

Evaluation of radiation dose during pacemaker implantations



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Introduction

- The implantation of permanent cardiac pacemakers is a quite common and simple procedure where fluoroscopy is employed in the manipulations required for the successful placement of the pacemaker.
- According to the EU directives and legislation, fluoroscopy should be used in such a way so that the radiation dose to the patients is as low as reasonably achievable (ALARA principle).

Purpose



The purpose of the study was to evaluate patient radiation doses during implantation of permanent cardiac pacemakers and compare with other interventional procedures.

Materials and Methods

- X-ray equipment:
 - ✓ The procedures were carried out with a recently installed mobile undercouch Philips BV Pulsera C-arm machine with a 23 cm diameter image intensifier.
 - ✓ The radiation dose is provided by the X-ray machine, in terms of Air-Kerma (AK). Kerma Air Product (KAP) was then estimated from AK and the X-ray field size.
- Types of pacemakers :
 - ✓ D (two leads are employed; one for pacing the right ventricle and one for atrial sensing)
 - ✓ V (a single lead is employed for both pacing and sensing).
- Cardiologists:

3 cardiologists performed the procedures, 2 of which had more than 10 years of experience and 1 had 2 years of experience.

Patient data

- 128 patients that underwent permanent pacemaker implantation were monitored.
- No restrictions on patient weight, sex or clinical condition was set.
- Procedures concerning patients in critical condition and procedures that were not successfully completed were not included in this study.
- Other patient parameters recorded were: patient weight, age, kV, mA and fluoroscopy time (T).
- The effective dose (E) was estimated using a conversion factor of 0.18 mSv/Gycm^2 .

Results (1)

		KAP (Gycm ²)	T (min)	E (mSv)
All patients	median	6.4	5.14	1.1
	min	1.3	0.05	0.2
	max	45.7	27.4	8.2
type D	median	6.3	5.2	1.1
type V	median	7.1	5.4	1.3

- 13 out of the 128 patients (10 %) had a V type pacemaker and the rest 90% had a type D pacemaker.
- Doses did not exhibit a normal distribution, so median (range) values were estimated.
- Max/min KAP ratio was approximately 35.
- The last 2 rows show the median values of KAP depending on the type of pacemaker.

Results (2)

Operator	N procedures	median	
		T (min)	KAP (Gycm ²)
1	32	6.3	6
2	62	4.5	5.2
3	14	6.2	10

- There was no statistically significant difference between operator 1 and 2.
- Median KAP of operator 3 was almost double than corresponding values of operators 1 and 2 due to:
 1. *More limited experience*
 2. *Use of angulated views*

Discussion

- Large range of radiation doses were observed.
- There was no statistically significant difference between type D and V pacemakers ($p=0,31$)
- Median E was 1.1 mSv, which corresponds to approximately one lumbar spine X-ray radiography ($E=1.2$ mSv, *NRPB W-4 2002*).
- Pacemaker implantation E in our hospital is:
 - ✓ *similar to the value given by NRPB W-4 2002*
 - ✓ *much lower than a coronary angiography (~ 8 mSv) or a electrophysiology study (~ 6 mSv).*

Conclusion



- The results of the study show that the level of radiation dose is low compared to other interventional cardiology procedures and is comparable to the conventional lumbar spine radiography.
- It seems that the experience of the cardiologist and the use of angulated views increase the radiation dose to the patient and will be investigated in more detail in the near future.