

RADYOLOJİ KİŞ OKULU 2019

4 -10 Şubat 2019
Mirage Park Otel, Antalya



RADYOLOJİDE OPTİMİZASYON

Dr. Gökçe Kaan ATAÇ
Ufuk Üniversitesi Tıp Fakültesi
Radyoloji AD.

SUNUM

- Optimizasyon (NE)
- Kim yapmalı
- Neden gerekli
- Nasıl yapılmalı
- Ne zaman
- Nerede

OPTİMİZASYON

OPTİMİZASYON

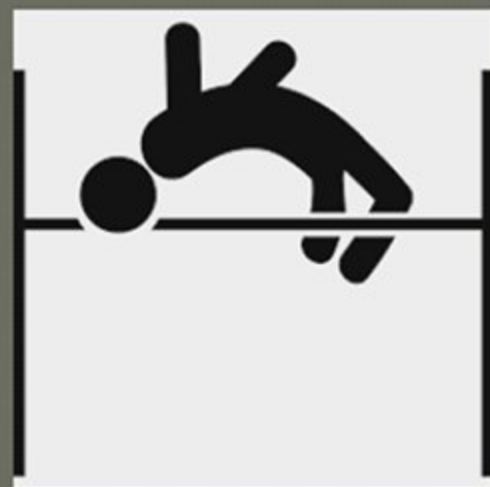
● Gerekçelendirme



● Optimizasyon



● Doz referans düzeyleri (DRL)



OPTİMİZASYON

- “As Low As Reasonably Achievable”
- Görüntü kalitesi **X** Düşük Hasta Dozu,
- Radyografi, Mammografi, Floro, BT,
- Etkin doz
- Doz belirteçleri

RADYASYON DOZU

RADYASYON DOZU

X IŞINI

**Organ-doku
dozu (Gy)**

Belirli dokuda absorbe edilen

doku ağırlık
faktörü



**Doz
eşdeğeri
(Sievert)**

Organ-dokuda

toplamı



**Etkin doz
(Sievert)**

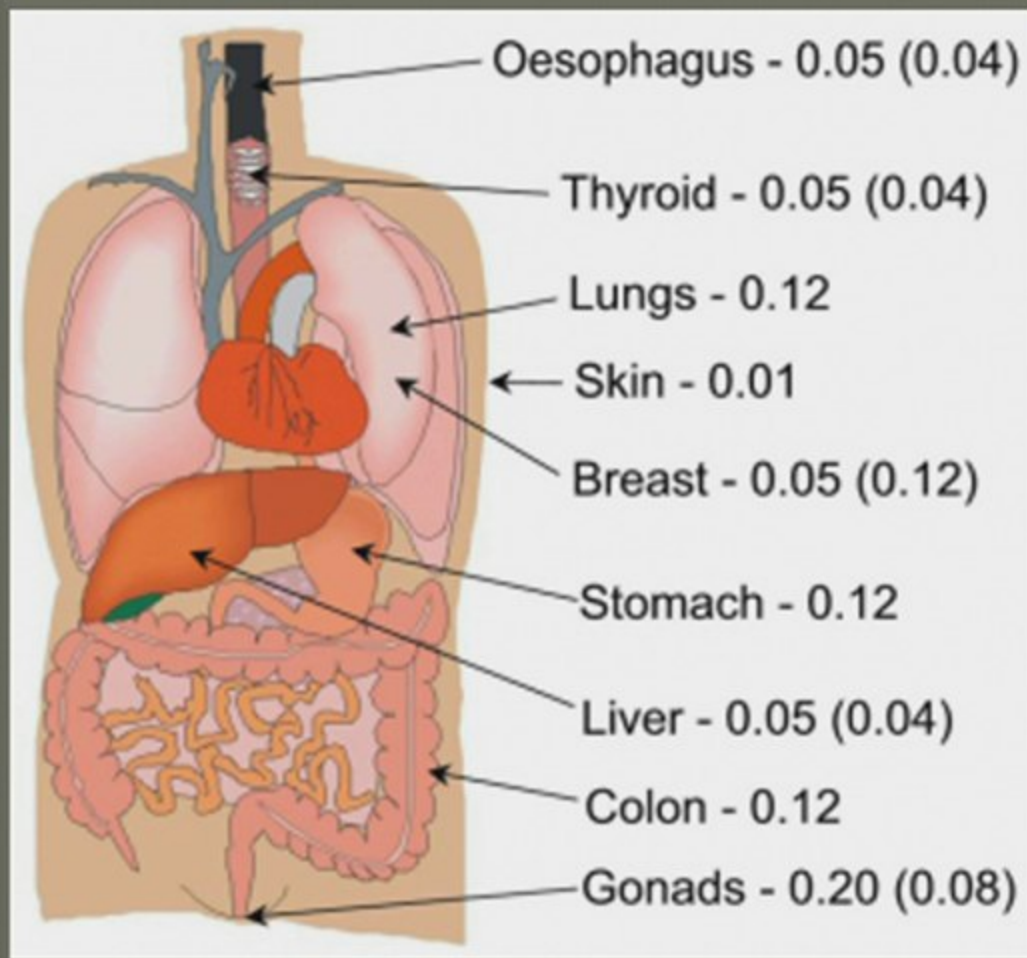
Tüm organ-
doku toplamı

GONADLAR 0.20 → 0.08
MEME AKC 0.05 → 0.12
ICRP 2007

EFFEKTİF DOZ

Absorbe edilen

doz ağırlık faktörleri



10 mGy

$$\text{Ö} \rightarrow 0.04 \times 10 = 0.4$$

$$\text{T} \rightarrow 0.04 \times 10 = 0.4$$

$$\text{L} \rightarrow 0.12 \times 10 = 1.2$$

$$\text{S} \rightarrow 0.01 \times 10 = 0.1$$

$$\text{B} \rightarrow 0.12 \times 10 = 1.2$$

$$\Sigma 3.3 \text{ mSv}$$

10 mGy



$$\text{S} \rightarrow 0.12 \times 10 = 1.2$$

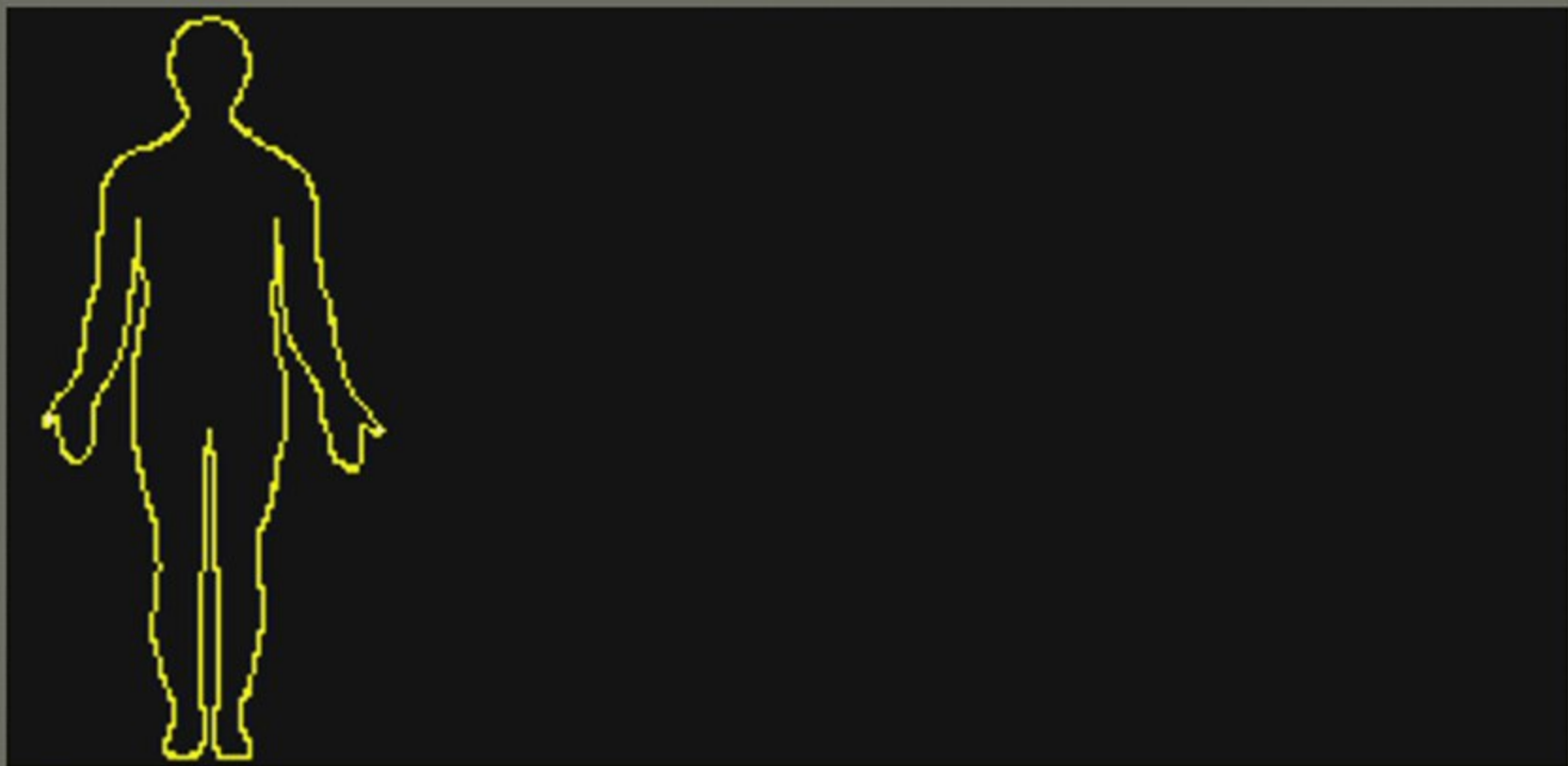
$$\text{L} \rightarrow 0.05 \times 10 = 0.5$$

