RADIATION ACCIDENTS AND CT EXTRAVASATIONS

BRANDON PREAP

MEDICAL IMAGING PHYSICS REGISTRAR



ACKNOWLEDGEMENTS

- Jenny Diffey Senior Medical Physics Specialist
- Keira Gordon Senior CT Radiographer (Maitland Hospital, NSW)
- Nicholas Marks Senior CT Radiographer (Calvary Mater Hospital, NSW)



MOTIVATION – DEFINITIONS AND CLARIFICATIONS

Reportable Radiation Accident – NSW Radiation Control Regulation 2013 (Division 5, Subdivision 7)

(1) For the purposes of this Regulation, a *radiation accident* is to be treated as having occurred if there is an occurrence that involves the unplanned or unexpected emission of radiation (including spillage or leakage of a radioactive substance or damage to radiation apparatus) and that is of such a nature or extent that it is likely

(a) that one or more persons have, or could have, received an effective dose of radiation equal to or in excess of

(i) 5 millisieverts, in the case of an occupationally exposed person, or

ii) 1 millisievert, in any other case

Non-occupational

MOTIVATION – DEFINITIONS AND CLARIFICATIONS

NSW EPA Website

• Clarification with CT Extravasations in 2020

Clarification of reportable extravasation incidents

Under the legislation, any unplanned exposure to radiation resulting from an extravasation incident is considered a reportable radiation accident. This includes repeat contrast/CT scans arising from an extravasation.

THE QUESTION

If an extravasation occurred in a CT contrast procedure, at what stage will the effective dose be greater than 1 mSv?

CT PULMONARY ANGIOGRAMS (CTPA)

• Common procedure that uses contrast agent











CT PULMONARY ANGIOGRAMS (CTPA)

• Extravasation checkpoints

Flashback

• Nurse - blood pulled back into saline syringe, then pushed back into patient.

Flow Check

- Nurse Checks flow of contrast up patient's arm and patient response.
- Radiographer monitors pressure in contrast injector and patient response.

Monitoring

Scout View

Pre-monitoring

Indicator monitoring

• Radiographer – checks immediate indicators of contrast flow (e.g. Vena Cava) and patient response.

Acquisition

Reporting

- Radiographer Ensures correct images and flow of contrast
- Radiologist Able to report on diagnostic images

INVESTIGATION

• At what point does the scan reach 1 mSv?



METHOD

Data Collection

- 20 CTPA patients in the Hunter New England LHD
 - 1:1 male-female
 - >21 years of age
- Patient Protocols
 - kVp
 - CTDI volume
 - Reconstructed Slice Thickness
- DICOM tags
 - CT scanner
 - Collimation

Dosimetry

- Scout view Schmidt *et al* (2013)
 - Both LAT and AP views
- CTEXPO2.8

	Scan	κv	mAs / ref.	CTDivol* mGy	DLP mGycm	TI s	cSL mm
Patient Position F-SP Topo PreMonitoring Contract	1 2	Sn100 100	75 mA 23	0.01 L 0.76 L	0.4 0.8	2.2 0.33	0.6 10.0
Monitoring CTPA	3 9	100 80	23 123 /287	4.64 L 2.30 L	4.6 76.7	0.33 0.33	10.0 0.6
Medium Type		loc	line Conc. mg/ml	Volume mi	Flow ml/s	/ CM	l Ratio
Contrast Optiray Saline			350	37 30	4.5 4.5		100%

RESULTS

- Averaged across both sexes
 - 10 male, 10 female

	Pre-monitoring				
).6 mSv		Monitoring			≈6.2 mSv
	< 0.05 msv	0.1 mSv	Helical Acqui	isition	
			5.4 mSv		

RESULTS

- Averaged across both sexes
 - Scout both LAT + PA views ($\approx 0.6 \text{ mSv}$)
 - Not all vendors do both views
 - Pre-monitoring = 0.05 mSv.



DISCUSSION POINTS FROM DATA



Reportable Radiation

- Dosimetry for the worst case scenario
 - Scout view (LAT + AP)
 - Pre-monitoring (0.05 mSv)
- A repeat of only the acquisition scan would be classed as a reportable radiation accident.
 - Several checkpoints for extravasation have taken place before this.
- Presented at the NSW Hospital and University Radiation Safety Officers Group (HURSOG)
 - Unplanned AND > 1 mSv

PART 2 - EXTRAVASATION DATA COLLECTION

- Update of our HNE Radiation Accident Form
- Conduct preliminary data collection of ALL CT extravasations
 - Occurrence of extravasation detection
 - Occurrence of repeated scans

Details of the accident	
Exact location of accident	
Date and time of accident	
Names and positions of people involved	
Detailed description of accident	
Technique factors (for dosimetry calculation)	X-ray: complete sections overleaf Nuclear medicine: Radionuclide or radiopharmaceutical involved, including activity.
Details of any injuries that may have occurred	□ Extravasation (fill "Patient Details" and "Extravasation Details" Box)

Extravasation Details	
After what stage was extravasation detected?	What scan(s) were repeated?
□ Scout/Topogram	□ Scout/Topogram
Pre-monitoring/Control Scan	Pre-monitoring/Control Scan
Monitoring/Test Bolus	□ Monitoring/Test Bolus
Acquisition	□ Acquisition

IMPLEMENTATION

- Initial pushback and confusion
 - Increases paperwork
 - Questioning of repeat exposures from a Valsalva Manoeuvre
- Modification of the Radiation Accident Form to just include repeat acquisition scan
- Clarification of extravasation

Details of the accident			
Exact location of accident			
Date and time of accident			
Names and positions of people involved			
Detailed description of accident			
Technique factors (for dosimetry calculation)	X-ray / CT / Fluoro: complete sections overleaf Nuclear medicine: please type below - radiopharmaceutical and activity.		
Details of any injuries that may have occurred	 N/A Extravasation Other: please type details below 		

Extravasation of CT Contrast Agent: CLARIFICATION

Note that extravasation is only classed as a Radiation Accident **IF** the patient receives repeated CT scans resulting in an additional effective dose of at least 1 mSv.

In practice, this situation only arises if the diagnostic acquisition scan (or perfusion scan) is repeated due to extravasation of contrast or inadequate contrast delivery. If only the bolus monitoring scans are repeated, the dose will be below the threshold for reporting and there is no need to notify the medical physicists.

THANK YOU

BRANDON PREAP

MEDICAL IMAGING PHYSICS REGISTRAR

BRANDON.PREAP@HEALTH.NSW.GOV.AU



Health Hunter New England Local Health District