DOSES RECEIVED DURING INTERVENTIONAL PROCEDURES

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Introduction

In the United Kingdom, radiation doses from medical sources make up 97% of the total collective effective dose to the population from man-made sources [1], due mainly to the large number of x-rays performed. The contribution of interventional radiology procedures to the collective effective dose in the U.K. is unknown as these procedures are not regularly monitored. The contribution of interventional to the population dose from medical exposures could be as high as 40% in some countries. Thus there is some uncertainty in the collective effective dose from medical sources in the U.K. Furthermore, there is no mention of interventional radiology by the National Protocol. Radiation dose and risks from these procedures are therefore of interest.

It is surprising, therefore that the effective dose to patients from many interventional radiology procedures has not been assessed in large scale regional studies. Though the frequency of the procedures is low, the dose for each examination can be high. Patient exposures are high because the screening times are often long and a large number of radiographic exposures are taken. It is therefore necessary to monitor the dose patients receive during these procedures.

Interventional studies performed on twenty-two different fluoroscopy sets were monitored as part of a Regional patient dosimetry programme. The data have been collected using a computer to read and reset the dose-area product meter and also to collect patient and examination details. Data is loaded onto the regional database at quarterly intervals. All the examinations performed in the room are monitored including many interventional procedures.

Method

Diamentors, (PTW, Freiberg), were used to measure the dose-area product. A Diamentor consists of a large area ionisation chamber and control box. Data was collected for a range of examinations including angioplasty, biliary drainage, embolisation and nephrostomy. The examinations included in this study were performed on twenty-two different sets.

The dosimetry method was based on recommendations made in the National Patient Dosimetry Protocol [2]. The dose-area product is particularly useful for assessing and comparing the radiation dose from screening procedures, where the dose-area product provides a more useful indication of overall patient exposure than measurements of surface dose to particular location. Calibration of the instruments was carried out insitu, using a method traceable to a National Standard [3]. The collection of data in this dose survey was automated by use of an IBM compatible laptop computer to read and reset the Diamentor remotely and also to record the patients and the examination details as follows;

Patients: Name, Age, Sex, Height, Weight

Examination:kV, Screening Time, Number of Radiographs, Number of Spot Exposures, Radiologist

This represents a convenient and practical method of collecting data for a large scale survey of this kind.

The results from each department were copied onto floppy disc and sent to the regional centre at quarterly intervals. At the data collection centre the results were loaded onto the database. In order to make meaningful comparisons, the dose area product values were size corrected, as described elsewhere [7] , to the value the patient would have received had they been reference man size. This method uses the concept of equivalent diameter [8]. The patient is approximated by a cylinder of water having the same height and weight as the body. This reduces the variability due to patient size but does not limit the patient size sample. This correction was applied only to examinations involving the main trunk of the body.

Uncertainties

The uncertainty in the dose-area product reading as quoted by the manufactures is ±3% [8]. The calibration factor, which converts the dose-area product meter reading to mGycm^2 is slightly dependent on the tube potential but a single calibration factor is applied to all the data resulting in an overall uncertainty of ±10% in the result.

Results

The results of the dose survey are summarised in table I, giving the mean and median dose-area product values and size corrected dose-area product for each examination. The number of patients, mean screening time, mean energy imparted number of radiographs and number of spot exposures are also given for each examination. The results presented include over seven hundred interventional procedures. Figure 1 illustrates the variation in dose during these procedures, with the dose received during barium studies also shown.

Table I Summary of Results for Interventional Procedures

Examination	Number of Patients	Dose-Area Product Gycm^2		Size Corrected Dose-Area Product Gycm^2		Mean Screening Time (secs)	Mean Number Radiographs	Mean Number Spot Exposures	Mean Energy Imparted mJ
		Mean	Median	Mean	Median				
Angioplasty	337	12.9	7.8	14.3	7.4	446.8	0.6	30.1	126.0
Oesophageal Dilatation	25	12.2	7.5	16.0	8.0	278.4	0.3	2.0	511.1
PTC	83	36.0	25.6	34.3	28.6	874.9	0.7	6.1	352.4
Fluoro Guided Biopsy	65	5.5	1.5	5.4	1.7	123.8	0.3	1.2	54.3
Nephrostomy Drainage	51	16.5	11.2	16.5	13.2	568.3	0.2	4.1	160.5
Nephrostomy	20	12.3	10.3	13.2	8.7	566.3	0.4	2.6	119.9
Embolisation	92	115.1	16.4	110.1	85.0	1404.5	0.0	200.0	1202.2
Biliary Intervention	55	42.1	25.9	40.2	29.8	662.6	0.4	8.3	376.4
Biliary Drainage	42	33.4	35.2	37.0	32.3	1056.8	0.4	5.8	384.0
Dilatation	22	8.4	1.5	10.7	2.5	227.8	0.1	2.4	106.2
Stent	19	40.9	23.9	36.5	25.3	1049.3	0.0	17.6	378.5
Coronary Angiography	1738	56.8	44.5	47.7	37.0	339.7	0.2	580.0	449.1
Coronary Angioplasty	182	77.9	59.8	72.2	66.9	702.8	0.1	395.0	674.1
Radio Frequency Ablation	61	106.3	74.3	91.1	67.0	1718.3	0	75.6	826.4
Mitral Valvuoplsty	31	151.9	116.0	161.9	109.8	2058.6	0	331.9	1348.3

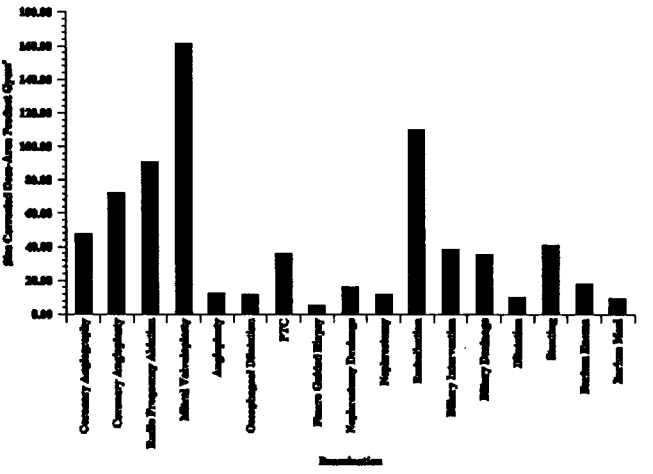

Figure 1 Mean Dose-Area Products for Interventional Procedures

Conclusion

Results are presented here from 2789 patients undergoing a range of interventional procedures. Comparing the results here with the results in [9], 47.7, 72.2,37 161.9 are the results obtained in this study compared with 66.5, 87.5, 68.9, 96.4 from [9] for coronary angiography, coronary angioplasty, biliary drainage and mitral valvuloplasty respectively. Though these examinations are infrequent, contribute significantly to the total dose from medical exposures. These results may be used to compare departments and hence optimise the dose during these procedures.

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