$$\text{C} \rightarrow 0.12 \times 10 = 1.2$$

$$\text{G} \rightarrow 0.20 \times 10 = 2$$

$$\Sigma 4.9 \text{ mSv}$$

EFFEKTİF DOZ



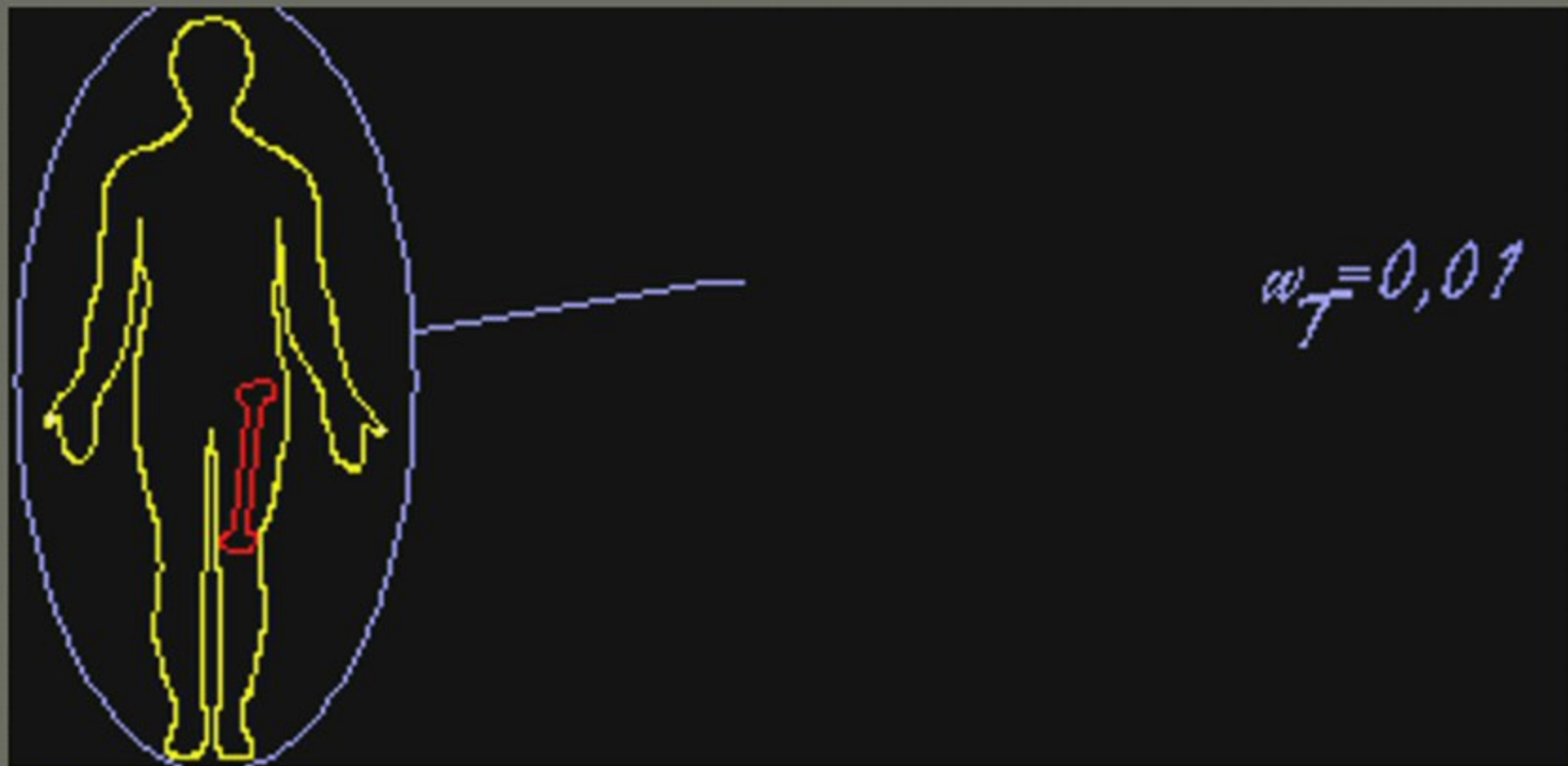
https://www.remm.nlm.gov/dose_animations.htm

EFFEKTİF DOZ



https://www.remm.nlm.gov/dose_animations.htm

EFFEKTİF DOZ



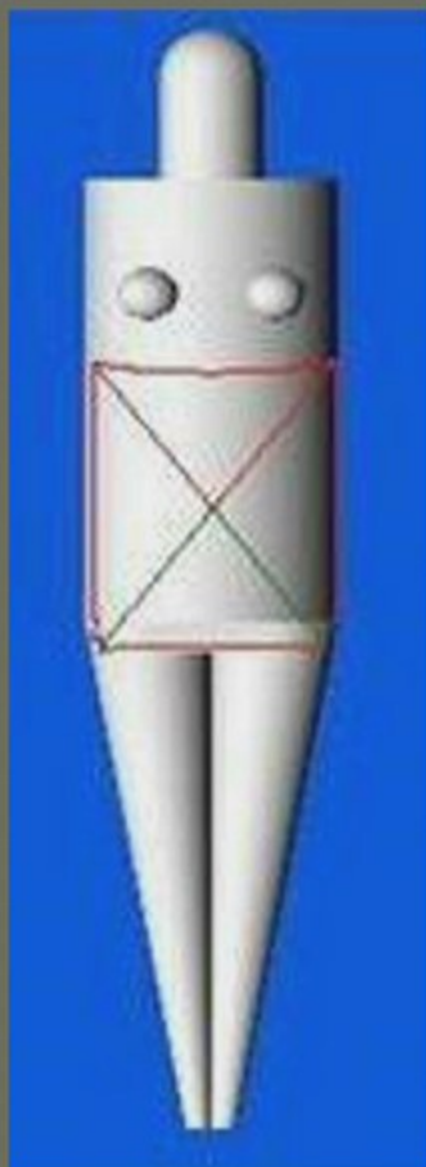
https://www.remm.nlm.gov/dose_animations.htm

EFFEKTİF DOZ



https://www.remm.nlm.gov/dose_animations.htm

ORTALAMA DOZ



RADYOGRAFI	EFFEKTİF DOZ (mSv)
Kranyum	0,1
Akciğer	0,1
Lomber vert.	1,5
Abdomen	0,7
İVP	3,0
Mide Barsak grafisi	6,0
Kolon Grafisi	8,0

BT DOZ BİRİMLERİ

**1/3 CTDI
CENTER**



**2/3 CTDI
PERİFER**

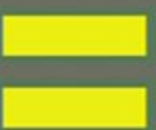


CTDI W

CTDI W



PITCH

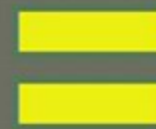


**CTDI
VOLUME**

**CTDI
VOLUME**



TARAMA
UZUNLUĞU



DLP

DLP



KATSAYI



**EFFEKTİF
DOZ**

BT DOZ BİRİMLERİ

1/3
CEM

CT

CT
VOI

D



DOZ

BT DOZ BİRİMLERİ

**1/3 CTDI
CENTER**



**2/3 CTDI
PERİFER**

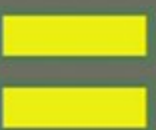


CTDI W

CTDI W



PITCH

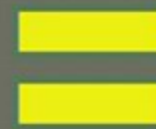


**CTDI
VOLUME**

**CTDI
VOLUME**



TARAMA
UZUNLUĞU



DLP

DLP



KATSAYI



**EFFEKTİF
DOZ**

BT DOZ BİRİMLERİ

1/3
CEM

CT

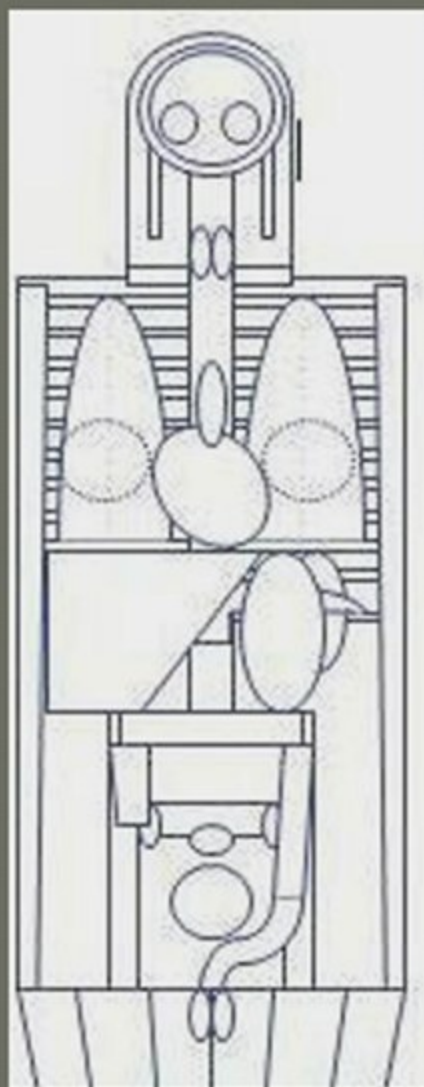
CT
VOI

D



DOZ

ORTALAMA DOZ-BT



BÖLGE	EFFEKTİF DOZ (mSv)
Kranyum	2
Servikal -Boyun	3
Akciğer - Toraks	7
Üç fazlı karaciğer	15
Kalsiyum skorlama	3
Koroner anjio BT	15
Tüm abdomen	16

KİM YAPMALI

RADYOLOJİ TAKIMI !

- Protokol oluşturma
- Periyodik kontrol ve düzeltme
- Radyolog
- Medikal Fizikçi ☺ ☹
- Tekniker



BEYAZ SAYFALAR

American College of Radiology White Paper on Radiation Dose in Medicine

E. Stephen Amis, Jr, MD^a, Priscilla F. Butler, MS^b, Kimberly E. Applegate, MD^c.

Insights Imaging (2011) 2:357–362

DOI 10.1007/s13244-011-0108-1

STATEMENT

White paper on radiation protection by the European Society of Radiology

FDA U.S. Food and Drug Administration
Protecting and Promoting Your Health

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Cosmetics

Tobacco Products

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[Home](#) > [Radiation-Emitting Products](#) > [Radiation Safety](#) > [Initiative to Reduce Unnecessary Radiation Exposure from Medical Imaging](#)

Initiative to Reduce
Unnecessary Radiation
Exposure from Medical Imaging

Initiative to Reduce Unnecessary Radiation Exposure from Medical Imaging

NEDEN GEREKLİ

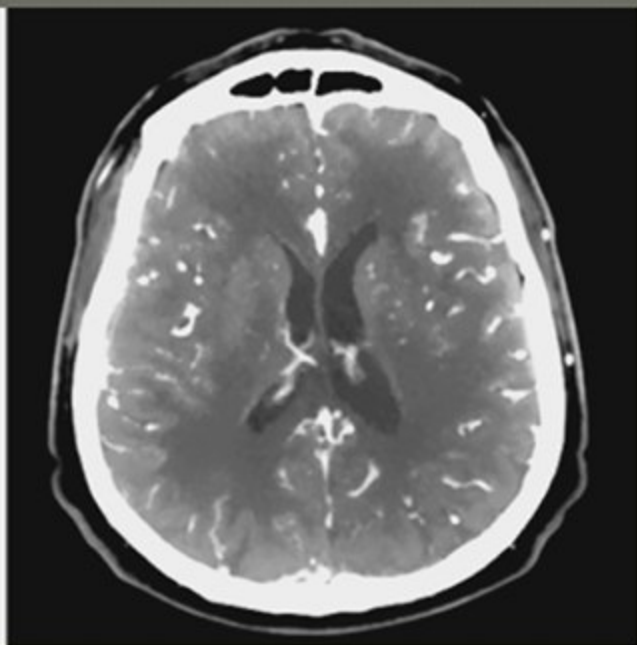
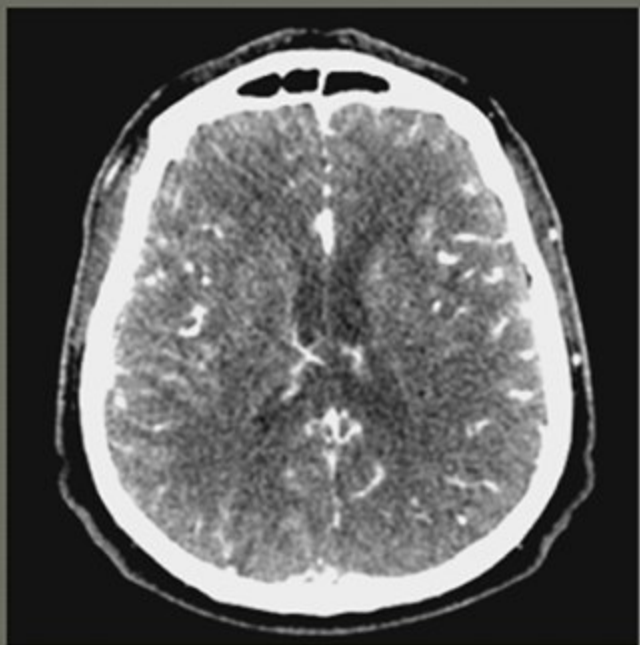
Mad River Community



