Establishing Dose Reference Levels for Peripherally Inserted Central Catheter and Central Venous Tunnelled Catheter in A Tertiary Hospital in Singapore

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Introduction

- As stated in the International Commission of Radiological Protection (ICRP), DRLs are an effective tool in providing optimum radiation safety for patients.
- This study aimed to establish dose reference levels (DRLs) of interventional procedures - peripherally inserted central catheter (PICC) and central venous tunnelled catheter (CVC), performed in a Vascular and Interventional Radiology (VIR) Department.

Methods

- A total of 896 of PICC and CVC procedures done in year 2022 were collected retrospectively from radiology information system.
- 23 samples were excluded due to incomplete data. The data collected included age, gender, fluoroscopy time (min), absorbed dose (mGy) and dose area product (DAP; µGym²).

Results

- The PICC group (n = 516) consisted of 34% female, 66% male with a mean age of 67.6 years while the CVC group (n=357) consisted of 40% female, 60% male with a mean age of 64 years.
- The DRLs of DAP and fluoroscopy time ranged from 6.84-9890 µGym² and 0.02-22.0 minutes for PICC; 4.16-8450 µGym² and 0.03-90.0 minutes for CVC respectively.

	Overall (N=873)	Procedure		P-value
		PICC (N=516)	CVC (N=357)	
Age				
Mean (SD)	66.1 (14.0)	67.6 (14.7)	64.0 (12.6)	<0.001'
Median [Q1, Q3]	67.0 [58.0, 76.0]	69.0 [60.8, 78.0]	65.0 [57.0, 73.0]	
Additional [min, max]	[18.0, 100]	[18.0, 100]	[22.0, 91.0]	
Gender				
F	316 (36 %)	173 (34 %)	143 (40 %)	0.0572
M	557 (64 %)	343 (66 %)	214 (60 %)	
Fluoroscopy time (min)				
Mean (SD)	2.43 (4.49)	2.20 (2.78)	2.77 (6.15)	0.304'
Median [Q1, Q3]	1.27 [0.570, 2.45]	1.28 [0.700, 2.33]	1.25 [0.490, 2.92]	
Additional [min, max]	[0.0200, 90.0]	[0.0200, 22.0]	[0.0300, 90.0]	
Absorbed dose (mGy)				
Mean (SD)	46.7 (447)	41.3 (459)	54.7 (430)	0.00261'
Median [Q1, Q3]	8.60 [4.50, 21.2]	7.58 [4.54, 16.1]	10.3 [4.40, 32.0]	
Additional [min, max]	[0.200, 10400]	[0.600, 10400]	[0.200, 8080]	
Dose Are Product (µGym²)				
Mean (SD)	491 (877)	427 (795)	584 (976)	0.511'
Median [Q1, Q3]	211 [104, 459]	208 [115, 377]	220 [91.5, 605]	
Additional [min, max]	[4.16, 9890]	[6.84, 9890]	[4.16, 8450]	

Table 1: Table above showed a total of PICC and CVC data collected.

	Overall (N=516)	Rooms		P-value
		L3ANG RM1 (N=191)	L3ANG RM2 (N=325)	
Age				
Mean (SD)	67.6 (14.7)	67.4 (15.4)	67.7 (14.3)	0.877'
Median [Q1, Q3]	69.0 [60.8, 78.0]	70.0 [61.0, 79.0]	69.0 [60.0, 77.0]	
Additional [min, max]	[18.0, 100]	[18.0, 96.0]	[24.0, 100]	
Gender				
F	173 (34 %)	66 (35 %)	107 (33 %)	0.777
M	343 (66 %)	125 (65 %)	218 (67 %)	
Fluoroscopy time (min)				
Mean (SD)	2.20 (2.78)	2.38 (2.96)	2.09 (2.67)	0.0518'
Median [Q1, Q3]	1.28 [0.700, 2.33]	1.30 [0.915, 2.46]	1.25 [0.530, 2.28]	
Additional [min, max]	[0.0200, 22.0]	[0.0200, 21.1]	[0.130, 22.0]	
Absorbed dose (mGy)				
Mean (SD)	41.3 (459)	80.6 (752)	18.1 (39.5)	<0.001'
Median [Q1, Q3]	7.58 [4.54, 16.1]	9.38 [5.26, 20.7]	7.20 [4.00, 13.4]	
Additional [min, max]	[0.600, 10400]	[1.00, 10400]	[0.600, 365]	
Dose Are Product (µGym²)				
Mean (SD)	427 (795)	451 (622)	413 (882)	<0.001'
Median [Q1, Q3]	208 [115, 377]	240 [146, 442]	184 [102, 340]	
Additional [min, max]	[6.84, 9890]	[6.84, 4120]	[11.5, 9890]	

