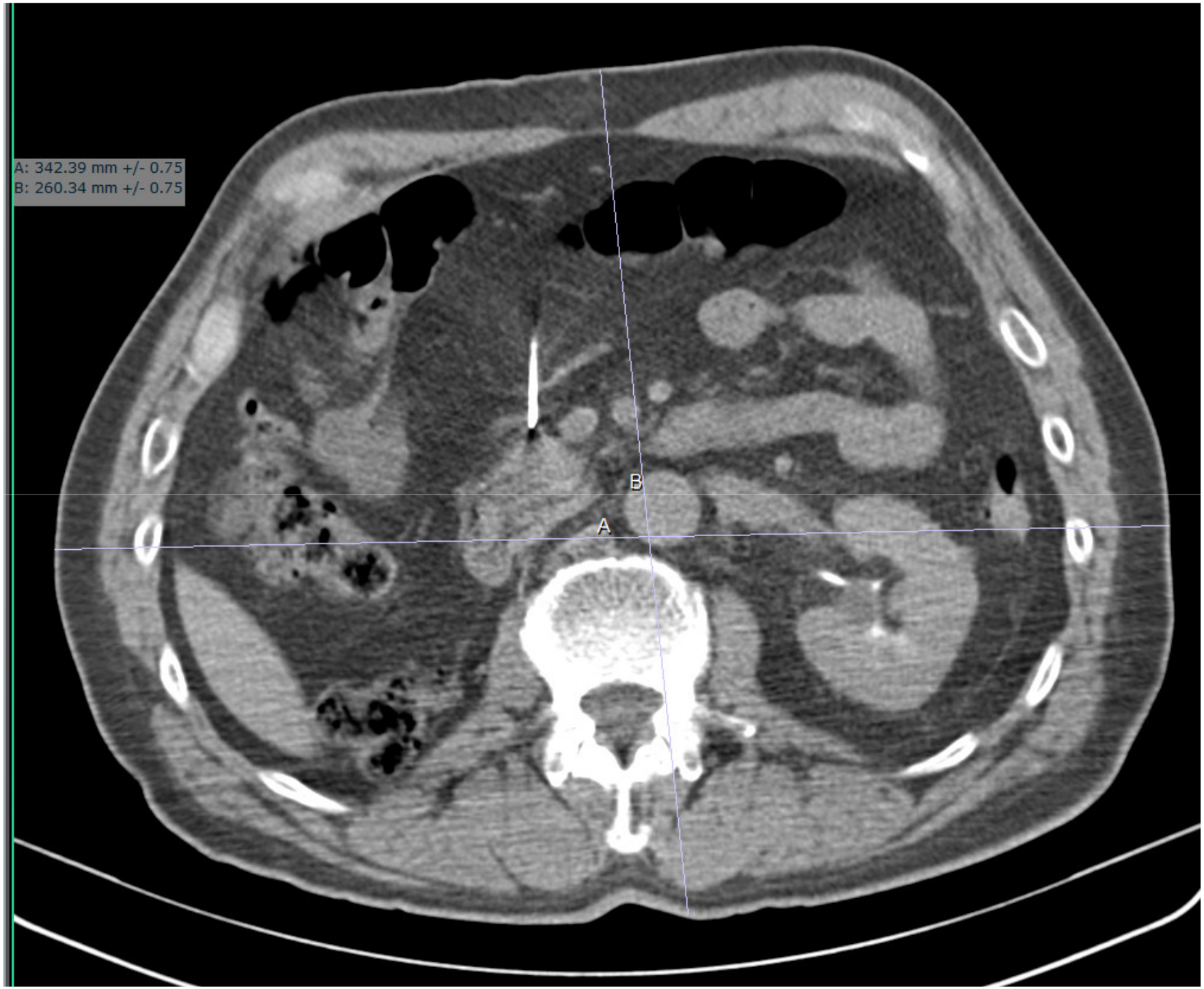
http://de.slideshare.net/sabmomo75/radiation-accident

- **How did this happen? (Accident causes)**
- An investigation by the Food and Drug Administration (FDA) was set
- Technicians intentionally used high levels of radiation to get clearer images. (Recommendation by the companies that supplied the scanners)
- No manufacturer-defined protocol provided to get reasonable and appropriate image quality and dose.
- Hospitals modified their own scanning protocols .