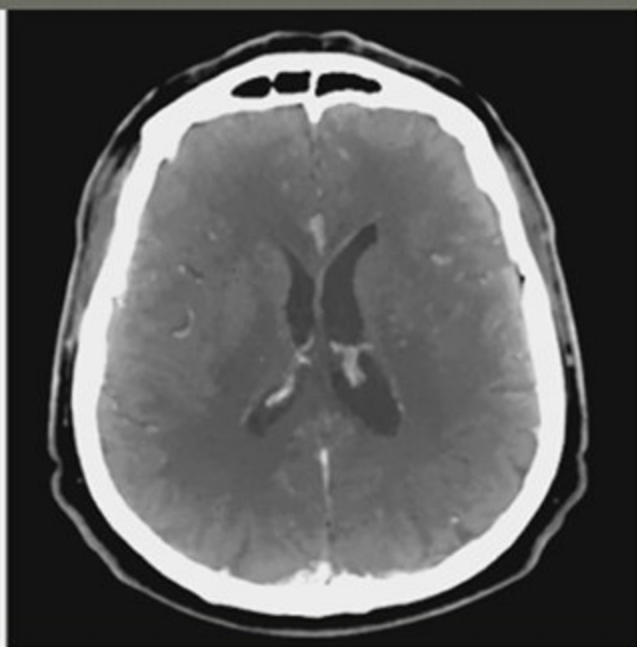
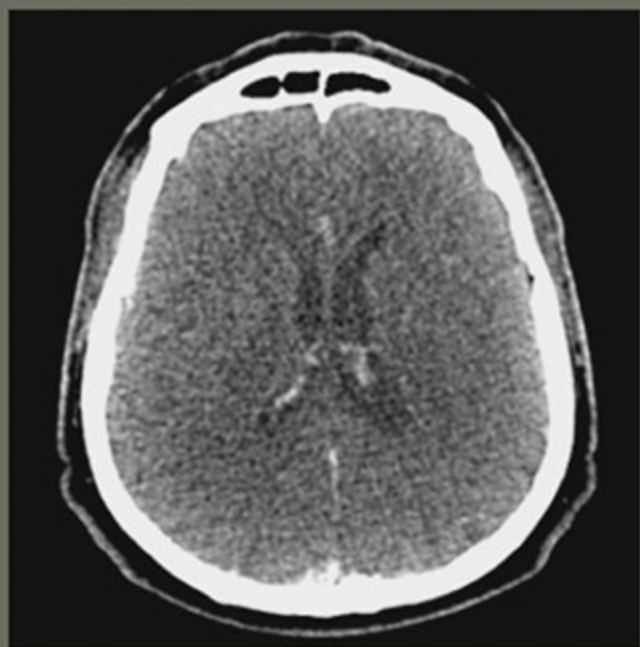
- Jacoby Roth
- Yataktan düşme
- C1-C4 arası BT incelemesi
- Teknisyen 161 defa BT çeker
- 25000 dolar ceza

- Dr. Fred Mettler;
- 5.3 Gy beyin ve tükürük bezi
- 7.3 Gy cilt
- 1.5 Gy lensler

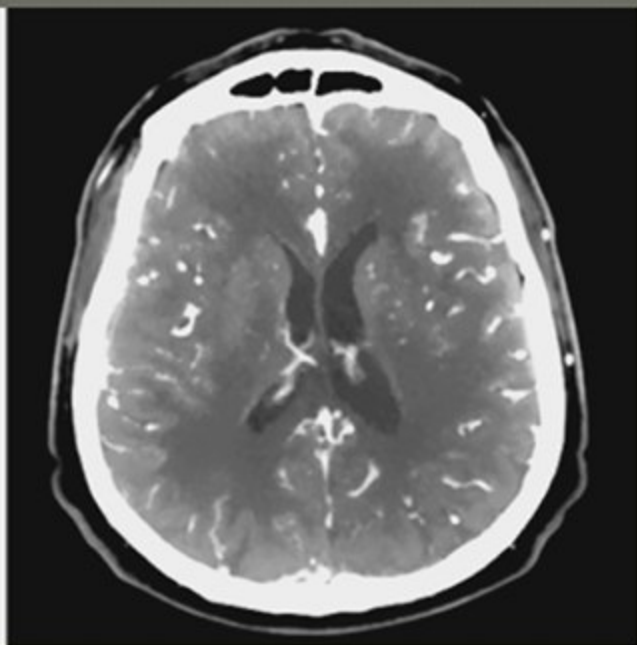
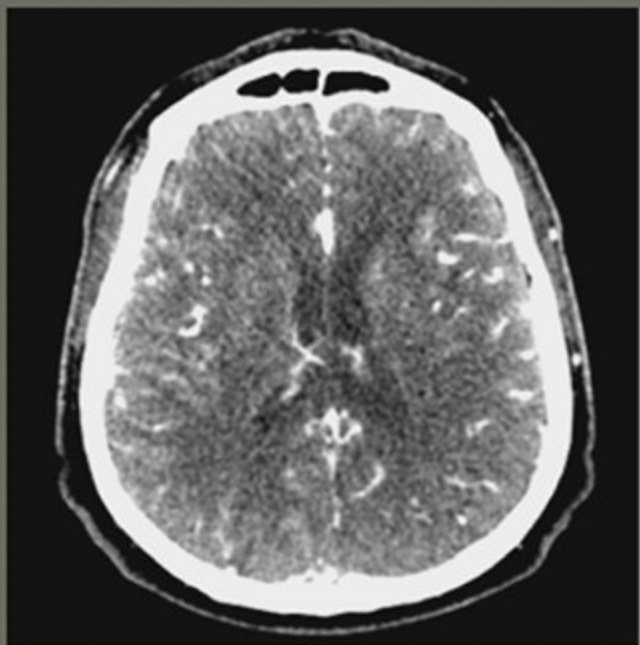
Cedars-Sinai Medical



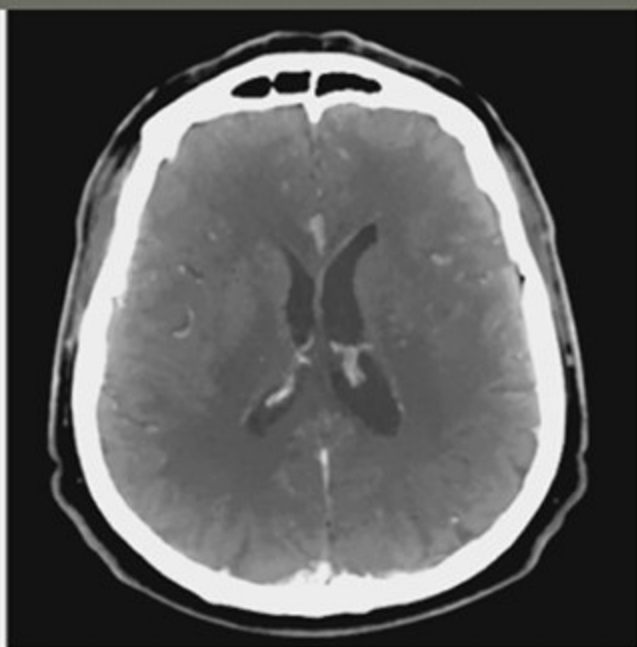
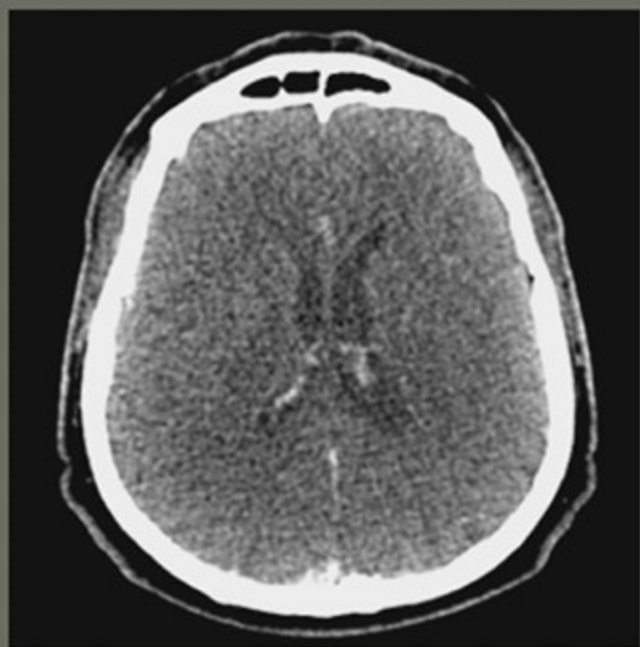
Cedars-Sinai Medical



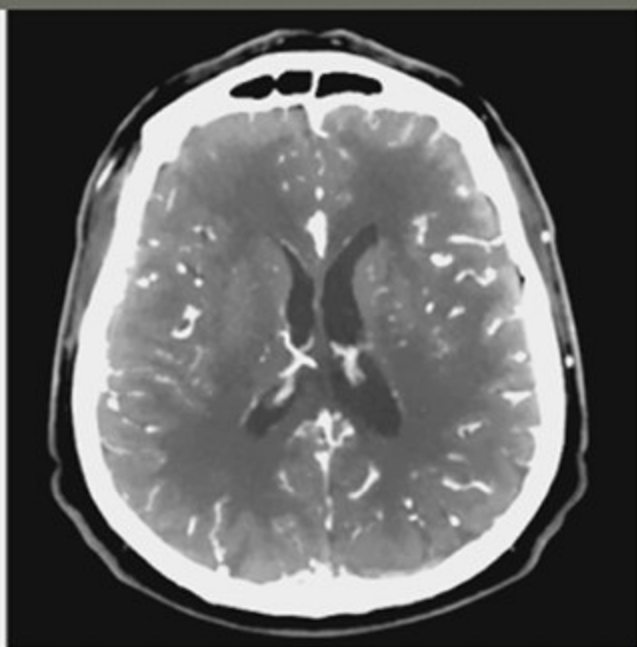
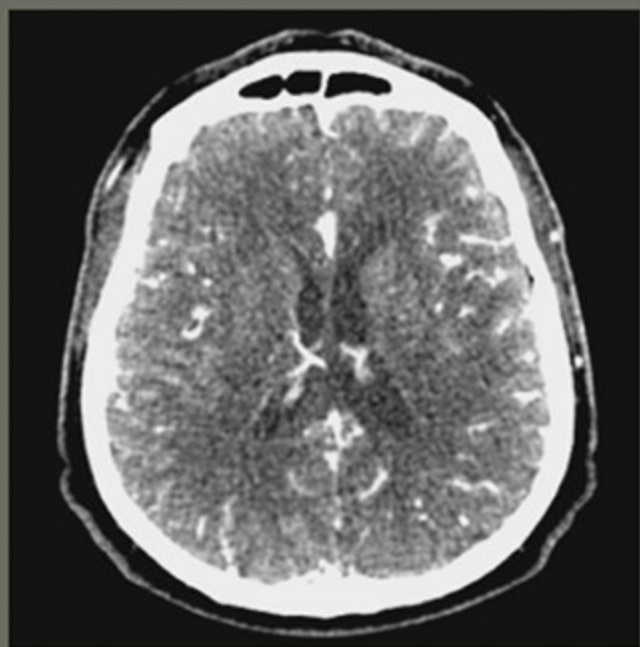
Cedars-Sinai Medical



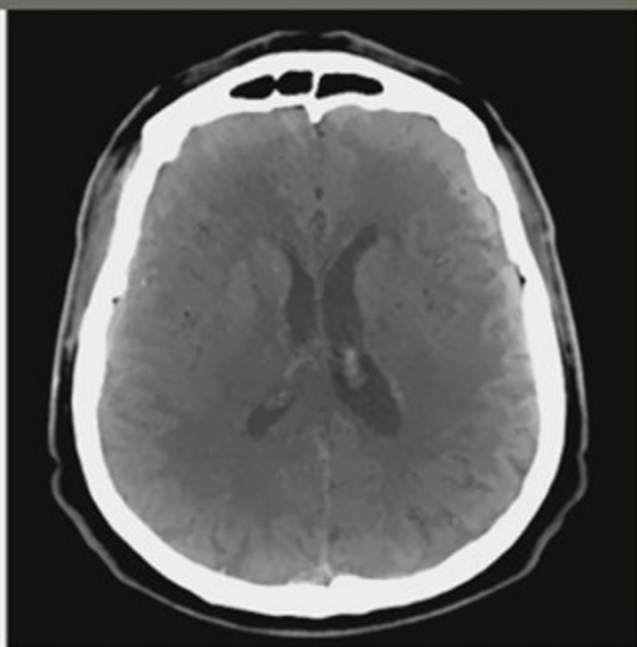
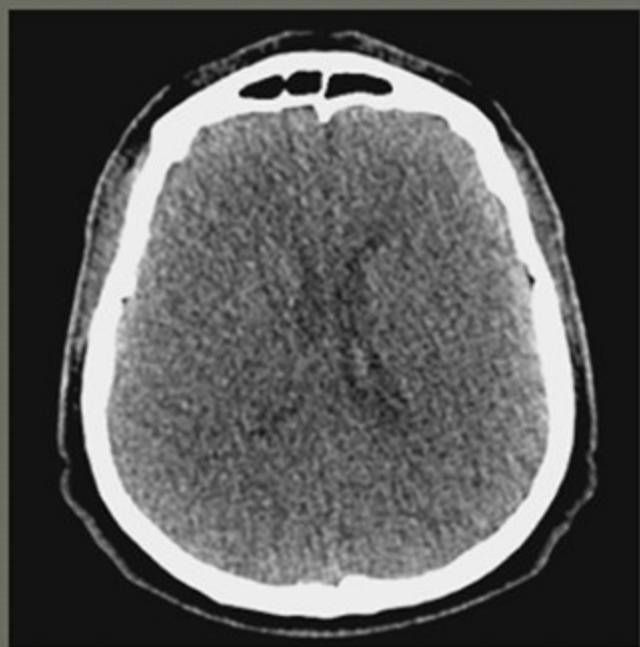
Cedars-Sinai Medical