Table 2: Table above showed PICC group by the rooms.

	Overall (N=357)	Rooms		P-value
		L3ANG RM1 (N=119)	L3ANG RM2 (N=238)	
Age				
Mean (SD)	64.0 (12.6)	64.6 (12.6)	63.8 (12.7)	0.422'
Median [Q1, Q3]	65.0 [57.0, 73.0]	66.0 [58.5, 73.0]	65.0 [56.0, 72.8]	
Additional [min, max]	[22.0, 91.0]	[25.0, 91.0]	[22.0, 91.0]	
Gender				
F	143 (40 %)	55 (46 %)	88 (37 %)	0.117
M	214 (60 %)	64 (54 %)	150 (63 %)	
Fluoroscopy time (min)				
Mean (SD)	2.77 (6.15)	3.76 (9.45)	2.28 (3.42)	0.0178'
Median [Q1, Q3]	1.25 [0.490, 2.92]	1.48 [0.690, 3.53]	1.24 [0.400, 2.39]	
Additional [min, max]	[0.0300, 90.0]	[0.0600, 90.0]	[0.0300, 31.6]	
Absorbed dose (mGy)				
Mean (SD)	54.7 (430)	108 (741)	28.2 (50.5)	0.00139'
Median [Q1, Q3]	10.3 [4.40, 32.0]	15.2 [6.42, 41.1]	8.70 [3.90, 27.6]	
Additional [min, max]	[0.200, 8080]	[0.600, 8080]	[0.200, 430]	
Dose Are Product (µGym²)				
Mean (SD)	584 (976)	629 (931)	561 (1000)	0.0188'
Median [Q1, Q3]	220 [91.5, 605]	273 [110, 741]	181 [77.0, 574]	
Additional [min, max]	[4.16, 8450]	[9.60, 5650]	[4.16, 8450]	

Table 3: Table above showed CVC group by the rooms.

Discussion

- The DRLs of The 75th percentile for DAP and fluoroscopy time were 377 µGym² and 2.33 minutes for PICC; 605 µGym² and 2.92 minutes for CVC respectively.
- Both DAP and fluoroscopy time acquired appeared to be at a higher value as compared to the literature found.
- There were chances of difficulty encountered during the procedure, such as the needs of fibrin sheath stripping for CVC or internal jugular vein stenosis in either PICC or CVC.
- Besides, PICC in the center was performed by nurses. Radiologist will only required to step into the procedure if performing nurses experiencing challenges in advancing wire or catheter.
- This resulted a longer fluoroscopy time and hence contributed to a higher DAP.

Institution / DAP (µGym²)	CGH	Arabi Met al (2022)	HIQA (2022)	Lee M. Y. et al (2019)
PICC	377	163	80	-
CVC	605	270	100	440

Table 4: Comparison of DAP with the other institutions.

Institution / Fluoro time (min)	CGH	Arabi Met al (2022)	Lee M. Y. et al (2019)
PICC	2.33	0.90	-
CVC	2.92	1.65	1.13

Table 5: Comparison of fluoroscopy time with the other institutions.

Diagram 1: Venogram performed demonstrated severe stenosis at the right subclavian-brachiocephalic confluence.

Diagram 2: Venogram performed right internal jugular vein to brachiocephalic vein stenosis with multiple collaterals.

Conclusion

- The 75th percentile of DAP and fluoroscopy time in this study showed a higher value as compare to literature however the ranged values showed the opposite, which may be due to the procedure's complexity and performer's competency.
- Obtaining these studied values as DRLs may help us to identify procedures that require improvement and to create awareness among performers in applying ALARA principles.

References

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