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Research on reducing radiation exposure during cardiac angiography.

K.Kato,H.Sato,T.Take,Y.Nakazawa,T.Kitanosono,H.Munechika
Depertment of Radiology,Showa university hospital,Hatanodai 1-5-8
Shinagawa-kuTokyo Japan

Background/Purpose

Recent advances in devices involving cardiac catheterization, especially interventional procedures, has lead to increase in examination time and consequent increase in fluoroscopy time and number of filming exposures. Increase in radiation exposure to the patients and the medical personnel has been closed up as a serious agenda.
In this study, we focused on the factors that lead to reduction in radiation exposure to the patients and medical staff, especially nurses, and discussed their efficacy.

Materials

Cardiac angiography equipment: Advantx LC+L/P (GE medical system Milwaukee)
Dosimeter: ion chamber survey meter MODEL 450 (VICTROREEN)
SKIN DOSE MONITOR MODEL SDM104-101（McMAHON）
Radiation protection equipment: protector 0.25mmPb (Maeda corp)
Angiocurtain (Hoshina corp)
Angiomat (Hoshina)
Protectieve shield 2.0mmPb (Crator XA corp)

Methods

1-1. 20 cases form cardiac angiography procedures performed during 1998 were videotaped and reviewed for unnecessary fluoroscopy and filming exposures.
1-2. Reduction in patient radiation dose from omitting the unnecessary irradiation were calculated.
1-3. Medical staff were notified of the calculations and were encouraged to take measures to reduce patient radiation exposures.
2-1. Scatter radiation distribution was measured in the cardiac angiography suite.
2-2. The angle of exposures during measurements were A-P, Lat, RAO, LAO, CRA and CAU.
2-3. Results from the measurements were clearly marked on the angiography suite floor using vinyl tape to make the medical personnel visually aware of the amount of radiation exposure they are receiving and to instruct them to keep as much distance from the x-ray generator as possible.
2-4. Film badge readings for the past two years were evaluated from the medical personnel, especially nurses who are thought to have the most radiation exposures, to evaluate the effect of the visual enlightenment and education.

Results

1. After reviewing the videotape of 20 cardiac angiography cases, and after subsequent education, mean fluoroscopic time was reduced from 45.9 minutes in 1998 to 39.6 minutes in 1999. (Table 1,Table 2)
2. Soft radiation filters and low flame rate exposures were selected for reducing patient radiation exposures. The filters resulted in approximately 4 kVp increase in the tube voltage but did not interfere with image quality and approximately 40% decrease in patient radiation exposure. Approximately 25% reduction in patient radiation exposure was monitored by reducing the flame rate from 30 flames per second to 15 flames per second.
3. Dose distribution in the cardiac angiography suite is shown in Figure 1. Together with radiation protection gear, nurses' radiation exposures were reduced up to 1/10.
4. Visual enlightenment with the floor vinyl tape markings of dose distribution resulted in monthly decrease in nurses' radiation exposure (Fig. 2) during the 2 year study period.

Discussion

Soft radiation filters resulted in increase of voltage by approximately 4kVp. Image degradation due to contrast deterioration did not occur at clinically noticeable level and was thought to be an effective measure in reducing radiation exposures.

Visual effect from vinyl tape markings based on the dose distribution measurements on the floor enabled easy and effective education to reduce radiation exposures. Excellent results were obtained. However, in a few of the personnel, slight increase in radiation exposures were noted after the initial decrease. Continuous education was thought to be necessary in obtaining lasting reduction of radiation exposures.

Conclusion

Factors in reducing patient and medical personnel radiation exposures and their efficacy were evaluated. 20% reduction in fluoroscopic time, 40% reduction by adding soft radiation filters and 25 reduction by reducing flame rates were made possible.

By appropriate protection gear, up to 90% reduction in radiation exposures were made possible. Visual markings of dose distribution was an highly effective means of education to the medical personnel notably nurses.

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	'98	'99
Non IVR	747	770
IVR	410	507
total	1157	1277

(cases)

Table1 Number of cases of cardiac IVR('98.'99)

		'98	'99
Non IVR	study time	62.9	79.6
	Fluorotime	19.1	17.5
	feet	322.5	295.4
IVR	study time	110.7	117.1
	Fluorotime	45.9	39.6
	feet	468.5	350.7

(time : min)

Table2 After reviewing the videotape of 20 cardiac angiography cases, and after subsequent education, mean fluoroscopic time was reduced from 45.9 minutes in 1998 to 39.6 minutes in 1999.