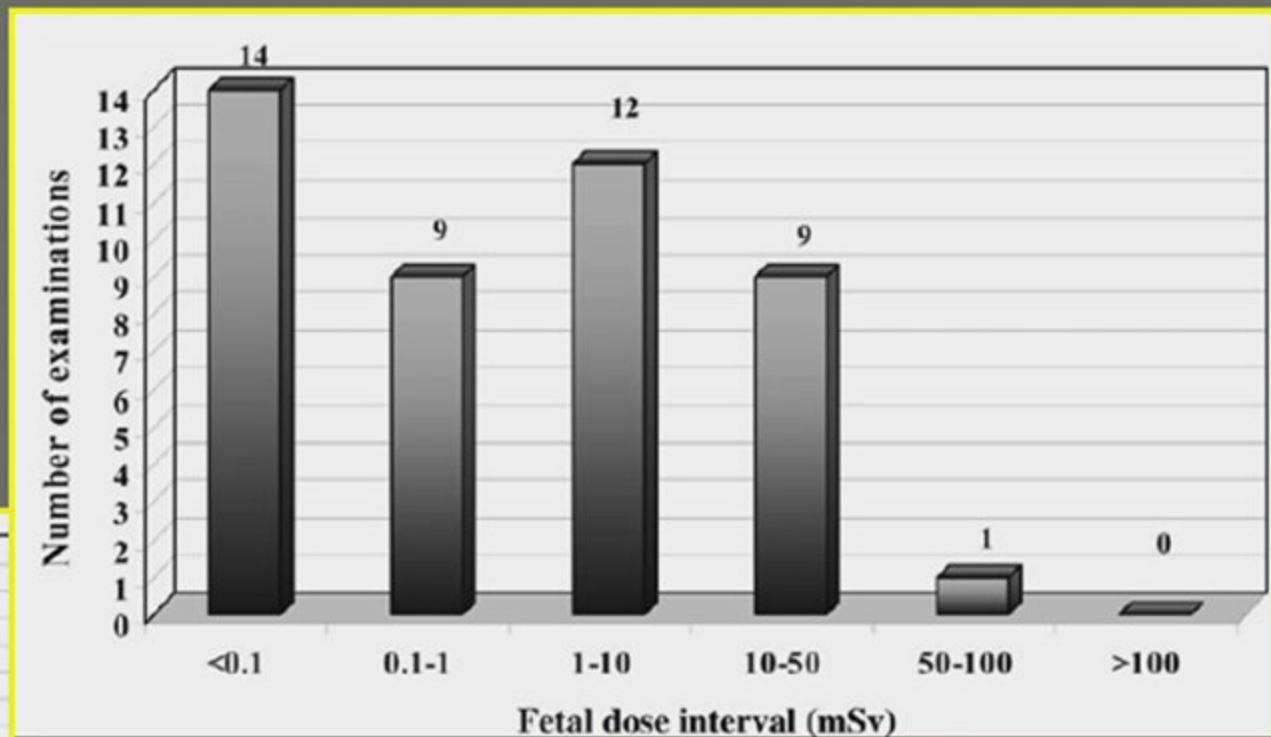
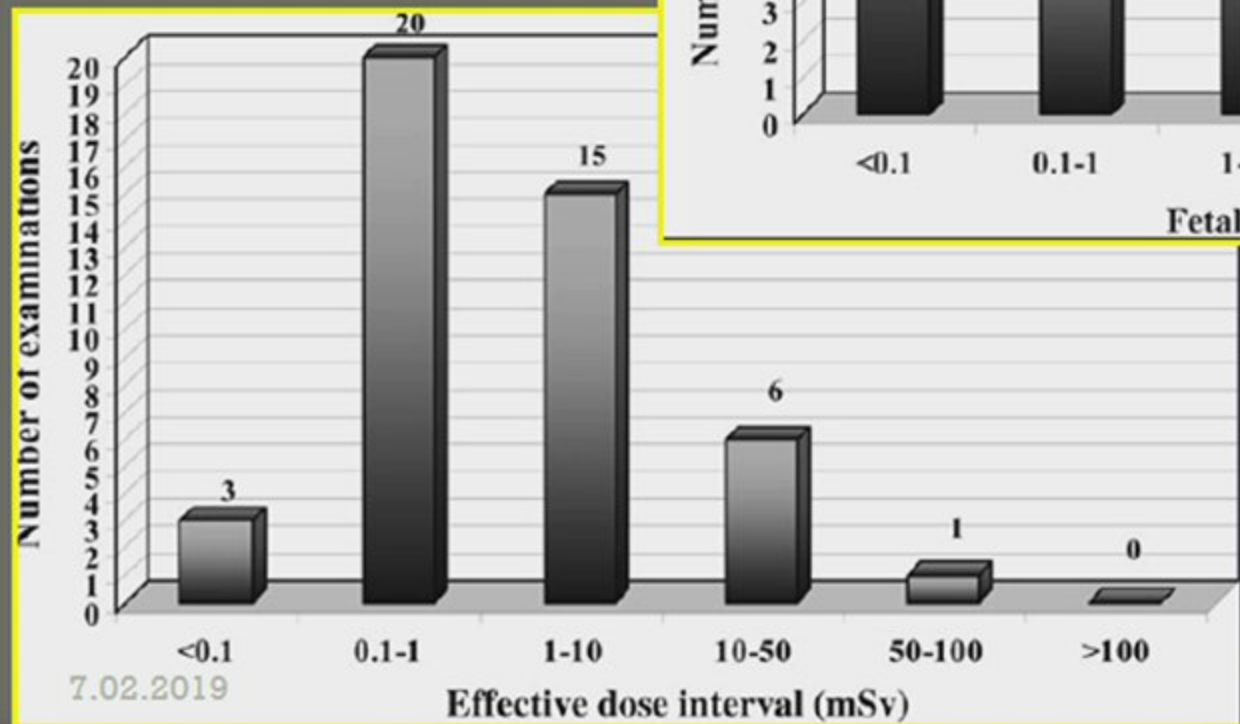
Cedars-Sinai Medical



Cedars-Sinai Medical

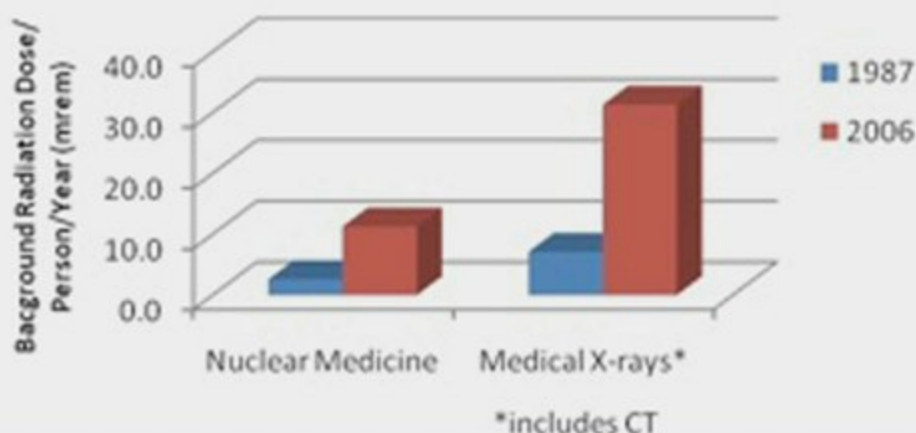


GEBELİKTE KAZA İLE



ARTAN UYGULAMALAR

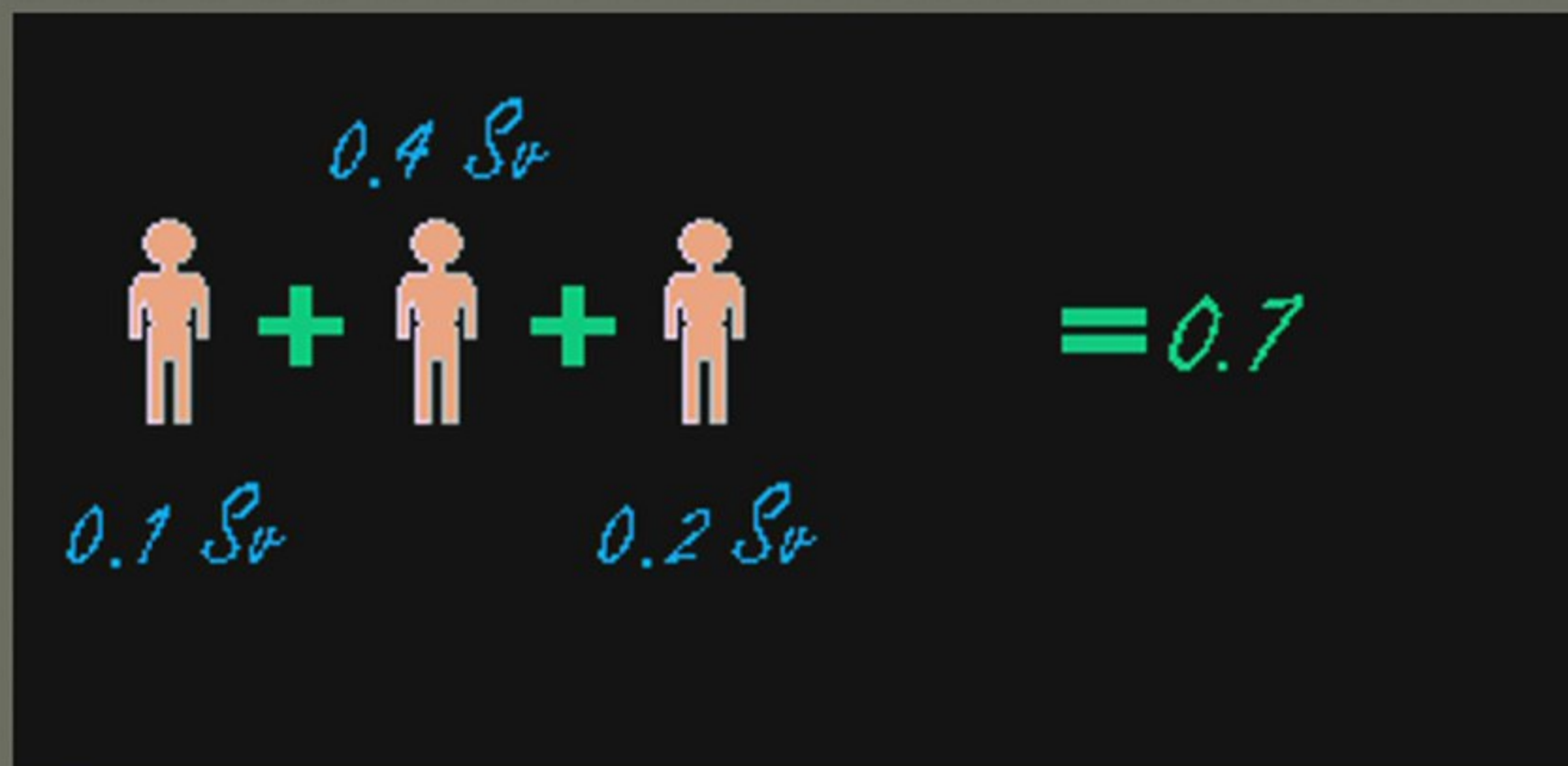
Contribution of Medical Imaging Exposure to U.S. Background, 1987 vs. 2006



