Comparing the radiation dose for L1-S1, nerve root blocks between surgeons and radiologists in the private sector and NHS.

Samantha Todd, M J H McCarthy, S H James, S Kamath, K Mukherjee and K Lyons

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Objective: To analyse and compare the radiation dosage (Gy.Cm2) administered by two groups of clinicians, Spinal Consultants (SC) and Radiology Consultants (RAD) within and between different contexts, the NHS or Private Practice (PP) for lumbar nerve root blocks / foraminal epidurals using fluoroscopy.

Background: There have been attempts to set standards for radiation dose exposure levels in keeping with national guidance from The Ionising Radiation (Medical Exposure) Regulations 2017 which outlines the use of the ALARA principles ("As low as reasonably achievable")[1,3]. Epidural injections are frequently used for the management of pain secondary to radiculopathy, with a fluoroscopy machine for needle guidance, which uses ionising radiation with its associated risks [3,5,6]. Currently the only guidelines that exist are from the UK Health Security Agency with proposed National Diagnostic Reference Levels (NDRLs) for lumbar spine X-Rays with radiation exposure of 6 Gy.Cm2 for X-ray guided interventions, which are different to fluoroscopy [4].

Methods: 500 patient's data was collected across a 5-year period between December 2018 and February 2024 for 5 different clinicians, 3 RADs and 2 SCs, for both the NHS and PP with one SC having trainee radiation dosage included in the NHS. The techniques used were single X-ray shots, done by the SC's, and continuous cinnefluoroscopy used by the RADs. One-way t-tests compared the mean radiation dose against proposed reference guidance levels, Welch's t-test analysed significant difference between the two groups and a one-way ANOVA determined the significance between the clinicians in each context.

Results: The One sample t-test reference values were set at 6 Gy.Cm2, with values taken from the NDRLs set at 6 Gy.Cm2. All values across the 3 tests in both one-tailed and two-tailed tests, showed that there is statistical significance with $p<0.001$, meaning that both groups separately had a different mean value for radiation dose when compared to the reference values. The average radiation dose for both groups in the NHS and PP was 2.66 Gy.Cm2 and the Welch's one tailed t-test showed that RAD's radiation dose were greater than the SC's in both contexts ($p < 0.001$). Post hoc tests for one-way ANOVA showed no significant difference between SC's in either context ($p = 1.00$). There was significant difference between the majority of RAD's and SC's ($p<0.001$). Two-way ANOVA tests between clinician group and pathology ($p= 0.916$) or clinician group and lumbar level ($p=0.120$) demonstrated no effect on radiation dose.

Figure 1

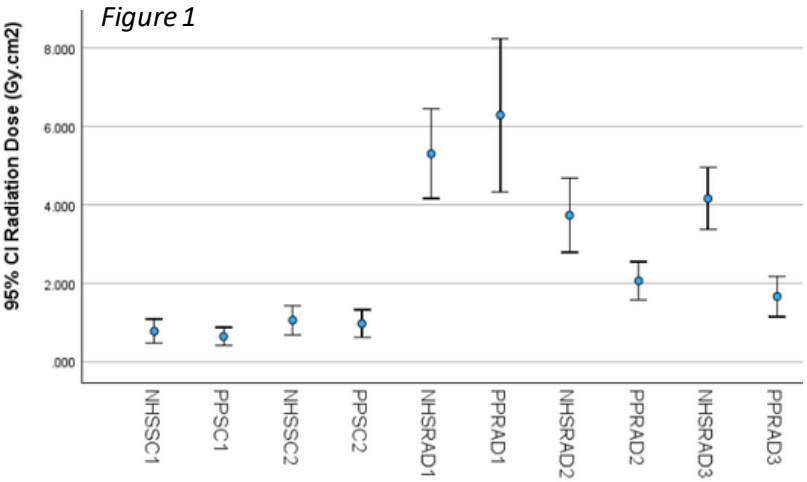

Table 1

Clinician	NHSSC1	PPSC1	NHSSC2	PPSC2	NHSRAD1	PPRAD1	NHSRAD2	PPRAD2	NHSRAD3	PPRAD3
NHSSC1		1.00	1.00	1.00	<0.001	<0.001	<0.001	0.532	<0.001	0.912
PPSC1			1.00	1.00	<0.001	<0.001	<0.001	0.382	<0.001	0.815
NHSSC2				1.00	<0.001	<0.001	<0.001	0.831	<0.001	0.993
PPSC2					<0.001	<0.001	<0.001	0.747	<0.001	0.981
NHSRAD1						0.842	0.240	<0.001	0.692	<0.001
PPRAD1							0.001	<0.001	0.190	<0.001
NHSRAD2								0.164	1.00	0.027
PPRAD2									0.023	1.00
NHSRAD3										0.002
PPRAD3										

Figure 1: Error bars showing the 95% Confidence Interval (CI) for Radiation dose (Gy.cm2) per clinician category.
Table 1: Table showing the relationships between the categories using Post Hoc Tests (Tukey HSD) multiple comparisons where the mean difference is significant at the 0.05 level.

Conclusion and Suggestions:

Both SCs had lower radiation doses than RADs where the results showed that the amount of radiation exposure given during nerve root blocks/foraminal epidurals were dependent on the clinician and the techniques used. The results suggested that a radiation dose lower than the proposed NDRL's 6 Gy.Cm2 can be achieved, where the mean radiation dose for both groups across both contexts was 2.66 Gy.Cm2. Where group 1's average radiation was significantly lower than group 2's radiation, it can be suggested that the use of the single image and last image hold techniques had an impact on lowering the radiation exposure. Both techniques used by group 1 and group 2 were for the same procedures, therefore, the primary focus should be on reducing the radiation as there are risks to both patient and clinician health at higher doses.

References: *1) Britain, G. 2017. The Ionising Radiation (Medical Exposure) Regulations 2017. Stationery Office. 2) Cloutier, D. 2015. Radiation Exposure in Orthopedics. JBJS Journal of Orthopaedics for Physician Assistants 3(2). 3) Cohen, S. L. et al, Radiation Dose Practice Audit of 6,234 Fluoroscopically-Guided Spinal Injections, (2150-1149 (Electronic)). 4) Executive, H. a. S. 2018. Work With Ionising Radiation: Ionising Radiation Regulations 2017 Approved Code of Practice, L121. TSO (The Stationery Office). 5) Kazi Z Hassan et al 2023. Epidural Steroids. [Accessed: 20th April 2024]. 6) Manchikanti, L et al 2016. Epidural injections for lumbar radiculopathy and spinal stenosis: a comparative systematic review and meta-analysis. Pain physician 19(3), p. E365.*

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Methods and Statistical analysis: 500 patient's data was collected across a 5-year period between December 2018 and February 2024 for 5 different clinicians, 3 RADs and 2 SCs, for both the NHS and PP with one SC having trainee radiation dosage included on the NHS. The techniques used were single X-ray shots, done by the SC's, and continuous cinnefluoroscopy used by the RADs. One-way t-tests compared the mean radiation dose against proposed reference guidance levels, Welch's t-test analysed significant difference between the two groups and a one-way ANOVA determined the significance between the clinicians in each context.

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