The consequences, impact and implications

- In Addition to hair loss and skin redness, patients experienced headaches, memory loss and confusion.
- Over time, excessive radiation exposure can place patients at increased risk for long-term radiation effects, such as risk of brain damage and cancer.

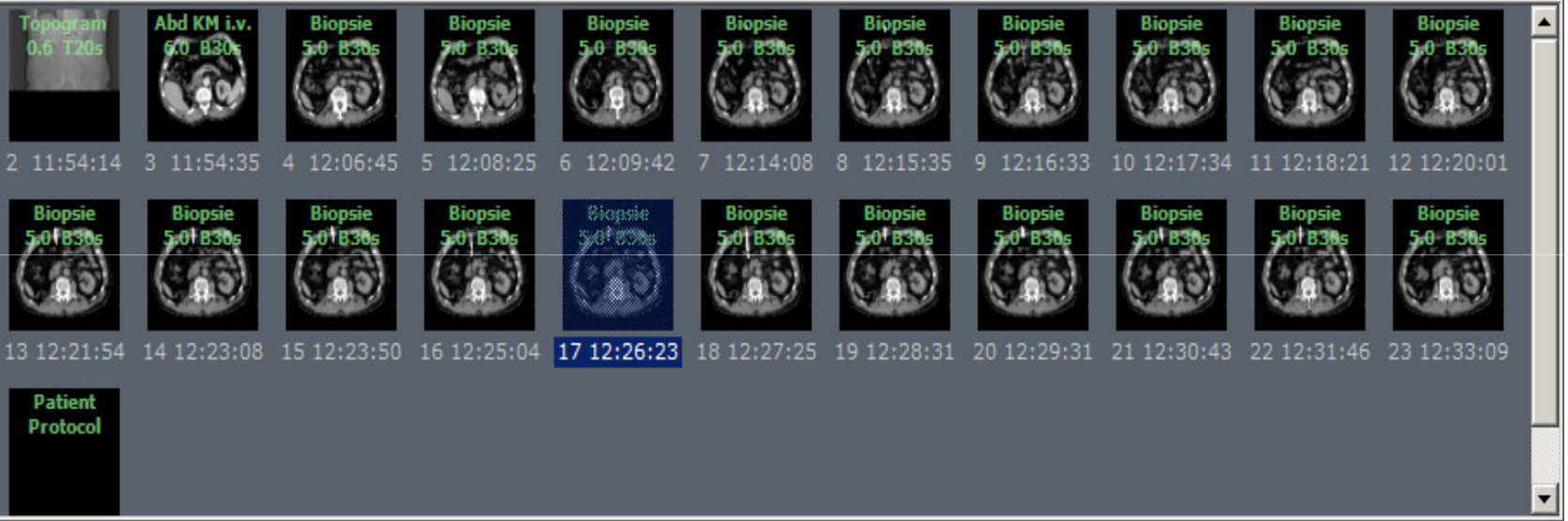
- **References**
- **U.S. Food and Drug Administration**
  - http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm193293.htm
  - http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm185898.htm
- **The New York Times news paper**. The New York Times Company (NYSE: NYT)


A: 342.39 mm +/- 0.75
B: 260.34 mm +/- 0.75
B
A

Enthält ...	Datum	Uhrzeit	Auftragsnum...	Anfordern...	Beschreibung	Befund	Studien Nr.	Status
CT\SR	22.05.2015	11:45:26	RN15040057	14VI	CT-gesteuerte diagnostische Punktion	X	P07_CT	verifiziert
CT\NM\O...	14.04.2015	15:07:50	RN15039611	14VI	Fremd-CD: PET^PETCT_AC_WholeBody...		001_SP	neu
CT\NM\PT	03.03.2015	11:42:49	RN15039611	14VI	Fremd-CD: Thorax^PET_CT_Ganzkoerpe...		001_SP	neu
SC	11.12.2013	16:22:00	EL1300336083	unbekannt	Endosonographie		EL13003360...	neu
SC	28.11.2013	07:30:00	EL1300334517	Schuhmach...	Endosonographie		EL13003345...	neu