Tablo 8.2. Yıllara ve Sektörlere Göre Hastanelere Müracaat Sayısı, Türkiye

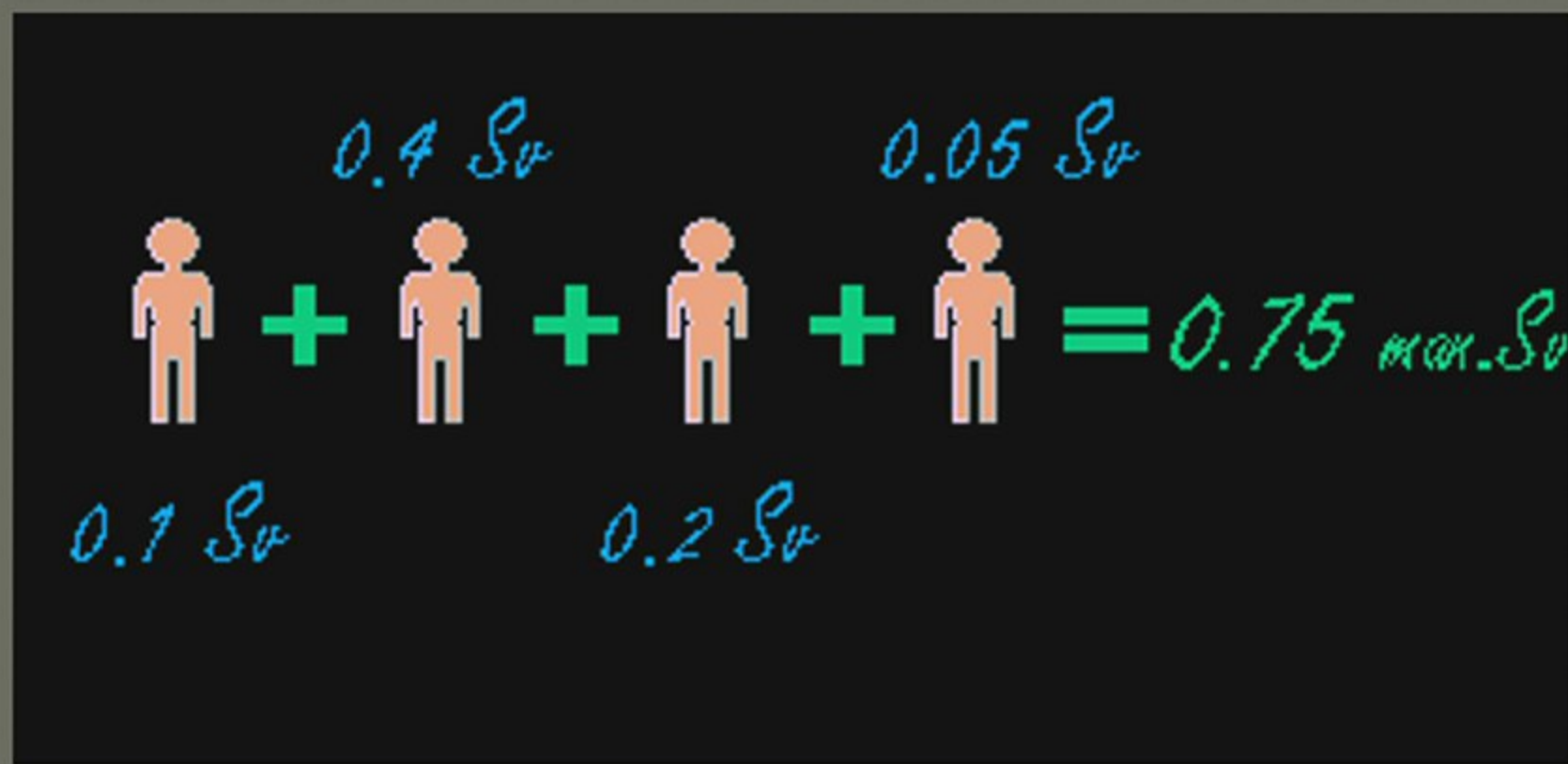
	2002	2012	2013	2014	2015	2016
Sağlık Bakanlığı	109.793.128	260.974.401	277.485.135	292.100.331	306.825.524	340.080.539
Üniversite	8.823.361	27.080.436	29.985.697	32.143.930	34.539.363	36.420.413
Özel	5.697.170	66.582.098	71.341.411	72.333.383	77.217.044	71.147.878
Toplam	124.313.659	354.636.935	378.812.243	396.577.644	418.581.931	447.648.830

KOLEKTİF DOZ

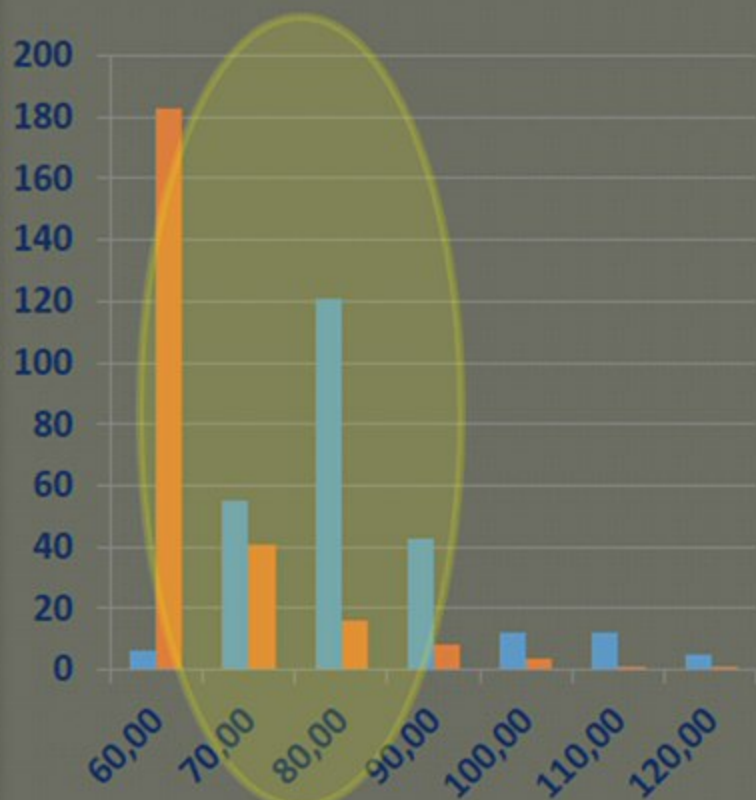


https://www.remm.nlm.gov/dose_animations.htm

KOLEKTİF DOZ

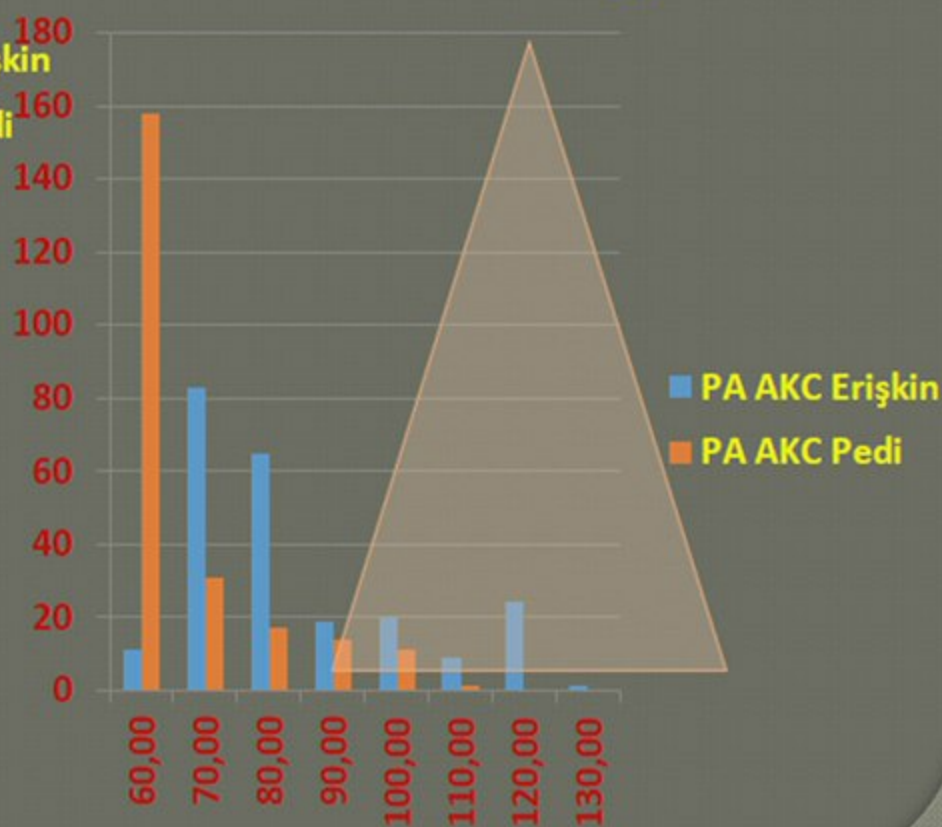


PA AKCİĞER & DÜSG?



**DÜSG
kVp**

**PA AKCİĞER
kVp**



NASIL YAPILMALI

GENEL OLARAK

- Uygun protokol kullan
- Tekrar yapma(yanlış hasta, taraf, parametre)
- Temel parameterlerin görüntüye etkisini bil
- Endikasyona göre görüntüle
- Gürültüye razı ol 😊