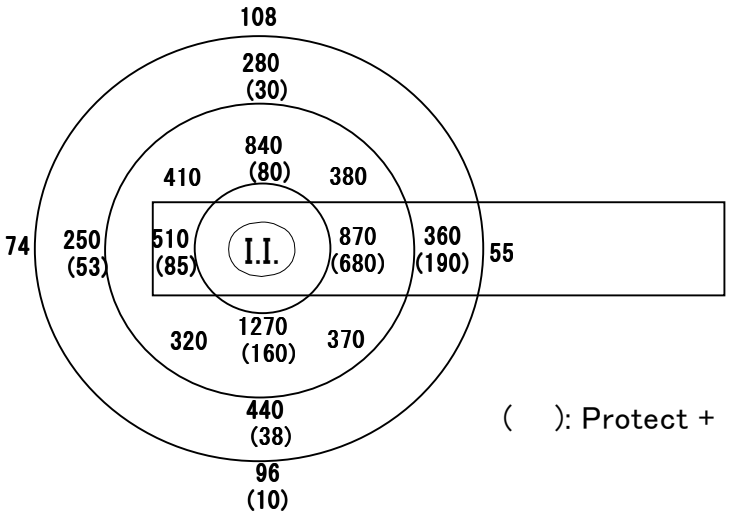

Fig.1 Dose distribution in the cardiac angiography suite is shown. Together with radiation protection gear, nurses' radiation exposures were reduced up to 1/10.

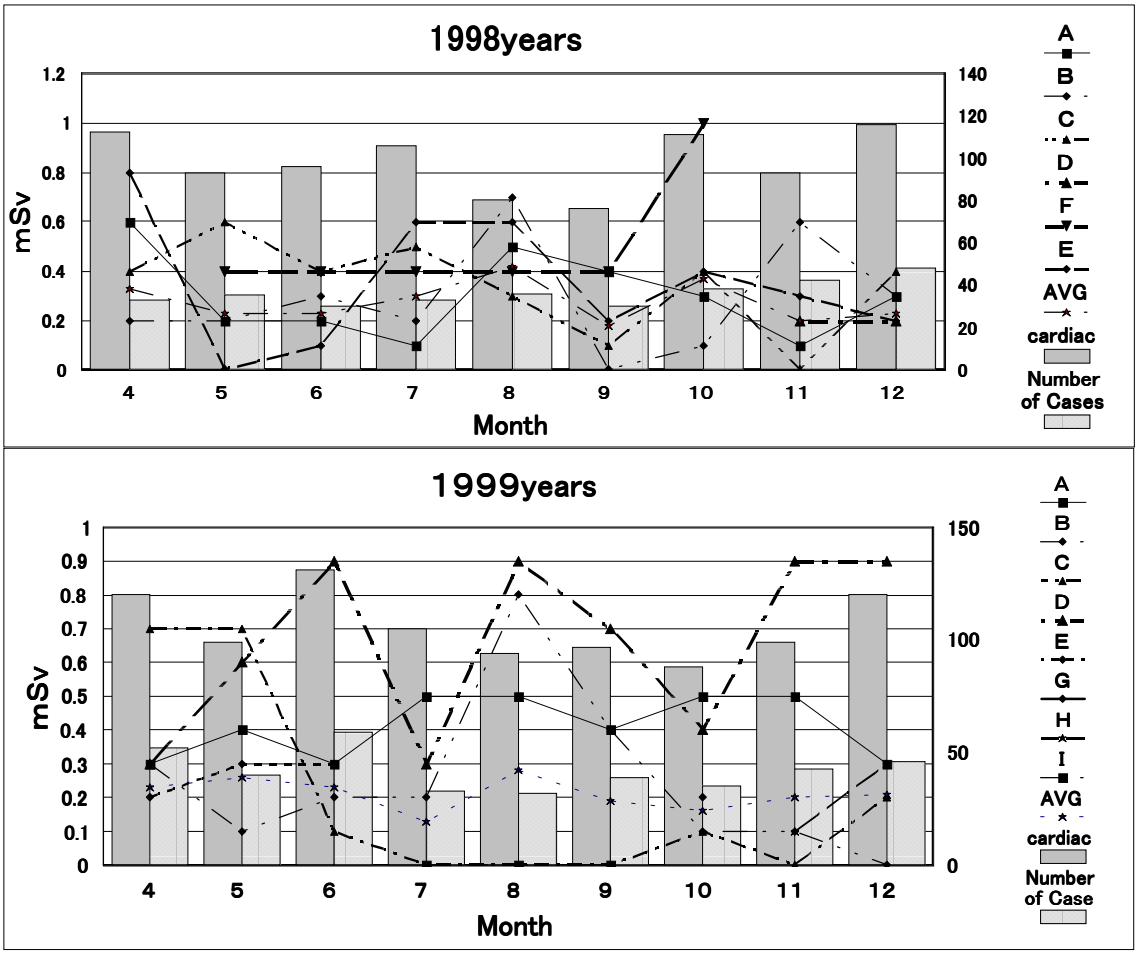

Fig.2 Visual enlightenment with the floor vinyl tape markings of dose distribution resulted in monthly decrease in nurses' radiation exposure during the 2 year study period.

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