Patient Effective Dose during pacemaker implantation at a Flat Panel and Image Intensifier angiography system

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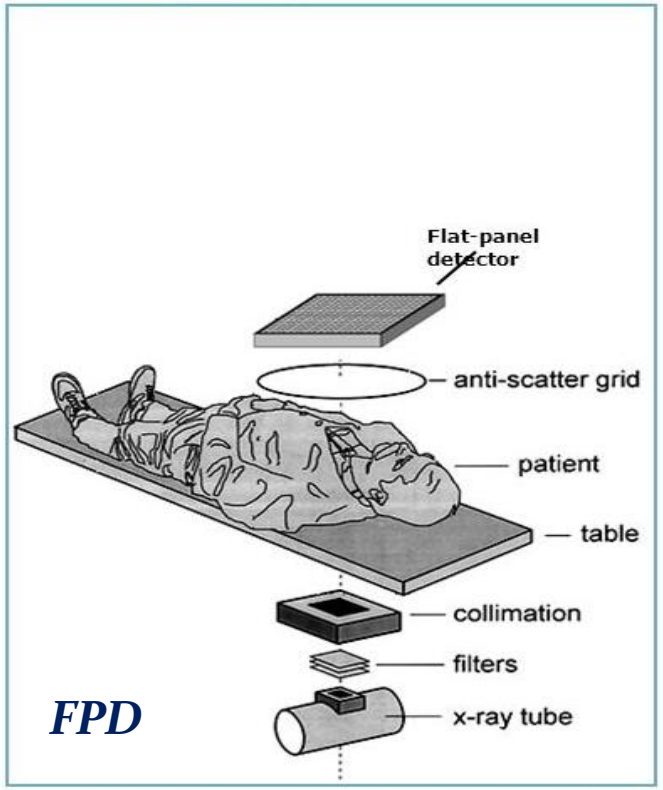
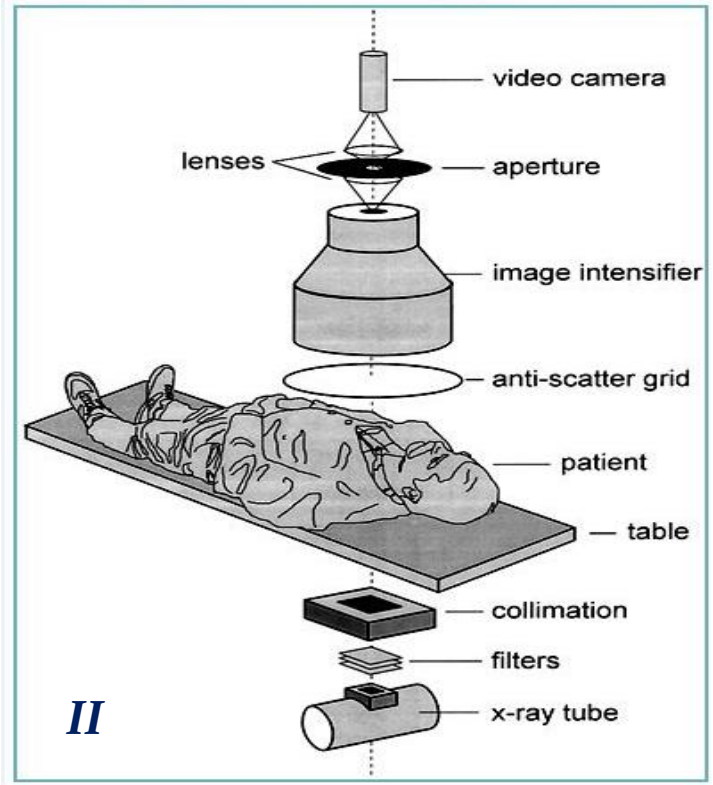
1. Purpose

Pacemaker implantation is a minimally invasive technique performed under fluoroscopic guidance. This study aims to compare Effective Dose (ED) delivered to patients at pacemaker implantation procedures by two angiography systems of different image capture technology; one with flat panel detector (FPD) and one with image intensifier (II).





c.f. Bushberg, et al. The Essential Physics of Medical Imaging, 2nd ed., p. 232.

2. Methods

2.1 Data Collection

A retrospective analysis of 70 pacemaker implantations by a FPD and an II angiography system involving data:

- DAP(Gy × cm²) → ***× 0.2 mSv/(Gy×cm²)*** → Effective Dose (mSv)
- Fluoroscopy time (t_f)
- Type of angiography system
- Operator's ID
- Patient's weight
- Patient's height

→ ***Weight/height²*** → BMI (kg/m²)

2. Methods

2.2 Data Grouping

- **Angiography system:** FPD - II
- **Fluoro time**: $1 \text{ min} \leq t_f < 5 \text{ min}$
  $101 \text{ min} \leq t_f \leq 5 \text{ min}$
- **BMI Categories**: Normal - Overweight - Obese
- **Operator's ID**: A - B - C



3. Results

3.1 Total ED estimation

Statistically significant differences between implantations in a FPD and II angiography system concerning:

Effective Dose & Fluoroscopy time

	FPD (n=35)		II (n=35)	
	ED (mSv)	**Time (sec)**	**ED (mSv)**	**Time (sec)**
Mean	***1.06***	300	***16.77***	910
Range	**0.09 – 3.78**	67 - 1062	**0.51 – 158.73**	108 - 6092

Why?