STANDART

EUROPEAN COMMISSION

EUROPEAN GUIDANCE
ON QUALITY CONTROL
FOR DIAGNOSTIC
RADIOGRAPHIC



EUR 16260 EN

Let us know

EUROPEAN COMMISSION

EUROPEAN GUIDANCE
ON QUALITY CONTROL
FOR DIAGNOSTIC
RADIOGRAPHIC
IN PAEDIATRIC



EUR 16261



DIMOND III

Image Quality and
Dose Management
For Digital Radiography

Final Report

H.P. Busch

Trier
2004

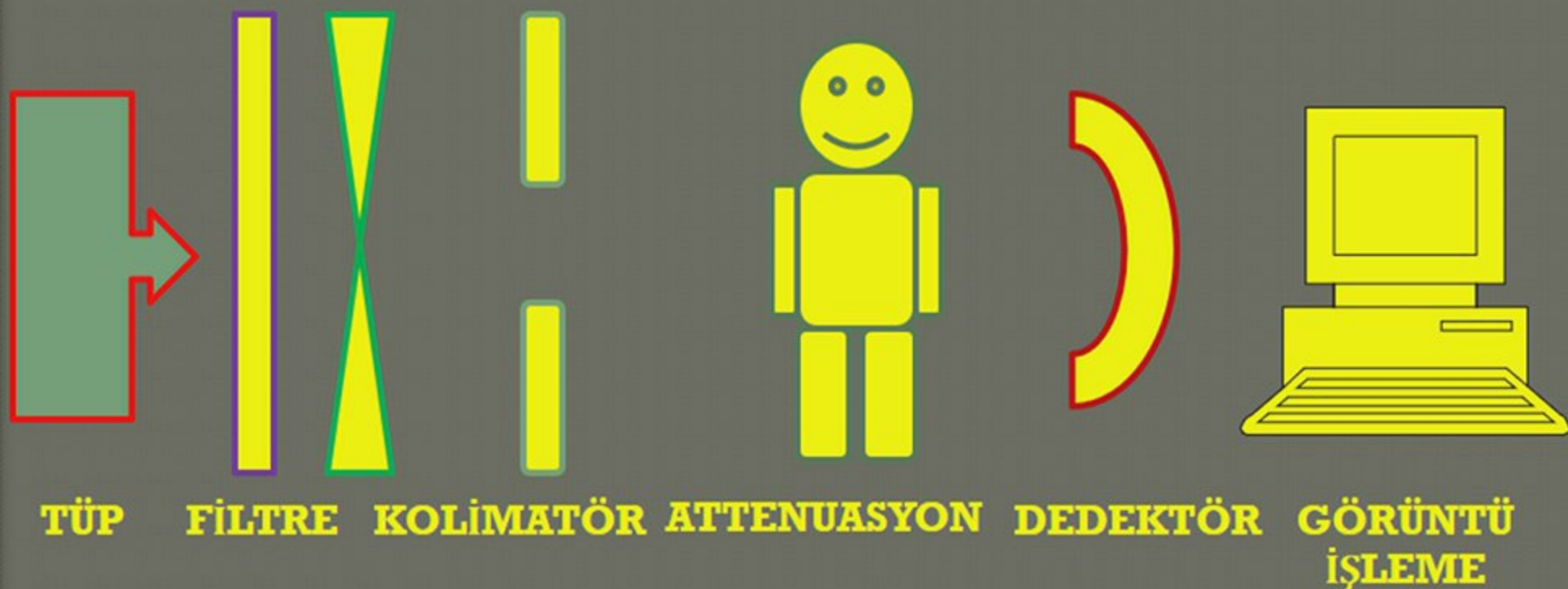
TRD

TÜRK RADYOLOJİ DERNEĞİ

MRG ve BT İNCELEME STANDARTLARI

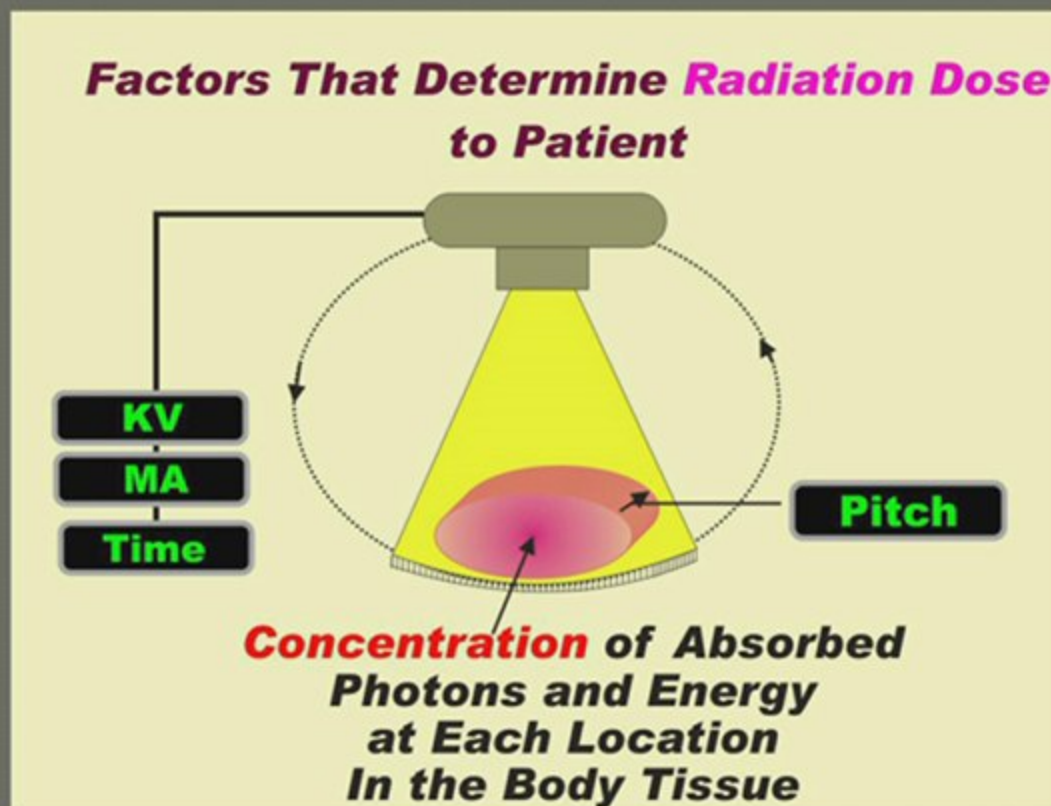
2018

BT GÖRÜNTÜLEME ZİNCİRİ



HASTA DOZU DÜŞÜRME

- Tarama alanı
- kVp^2
- mA
- Dönüş süresi (sn)
- Kesit kalınlığı (mm)
- Pitch
- Otomatik akım modülasyonu
- İteratif rekonstrüksiyon



AAPM BT PROTOKOL

Adult Routine Head CT Protocols Version 2.0 3/1/2016

ADULT HEAD – ROUTINE (AXIAL) (selected GE scanners)

[\(Back to INDEX\)](#)

SCOUT: Lateral, S150-I50. 120 kV, 10 mA PA Scout optional.

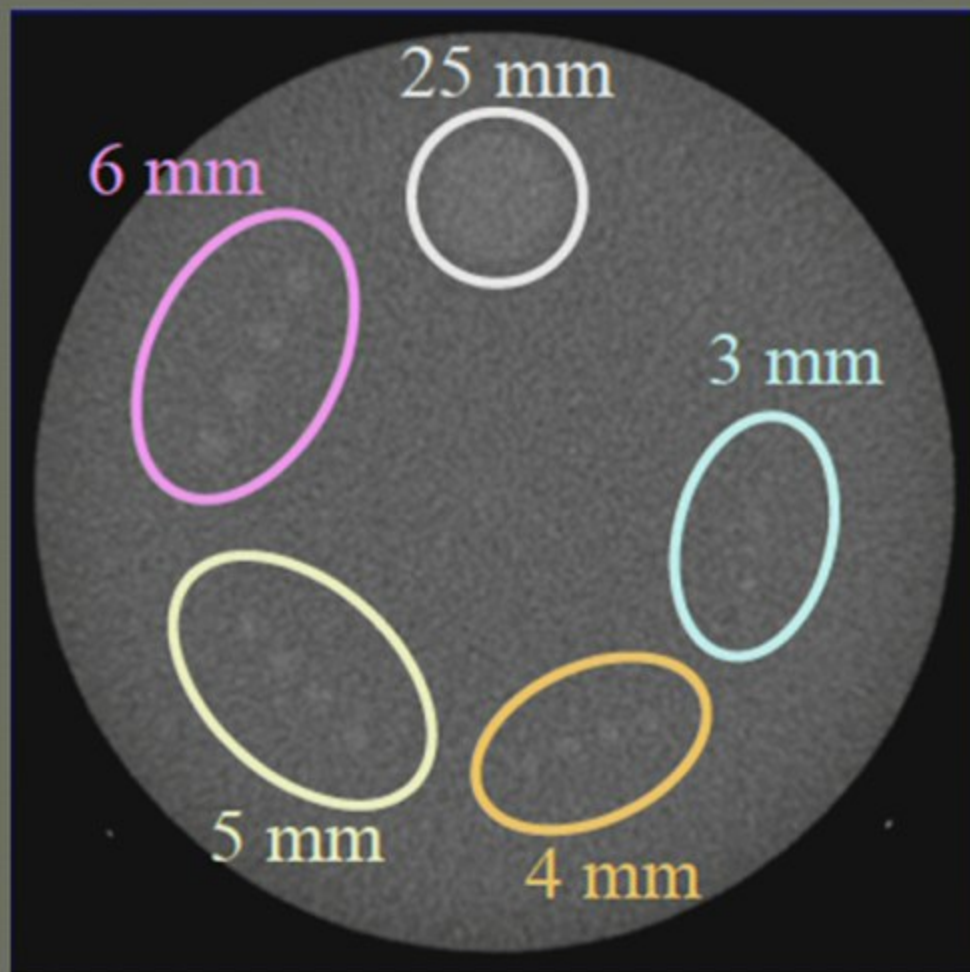
GE	LightSpeed Ultra (8)	BrightSpeed 16 Select	LightSpeed 16 BrightSpeed 16	LightSpeed Pro 16
Scan Type	AXIAL	AXIAL	AXIAL	AXIAL
Rotation Time (s)	2	2	2	2
Detector Configuration	4 x 2.5 (10mm, 2i)	4 x 2.5 (10mm, 2i)	16 x 0.625 (10mm, 2i)	16 x 0.625 (10mm, 2i)
Pitch	-	-	-	-
Table Feed/Interval (mm)	10	10	10	20
kV	120	120	120	120
mA	140	140	140	140
Auto-mA	no	No	no	no
SFOV	HEAD	HEAD	HEAD	HEAD
Breath-hold	--	--	--	--
Prep Delay	--	--	--	--
CTDI-vol (mGy)	58.2	62.8	57.7	62.2

Recon 1

Recon Start	Base of Skull	Base of Skull	Base of Skull	Base of Skull
Recon End	Vertex	Vertex	Vertex	Vertex
Plane	Axial	Axial	Axial	Axial
Algorithm	Std	Std	Std	Std

PITCH

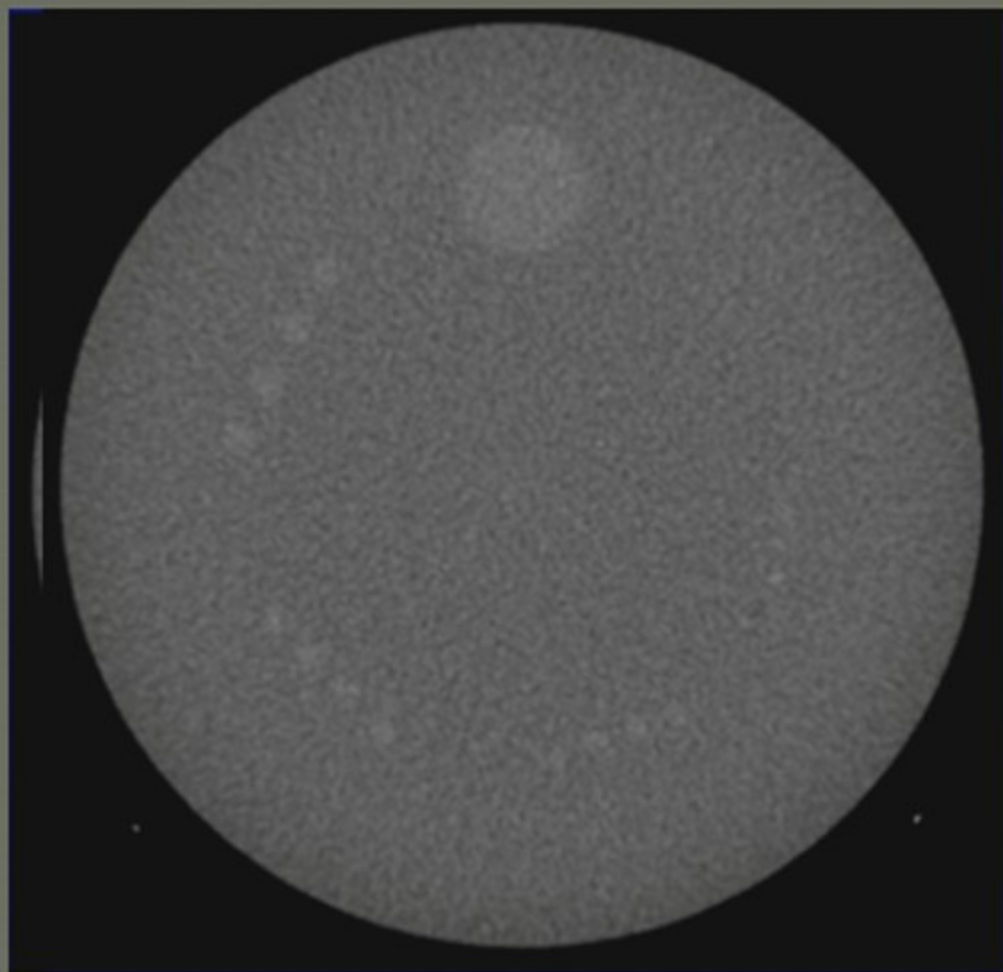
Pitch	CTDIvol
0,562	162
0,938	97
1,375	66
1,75	52