Serien

Serien | **Vorschau** | Befunde/Dokumente



Bilder

Bilddaten | **Vorschau**

Total mAs 8861 Total DLP 1705 mGy*cm

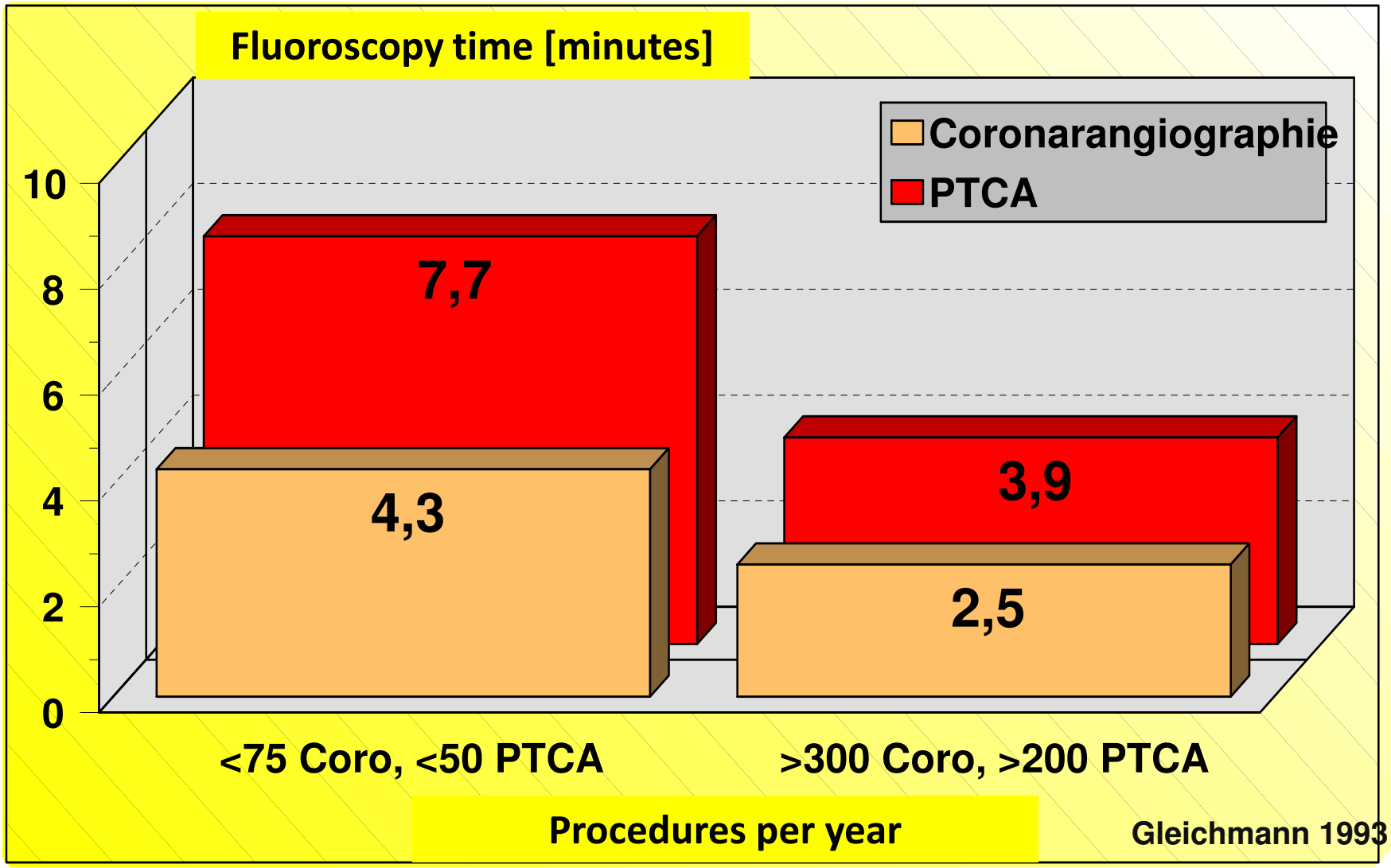
	Scan	kV	mAs / ref.	CTDIvol mGy	DLP mGy*cm	TI s	cSL mm
Patient Position H-SP							
Topogram	1	130		0.08(L)	3.86	4.0	0.6
Abd KM l.v.	2	130	124 / 140	12.66(L)	292.36	0.6	1.2
Biopsie	3	130	89 / 105	9.07(L)	58.16	0.6	1.2
Biopsie	4	130	94 / 105	9.61(L)	74.55	0.6	1.2
Biopsie	5	130	93 / 105	9.53(L)	99.69	0.6	1.2
Biopsie	6	130	90 / 105	9.23(L)	67.90	0.6	1.2
Biopsie	7	130	92 / 105	9.38(L)	69.02	0.6	1.2
Biopsie	8	130	90 / 105	9.23(L)	67.90	0.6	1.2
Biopsie	9	130	92 / 105	9.38(L)	69.02	0.6	1.2
Biopsie	10	130	93 / 105	9.53(L)	70.14	0.6	1.2
Biopsie	11	130	87 / 105	8.92(L)	65.65	0.6	1.2
Biopsie	12	130	93 / 105	9.53(L)	70.14	0.6	1.2
Biopsie	13	130	93 / 105	9.53(L)	70.14	0.6	1.2
Biopsie	14	130	92 / 105	9.38(L)	69.02	0.6	1.2
Biopsie	15	130	90 / 105	9.23(L)	67.90	0.6	1.2
Biopsie	16	130	93 / 105	9.53(L)	70.14	0.6	1.2
Biopsie	17	130	93 / 105	9.53(L)	70.14	0.6	1.2
Biopsie	18	130	93 / 105	9.53(L)	70.14	0.6	1.2
Biopsie	19	130	93 / 105	9.53(L)	70.14	0.6	1.2
Biopsie	20	130	93 / 105	9.53(L)	70.14	0.6	1.2
Biopsie	21	130	90 / 105	9.23(L)	67.90	0.6	1.2
Biopsie	22	130	95 / 105	9.68(L)	71.26	0.6	1.2

