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HOW CHANGES IN A RADIOLOGIST'S TECHNIQUE CAN REDUCE PATIENT DOSE IN BARIUM ENEMA STUDIES

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Abstract

Changes in a radiologist's technique, especially utilising digital technology, can lead to substantial dose savings in barium enema examinations. Data will be provided showing a 20% saving with only minimal change in technique.

1. Introduction

Since the publication of ICRP60, there has been a considerable amount of work carried out by many to reduce the dose received by patients during common fluoroscopy procedures. This has included equipment improvements, optimisation of equipment, use of fast film/screen combinations, etc. Papers have been published showing large dose savings can be made by attention to equipment [1, 2], but also numbers of papers have been published which have commented that dose can vary considerably depending on the clinical technique [3-11]. These comments do not appear to have been noticed by the radiological community at large, but there are exceptions [12,13]. Many suggest that dose can be reduced by careful clinical radiological technique. This paper follows on from my presentation at IRPA10 [12].

Table 1. Dose results for Barium Enemas.

	Films	Scr.Time	DAP Gycm^2	Films	Scr. Time	DAP Gycm^2
Martin [1] (Range)	12.2 (11.8-12.5)	1.6 (1.5-2.2)	26.1 (11.9-37.6)	12.2 (12-12.4)	3.1 (2.5-3.7)	17.3 (8-26.6)
Hart [7]	10.1	2.9	20	10.7	3.8	16.6
Broadhead [8] (Range)	9.2 (0-30)	2.9 (0.7-38)	21.3 (0.2-1110)	9.7 (0-90)	2.8 (0.5-14)	11.7 (1-399)
Geleijns [9]	28	7.7	21.4	27	7.8	15.3
Warren-Forward [14] (Range)	6.8 (3-11)	2.4 (1.8-3.2)	29.2 (15-47)	8 (3-15)	2 (1.5-2.3)	25 (16-39)
Yakoumakis [2]	7.4	6.2	35			
Lampinen [15] (Range)	11.6 (3-21)	3.2 (1.4-11.9)	35.8 (8-140)			
Ruiz – Cruces[13]		3.8	56.9			
Vaño[16]			49			
Corbett[12] (Range)	12 (9-14)	1.8 (1-3.7)	23.8 (10.1-46.9)	12 (9-14)	3.2 (0.3-9.6)	23.8 (1.4-78)

2. Discussion

Table 1 gives published results for barium enemas from authors from several countries, my results and personal observations from Professor Vaño, Spain [16].
The introduction of Reference Dose Levels in the European Union has spawned a number of publications and conferences [17-20] to highlight their use. These have been well attended by medical physicists. Very few radiologists have attended or shown any interest so far. The purpose of Reference Doses or Levels is to instigate an investigation as to why any examination should give consistently high dose over a period of time. These levels have to be set either EU wide, Country wide or even just within a department. However it is quite clear from the tables that there is a considerable variation between doses in different countries, departments and even equipment. While the equipment variation is well known and has been addressed before, the variation in technique between individual radiologists has not been extensively investigated. I feel this is largely because of that jealously guarded 'right': clinical autonomy. This means that any radiologist feels he or she may use as much radiation as they feel like to get the required clinical information. Each radiologist has his or her own way of doing things. Some take more films, some use extensive screening, and some use video grab. None, or very few, use the same way. From the tables, it can clearly be seen that there must be a major philosophical difference between the way radiologists in the UK, as a whole, work and elsewhere. UK doses are low compared with many other countries. Ruiz-Cruces reports average doses of 56.9 $Gycm^2$, almost 5 times greater than doses from Hairmyres Hospital, described in Table 3. There is even a drive led by the UK National Radiological Protection Board (NRPB) for even lower doses, achievable doses [21]. It will be very difficult to measure the influence of this dose variation, as clinical outcome studies have not to my knowledge been published. Work has been done in Edinburgh, Scotland, on this, which is the subject of a further paper currently in preparation.

Table 2. Dose data from Stonehouse Hospital

Radiologist	Procedure	Films	Screening Time	Dose ($Gycm^2$)
A	Enema	8.7 (4-11)	4.5 (1.1-10.4)	55.1 (30.7-111.5)
B	Enema	8.5 (6-10)	2 (1.4-4.9)	30.1 (13.1-54.2)
C	Enema	11 (9-12)	1.4 (1-2.2)	30.8 (10.8-50)

Table 3. Dose data from Hairmyres Hospital

Radiologist	Procedure	Screening Time	Dose ($Gycm^2$)
C - 1996	Enema	1.8	17.4
C – 1998	Enema	1.5	14.6
D – 1996	Enema	4.3	32.3
D – 1998	Enema	3.7	29.3
E – 1996	Enema	4	29.2
E – 1998	Enema	4.2	30.4
C - 2000	Enema	1.3	11.4

I have mentioned that there can be differences in dose between individual radiologists using the same equipment. Table 2 shows some results by radiologists for an analogue unit in our department. Two radiologists have similar DAP results, though with varying screening times and film numbers. The other radiologist screens nearly three times as much and has doses almost double the Scottish Reference Dose Levels. (32Gycm^2). This was a radiologist of "the old school" who has now left our employ.

Some results of doses for enemas made at different years have been obtained following installation of a digital unit. While the doses remain within the Scottish Reference Dose Levels, 2 radiologists show a slight increase in mean dose and screening time with the passage of time, while Radiologist C shows no increase. This may reflect patient mix. The important aspect to note is that the dose levels remain well within the Scottish Reference Dose Levels. Consistently they are between half and a third of the doses reported in other countries.

However complacency is unacceptable. Recently I have introduced a new view into my routine for barium enema studies. This view, a prone shoot through of the rectum, carries a high dose. In order to reduce my dose overall, I now take the filing phase images as 'video grab', not as exposed images. I have found these to be acceptable for diagnostic purposes. This change, including introducing the new view, has led to a 20% reduction in the mean dose received by my patients: 14.6 Gycm^2 to 11.4 Gycm^2. There has also been a slight decrease in my screening time from 1.5 to 1.3 minutes. I am not yet happy to take more views by video grab, but I know others are working on this. It may well be that with even newer digital systems, we may be able to go as far as to obtain all views by video grab, with a major dose saving.

3. Conclusion

It remains unlikely that radiologists will willingly change their techniques to those that use less dose unless they can be shown that such techniques are just as good. This would require a massive re-education and training programme that may just not be cost effective, but perhaps I have shown by example that it is possible. However there remains a major difference between the doses from different countries that will have to be explained further. Analogue v. Digital technology is just not enough.

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