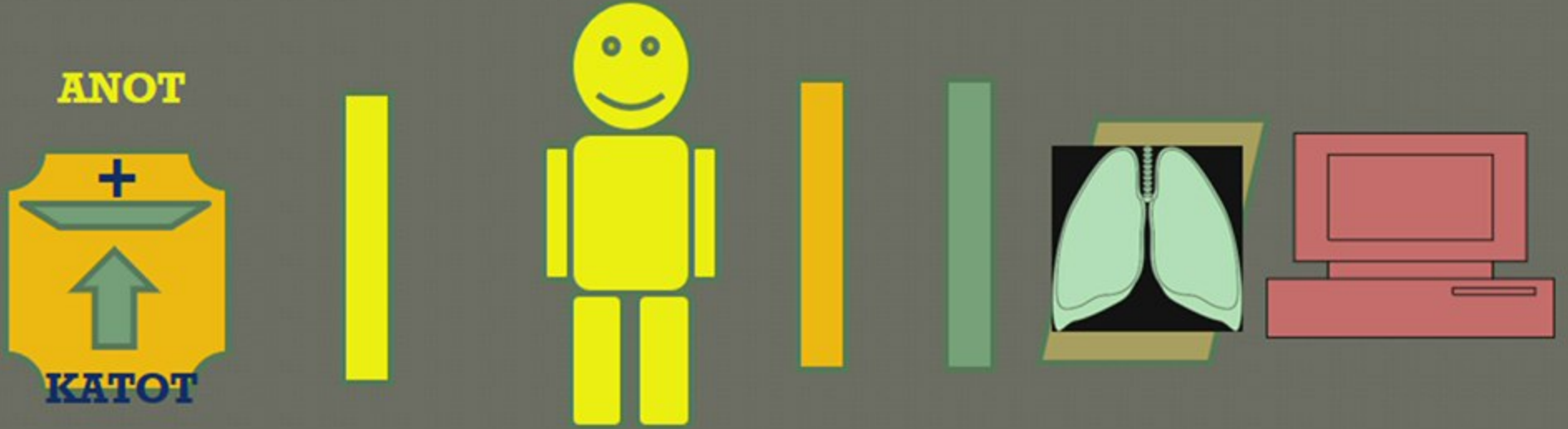
PITCH



Pitch	CTDIvol
0,562	162
0,938	97
1,375	66
1,75	52



GÖRÜNTÜLEME DİZGİSİ



X IŞIN TÜPÜ

FİLTRE

**HASTA-
OBJE**

GRİD

AEC

**DETEKTÖR
-FİLM**

**GÖRÜNTÜ
İŞLEME**

EKSPONER FAKTÖRLERİ

• 1.GÖRÜNTÜ

- KONTRAST
- GÜRÜLTÜ
- DİNAMİK ARALIK
- KALİTE

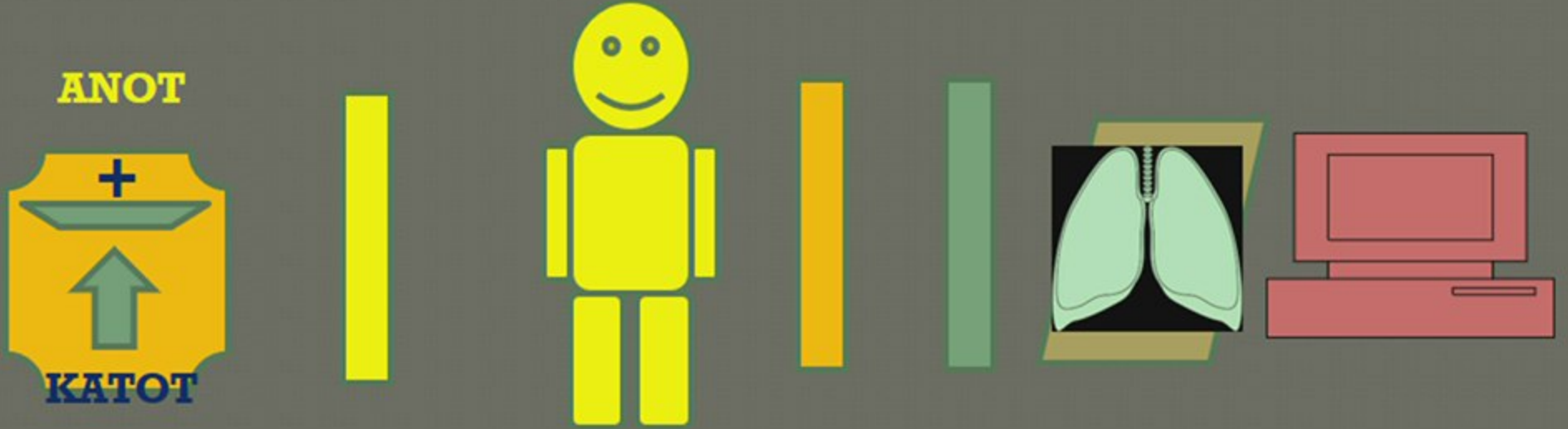
• 2.FAKTÖRLER

- KİLOVOLT
- MİLİAMPER
- SANİYE
- FİLTRE
- GRİD
- FİLM-DETEKTÖR
- AEC
- GÖRÜNTÜ İŞLEME

3.SONUÇLAR

- TANISAL ETKİNLİK
- HASTA DOZU

GÖRÜNTÜLEME DİZGİSİ



X IŞIN TÜPÜ

FİLTRE

**HASTA-
OBJE**

GRİD

AEC

**DETEKTÖR
-FİLM**

**GÖRÜNTÜ
İŞLEME**

EKSPONER FAKTÖRLERİ

• 1.GÖRÜNTÜ

- KONTRAST
- GÜRÜLTÜ
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- KALİTE

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- KİLOVOLT
- MİLİAMPER
- SANİYE
- FİLTRE
- GRİD
- FİLM-DETEKTÖR
- AEC
- GÖRÜNTÜ İŞLEME

3.SONUÇLAR

- TANISAL ETKİNLİK
- HASTA DOZU

Im: 1/1
Se: 1

40kvp4mAs
123456741
1.1.2000 M
Institution Name
1
DICOMIZED Images

WV: 128 WW: 256 (D)

21.2.2016 22:31:44

Im: 1/1
Se: 1

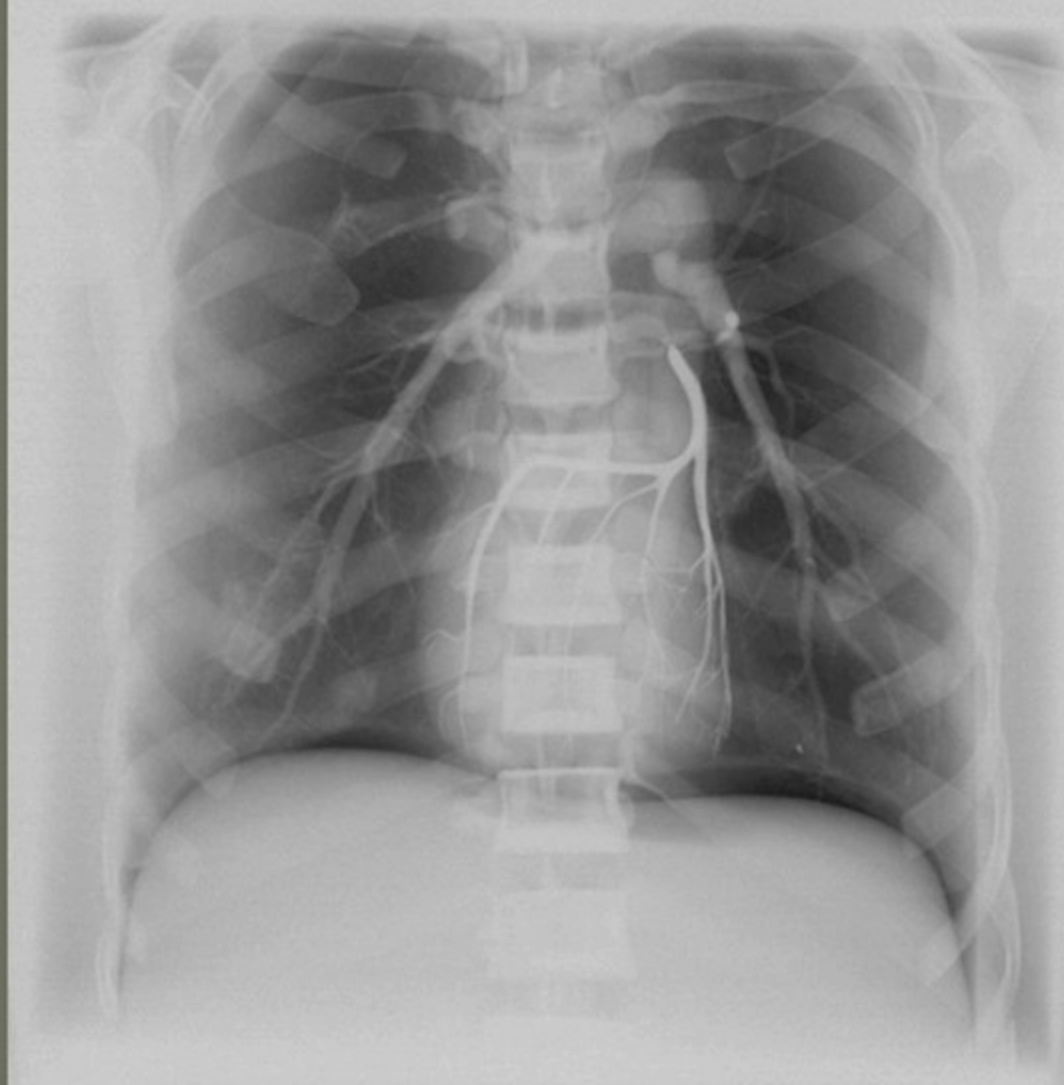
50kvp4mAs 40kvp4mAs
123456749 123456741
1.1.2000 M 1.1.2000 M
Institution Name Institution Name
1 1
DICOMIZED Images DICOMIZED Images

WL: 128 WW: 256 [D]

21.2.2016 22:36:51.16 22:31:44

Im: 1/1
Se: 1

60kvp4mAs	50kvp4mAs	40kvp4mAs
123456757	123456749	123456741
1.1.2000 M	1.1.2000 M	1.1.2000 M
Institution Name	tution Name	tution Name
1	1	1
DICOMIZED Images	ZED Images	IZED Images



WL: 128 WW: 256 [D]