- Patient's BMI → Different mAs → ED
- Operator's experience → Fluoroscopy time → ED
- Different image capture technology

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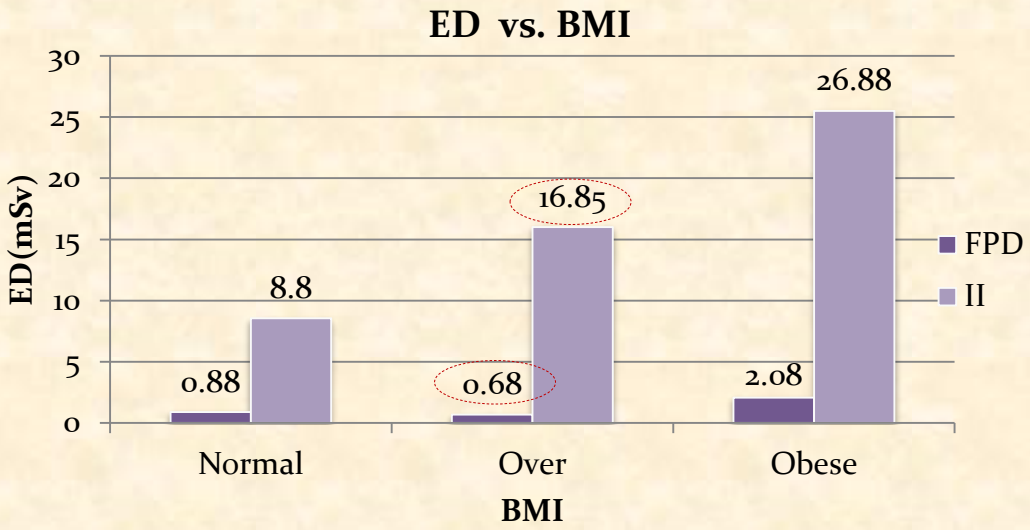
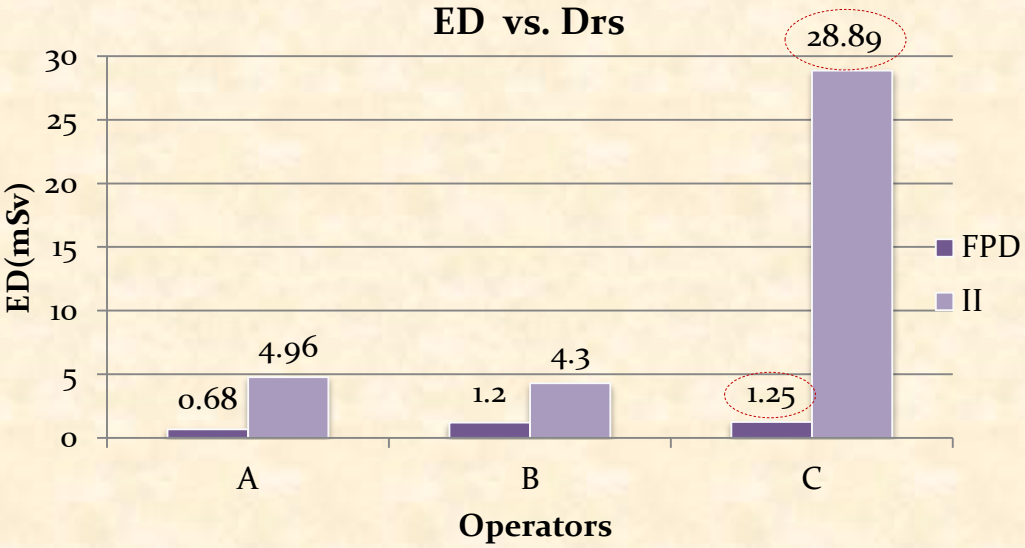
3. Results

3.2 *ED estimation: different BMIs and Operators*





- $ED_{II} > ED_{FPD}$ in all cases

Statistically significant differences
$p < 0,05$

- Operator C → greater amount of doses compared with A and B
  - More obese patients
  - Increased fluoroscopy time