Thresholds for patient follow-up as recommended by SIR (Stecker, 2009)

Parameter	Threshold
Peak skin dose (PSD)	3,000 mGy
Reference point air kerma	5,000 mGy
Kerma area product (KAP)	500 $Gy.cm^2$
Fluoroscopy time	60 min

Bsp. der CT-Punktion:
ESD ~ 0,2 Gy
z-Länge ~ 7 cm
Umfang ~ 100 cm
=> 700 cm^2 * 0,2 Gy = 140 Gy * cm^2

Training vs. Fluoroskopie Zeit



Gleichmann 1993

Risikokonstellationen:

- **Kardiologische Interventionen, besonders**
  > Ablationen
  > Klappenersatz
  > PTCA mit Stents

- **Neuroradiologische Interventionen**
  > AVM
  > Aneurysma-Coiling

- **Interventionelle Radiologie**

- **CT-Perfusion des Gehirns**
- **CT-Intervertionen, besonders CT-Fluoroskopie**

Weitere Informationen finden Sie unter:

MARTIR Trainings-CD (interventionelle Radiologie)
(http://ec.europa.eu/energy/nuclear/radiation_protection/publications_en.htm)

IAEA Trainingsmaterial
(http://rpop.iaea.org/RPoP/RPoP/Content/AdditionalResources/Training/index.htm)

http://ec.europa.eu/energy/nuclear/radiation_protection/publications_en.htm

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PET/CT →

The training material on this site is available for free downloading (subject to conditions specified in 'Intended use' and 'Disclaimer' below), and are on the topics of Radiation Protection in:

English

- Diagnostic and Interventional Radiology
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- Cardiology
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