21.2.2016 22:42:27 16 22:36:51 16 22:31:44

Im: 1/1
Se: 1

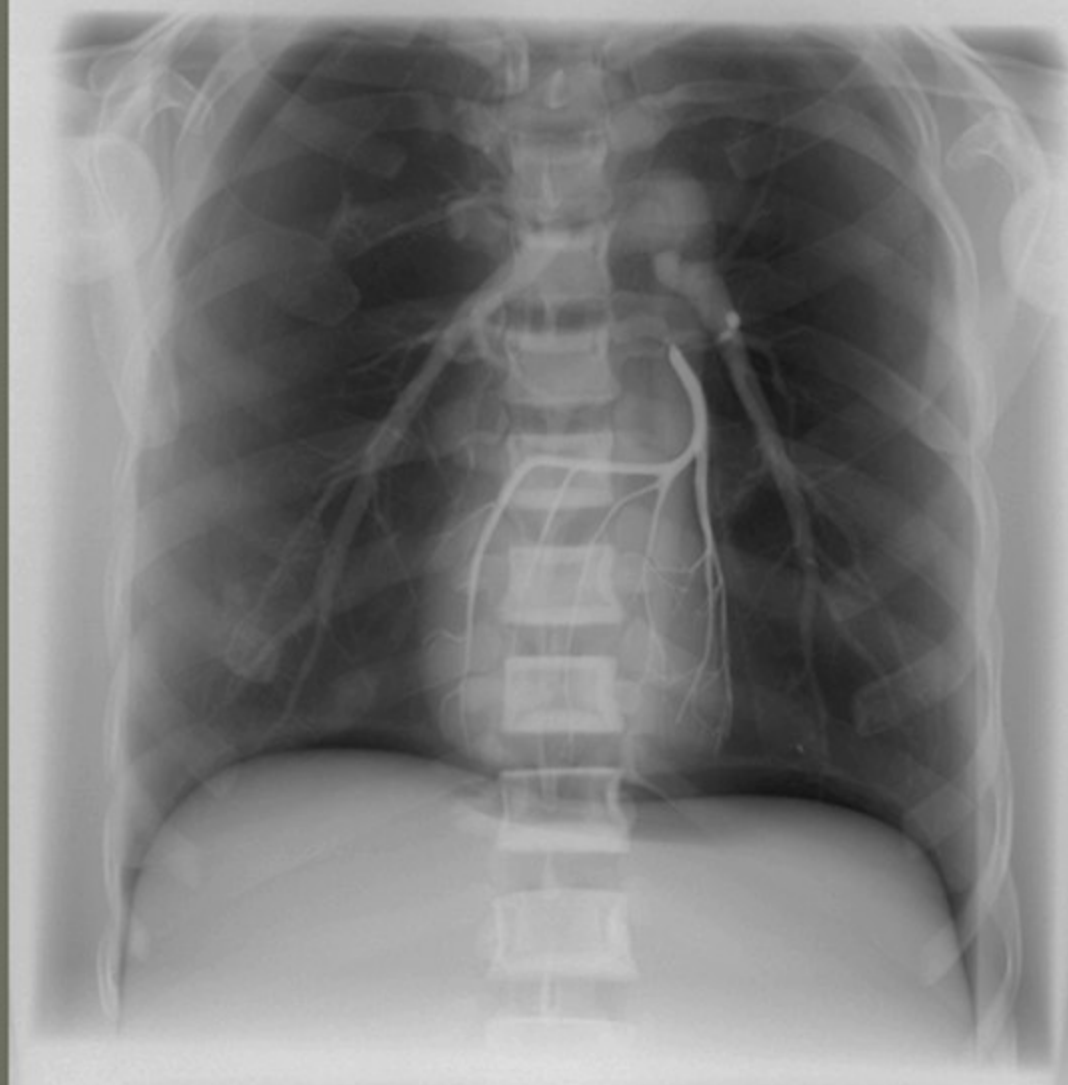
70kvp4mAs	60kvp4mAs	50kvp4mAs	40kvp4mAs
123456788	123456757	123456749	123456741
1.1.2000 M	1.1.2000 M	1.1.2000 M	1.1.2000 M
Institution Name	tution Name	tution Name	tution Name
1	1	1	1
DICOMIZED Images	ZED Images	ZED Images	ZED Images

WL: 128 WW: 256 [D]

21.2.2016 22:47:49 16 22:42:27 16 22:36:51 16 22:31:44

Im: 1/1
Se: 1

80kvp4mAs	70kvp4mAs	60kvp4mAs	50kvp4mAs	40kvp4mAs
123456774	123456785	123456757	123456749	123456741
1.1.2000 M	1.1.2000 M	1.1.2000 M	1.1.2000 M	1.1.2000 M
Institution Name	tution Name	tution Name	tution Name	tution Name
1	1	1	1	1
DICOMIZED Images	ZED Images	ZED Images	ZED Images	ZED Images



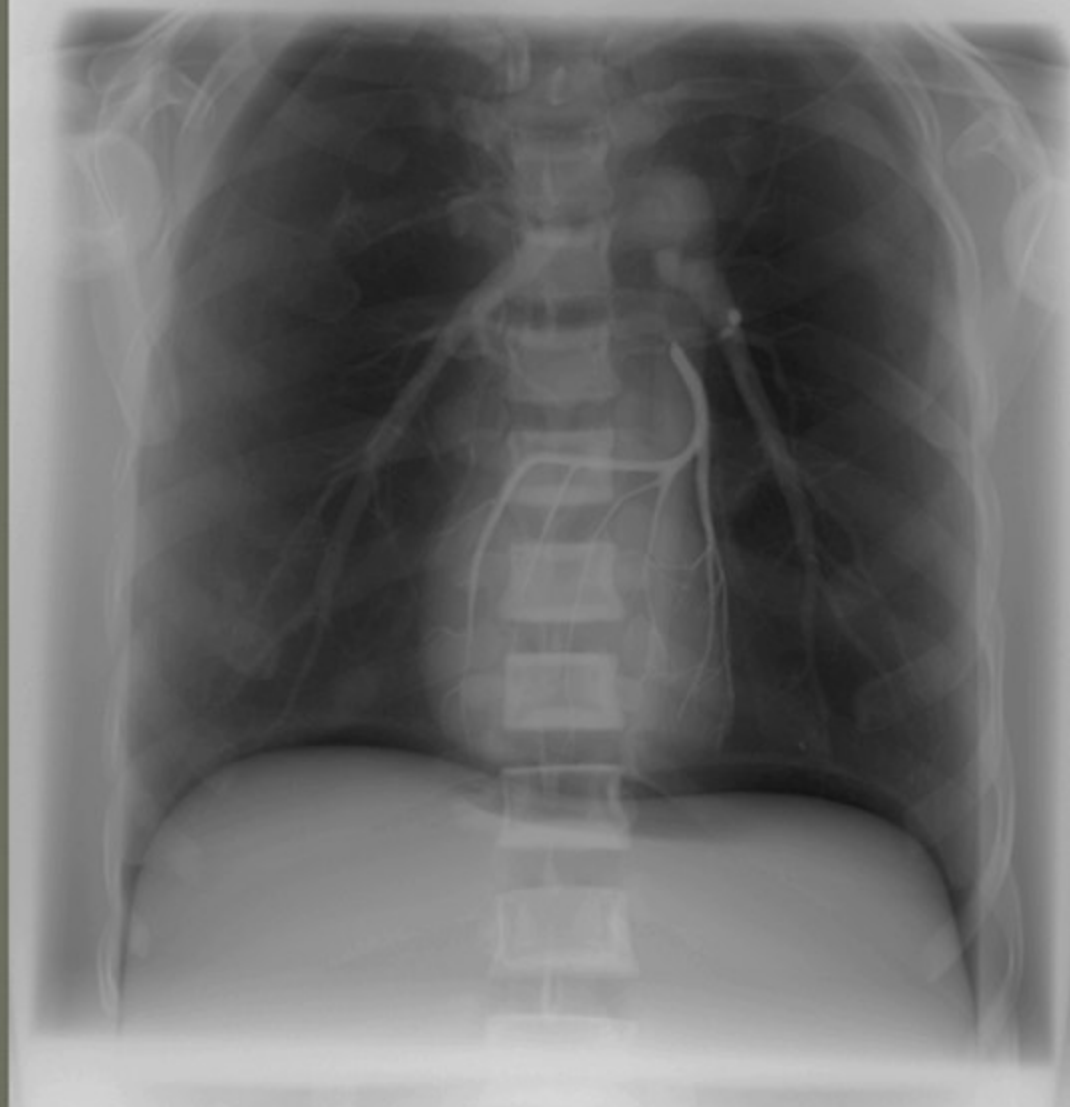
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21.2.2016 22:55:49 16 22:47:49 16 22:42:27 16 22:36:51 16 22:31:44

Im: 1/1

Se: 1

120kvp4mAs	80kvp4mAs	70kvp4mAs	60kvp4mAs	50kvp4mAs	40kvp4mAs
123456784	123456774	123456764	123456754	123456749	123456741
1.1.2000 M	1.1.2000 M	1.1.2000 M	1.1.2000 M	1.1.2000 M	1.1.2000 M
Institution Name	Institution Name	Institution Name	Institution Name	Institution Name	Institution Name
1	1	1	1	1	1
DICOMIZED Images	DICOMIZED Images	DICOMIZED Images	DICOMIZED Images	DICOMIZED Images	DICOMIZED Images



WL: 128 WW: 256 [D]

21.2.2016 23:07:29.2016 22:55:4916 22:47:4916 22:42:2716 22:36:5116 22:31:44

BİLGİSAYARLI TOMOGRAFİ

- Endikasyona göre protokol
- Kısa tarama alanı (mümkün olan)
- CTDI vol; 80, 50, 50, 30
- Tüp akım modülasyonu
- Gereksiz tekrar yapma

	BEYİN	GÖVDE
ERİŞKİN	80	50
ÇOCUK	50	30

RADYOGRAFİ

- Dijital grafi “look up table” ile kontrastı düzeltir ama detektöre ulaşmayan foton görüntü oluşturamaz.

- Yüksek kV
- Kolimasyon
- Filtrasyon



MAMOGRAFİ

- Sıkıştırma
- El çene kafa
- Aksiller kuyruk görülsün

FLOROSKOPI

- Hasta çalışanın radyasyon kaynağı
- Frekans düşük olmalı
- Skopi süresi grafiden uzun
- Aynı odağa skopi yapma
- Son resimi tut
- Detektör yakın tüp uzak
- Parametreleri kaydet takip et



DOZ HESAPLAMA

İŞLEM	FAKTÖR [mSv(mGy·cm ²) ⁻¹]
Tanısal Koroner anjio.	0,12
Anjioplasti	0.20-0.26
PTCA	0.18-0.28
Embolizasyon	0.26
Kardiyak RF ablasyon	0.10-0.23

$$E_{ef} = K \cdot DAP$$

$$E \text{ (anjio)} = 0.12 \times 3000 \\ = 360 \text{ mSv}$$

DOKU REAKSİYONU

Uzamis eritem ve epilasyon



Geçici eritem
ve epilasyon



Desquamasyon
kalıcı
epilasyon,
telenjektazi,
Deride atrofi



İkincil ülserasyon, derin
lezyona ilerleyiş

DOKU REAKSİYONU

DOZ(Gy)	<2 hf	2-8hf	6-52hf	>40hf
0-2	Ø	Ø	Ø	Ø
2-5	Tr eritem	Epilasyon	düzelme	Sağlam
5-10	Tr. eritem	Eritem/Epidualme*	Sağlam*	
10-15	Tr. eritem	Eritem/Epi Kalıcı Epi	Tele/Atr	
>15	Tr. Eritem*Desquam	Atr	Derin L	

* Yüksek dozda kalıcı etkiler olabilir

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DOKU REAKSİYONU

DOZ(Gy) <2 hf

2-8hf

6-52hf

>40hf

● 0-2

● 2-5

● 5-10

● 10-15

● >15Tr. Er



*** Yüksek dozda kalıcı etkiler olabilir**

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TAKİP

DOZ(Gy) Öneri

- 0-2 Bir takip önerisi yok
- 2-5 Eritem oluşabilir, kaybolur, rahatsız ise?
- 5-10 2-10 hf sonra kontrol, olası yeri,
doktoru
- 10-15 Tıbbi takip, profilaksi, ağrı kontrolü !
- >15 Tıbbi takip esas, nekroz ve ülser olası,
profilaksi, ağrı kontrolü !, doktoru

NE ZAMAN

PROTOKOLLER

1. Hasta dozlarında farklar var

1. Tekniker,

2. Cihazlar,

3. Merkezler arasında

2. Protokol HER YIL gözden geçirilmeli

3. El altında olmalı (SKS Soracak!)

4. DRL takibi kontrolü (kalite kontrolü!)

5. Doz takip sistemleri (tracking)

- ◉ **KİM** RADYOLOJİ TAKIMI
- ◉ **NE** OPTİMİZASYON
- ◉ **NEDEN** HASTA GÜVENLİĞİ
- ◉ **NASIL** PROTOKOL & STANDART
- ◉ **NE ZAMAN** PERİYODİK
- ◉ **NEREDE** TÜM MODALİTELER

TEŞEKKÜR EDERİM
