



How significant is the radiation exposure during electrophysiology study and ablation procedures for supraventricular tachycardia?



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ABSTRACT

Radiation exposure during electrophysiology procedures has been a point of discussion. We measured the ionising radiation dosage during ablation procedures for supraventricular tachycardia. This was compared with coronary angiographies performed via the radial route to put it in perspective. We found that the radiation dosage during the ablation procedure was far lower, less than forty percent of that during coronary angiography (Air Kerma $249.1 \text{ mGy} \pm 266.95 \text{ mGy}$ v/s $671.9 \text{ mGy} \pm 328.6 \text{ mGy}$; $p < 0.001$).

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1. Introduction

Radiation exposure during conventional electrophysiology and radiofrequency (EP/RFA) procedures has been a reason cited for the increasing use of newer expensive electroanatomic mapping systems. To put this in perspective, we compared the Ionizing Radiation (IR) exposure in conventional EP/RFA procedures for supraventricular tachycardia (SVT), with coronary angiography (CAG) performed via the radial route.

2. Method

We prospectively analyzed the two-month data (January and February 2020) of IR exposure in all successful SVT ablation procedures and radial CAG. Patients with atrioventricular nodal reentrant tachycardia, accessory pathways and atrial tachycardia were included. Patients with more than one tachycardia mechanism were excluded. In the CAG arm, we excluded patients with i) acute coronary syndrome taken for primary intervention, ii) anomalous coronary origins and iii) prior coronary artery bypass surgery. During CAG, fluoroscopy was at 15 frames per second (FPS) of pulse rate (PR), while EP/RFA was done mostly with 7.5 FPS of PR (during transseptal puncture, it was increased to 15 FPS). All the procedures

were done in a floor mounted catheterisation laboratory (Artis Zee, Siemens).

We collected the data regarding air kinetic energy release in matter (Kerma), measured in milli-gray (mGy), dose area product (DAP) measured in cGy.cm^2 , total cine exposures and the fluoroscopy time, measured in minutes. These we compared among the two groups using the independent 't' test.

3. Results

Altogether 55 patients with CAG and 45 patients with EP/RFA were found eligible for the study. All procedures were performed with conventional mapping. The age of the CAG group was 57.8 ± 11 years, with male/female distribution of 37/18; in the EP/RFA group the age was $42 \text{ years} \pm 15.2$ years, with male/female distribution of 22/23. The diagnoses were atrioventricular nodal re-entrant tachycardia (23, 51.1%) [amongst which 2 were atypical and rest typical], accessory pathways (18, 40.0%) [amongst which 9 were right sided pathways, 7 left sided pathways, 1 of coronary sinus diverticulum and 1 of anteroseptal pathway], and atrial tachycardia (4, 8.9%) [amongst which 2 were left atrial tachycardias, 1 was ablated from non-coronary sinus of aorta and 1 was ablated from upper septum]. Two left atrial tachycardias and 3 left-sided pathways required septal punctures. No jugular puncture was needed. All procedures were successful.

The details of IR exposure are detailed in Table 1. As evident, the Air Kerma was much less in EP/RFA as compared to CAG

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Table 1
Radiation dosage in coronary angiogram and electrophysiology study/radiofrequency ablation procedures.

Parameters	Coronary Angiogram (n = 55)	EP/RF ablation (n = 45)	p value
Air Kerma (mGy)	671.9 ± 328.6	249.1 ± 267.0	<0.001
Dose area product (cGy.cm ²)	3373.3 ± 1800.4	1747.7 ± 2309.0	<0.001
Fluoroscopy time (minutes)	3.6 ± 2.8	13.4 ± 10.6	<0.001
Cine exposures	9.6 ± 2.4	3.7 ± 4.1	<0.001

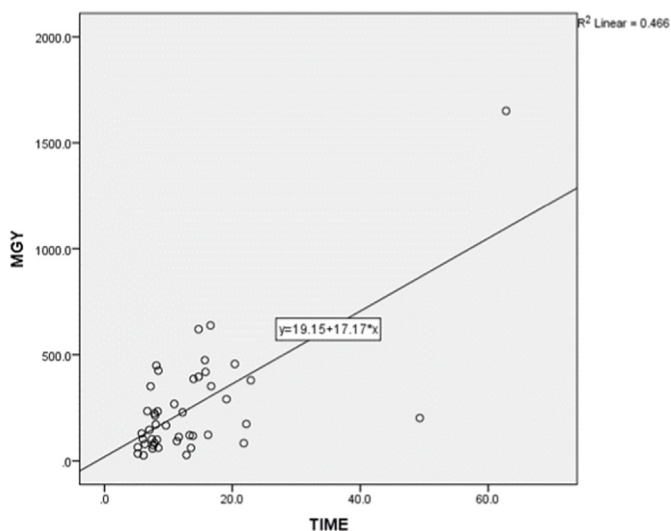


Fig. 1. Scatter diagram showing the relation between fluoroscopy time and Air Kerma of EP/RFA cases.

(249.1 ± 267 mGy v/s 671.9 ± 328.6 mGy, p < 0.001); as was DAP (1747.7 ± 2309 cGy cm² v/s 3373.3 ± 1800.4 cGy cm² p < 0.001). The total number of cine exposures were also much less in EP/RFA as compared to CAG (3.71 ± 4.1 v/s 9.55 ± 2.44, p < 0.001). The fluoroscopy time was higher in EP/RFA as compared to CAG (13.4 ± 10.6 min v/s 3.6 ± 2.8 min, p < 0.001). A Pearson product–moment correlation was run to determine the relationship between fluoroscopy time and Air Kerma in the EP/RFA group. There was a strong, positive correlation between fluoroscopy time and Air Kerma, which was statistically significant (r = .682, n = 45, p < .001). A linear regression established that fluoroscopy time statistically significantly predict Air Kerma, F (1, 43) = 37.47, p = .0001 and fluoroscopy time accounted for 46.6% of the explained variability in Air Kerma. The regression equation was predicted Air Kerma = 19.15 + 17.17 x (fluoroscopy time) (Fig. 1). According to this equation around 38 min (which is three times the mean fluoroscopy time of an EP/RFA case) of fluoroscopy time would be required in an EP/RFA case to equalize the mean radiation exposure of a CAG.

4. Discussion

Standard studies post 2010 show an average Air Kerma in the range of 500–600 mGy, average DAP around 3000–4000 cGy cm²

and average fluoroscopy time in the range 3–8 min for CAG.^{1,2} Studies on EP/RFA of SVT show Air Kerma in the range of 200–300 mGy, an average DAP of around 2000 cGy cm² and average fluoroscopy time of 12–15 min.^{3,4} Our study gives us similar findings in the two categories, and is unique in comparing the IR between CAG and EP/RFA in the same center. We found that a conventional EP/RFA procedure for an SVT can be done in much lesser IR exposure than a CAG procedure. The major factors for this are i) the requirement for a higher digital PR during CAG and ii) The negligible need for cine-imaging during EP/RFA procedures. Hence, despite a three-fold longer fluoroscopy time, the total IR for EP/RFA was just around 40% of that during CAG procedures. Next-generation operators may use low/zero-fluoroscopy techniques for the standard procedures included in this study. However, in addition to the financial burden, this has to match or better the excellent long-term safety record of AVNRT ablation using conventional mapping.

5. Conclusion

The radiation exposure during conventional EP/RFA procedures for SVT was modest, far less than that for a diagnostic CAG done via the radial route.

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Declaration of competing interest

None.

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