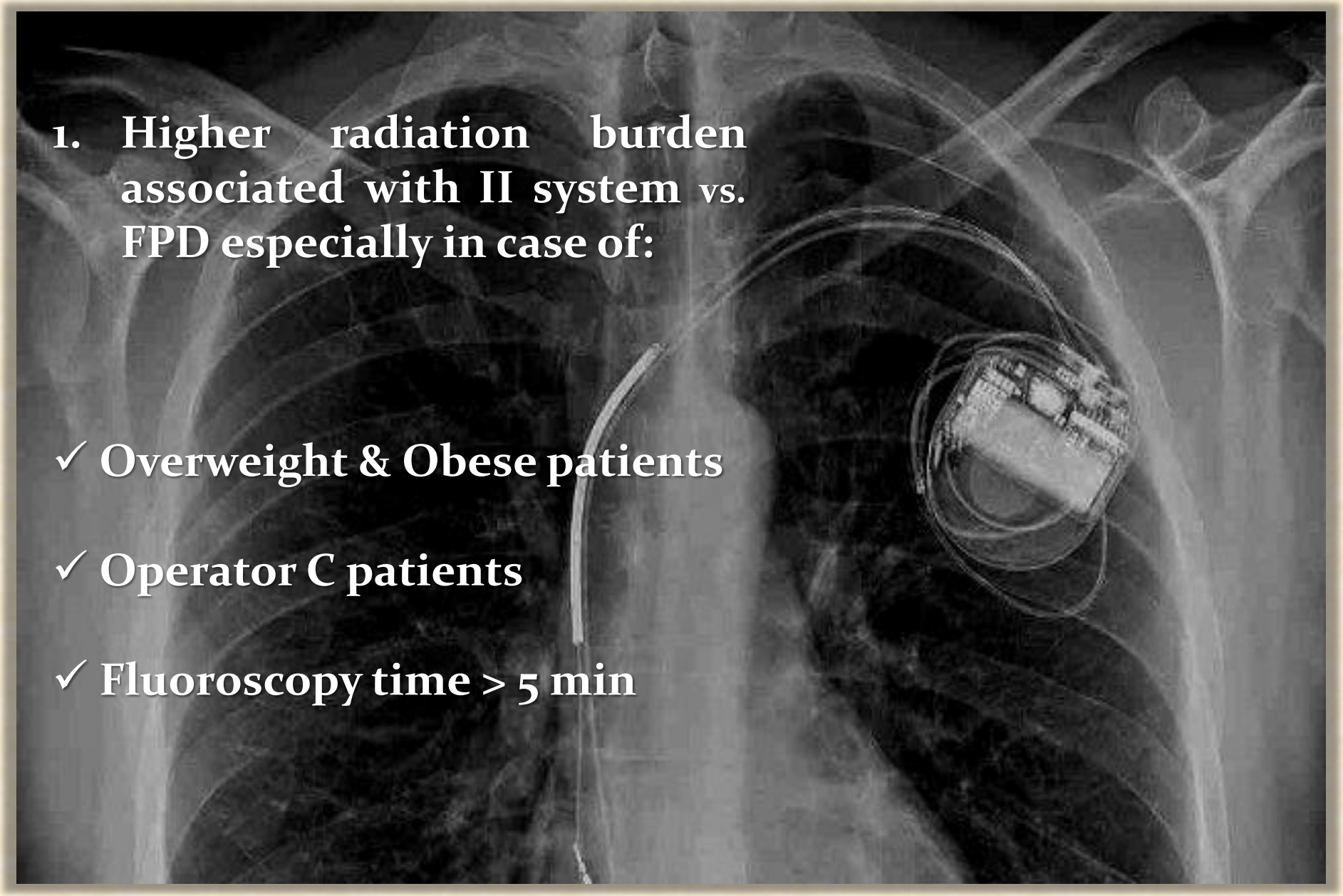
3. Results

3.3 *ED estimation: different fluoroscopy time for each BMI category*

BMI	FPD		II	
	Mean ED (mSv)	**Range**	**Mean ED (mSv)**	**Range**
$t_f < 5$ *min (n=34)*				
Normal	**0.49**	0.09 – 1.1	**0.5**	0.5 – 0.8
Overweight	**0.67**	0.4 – 1.2	**2.49**	1.86 – 3.58
Obese	**1.18**	1 – 1.3	**1.7**	0.8 – 3.3
$t_f > 5$ *min (n=36)*				
Normal	**1.57**	0.7 – 3.7	**12.29**	1.88 – 49.27
Overweight	**0.74**	0.45 – 1.26	**28.36**	6.27 – 103.6
Obese	**2.93**	2.93 – 3.45	**35.27**	5.84 – 158.73

- Even in the same time and BMI category, the ED involved in II angiography system is greater

4. Conclusion



1. **Higher radiation burden associated with II system vs. FPD especially in case of:**

- ✓ **Overweight & Obese patients**
- ✓ **Operator C patients**
- ✓ **Fluoroscopy time > 5 min**

4. Conclusion

2. Suggestions:

- ✓ Overweight & Obese patients' implantations at FPD system
- ✓ Cardiologists' training for minimization of fluoro time
- ✓ The impact of case severity on fluoro time → ED should be examined