I-131 RADIOIODINE THERANOSTICS FOR DIFFERENTIATED THYROID CANCER
PERSONALISED PREDICTIVE DOSIMETRY FOR I-131 MOLECULAR RADIOTHERAPY
Predictive Calculator © Dr Y.H. Kao MBBS MRCP FAMS FRACP FAANMS v230623

The Royal Melbourne Hospital

Date of Analysis	01 January 2023	ID Number	123456
First Name	Example	Date of Birth	1 January 2002
Surname	EXAMPLE	Gender (use list)	Female

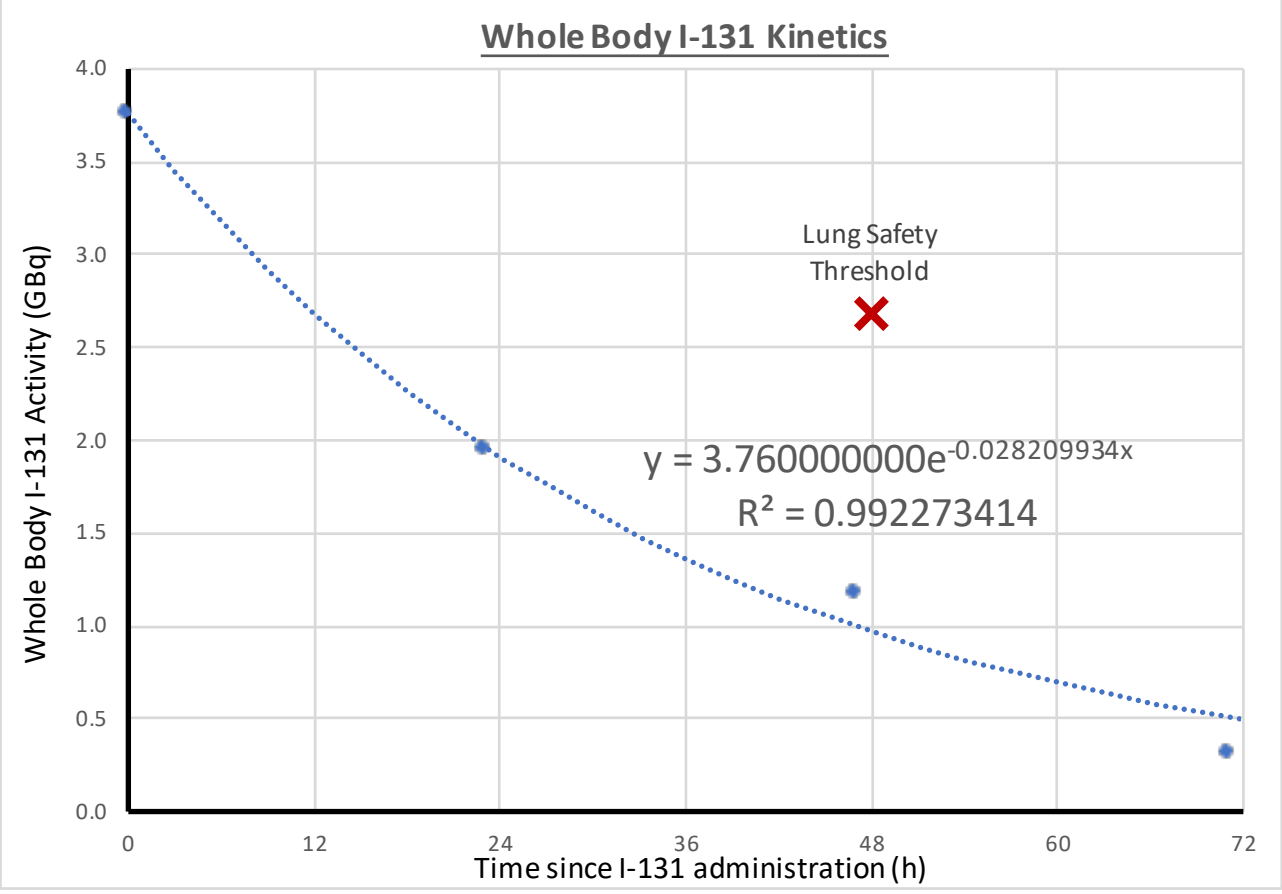
Lifetime cumulative Marrow I-131 absorbed dose limit	2.0	Gy	Blood is Marrow surrogate
Marrow absorbed dose rate constraint per fraction (#)	0.265	Gy/h per #	normalised to **A**o
Cumulative I-131 activity administered to date	3.76	GBq	
Cumulative I-131 Marrow absorbed dose to date	0.835	Gy	
The next I-131 therapy shall be the patient's	Second	fraction (#) of high activity I-131	
Predicted remaining Marrow absorbed dose tolerance	1.165	Gy	
Predicted whole body TIAC for the next I-131 fraction	28.0	h	
Predicted % of whole body TIAC attributed to Blood	15	%	
Predicted TIAC per ml of Blood for the next I-131 fraction	0.00163583	h/ml	
Predicted Blood absorbed dose per GBq of I-131	0.16880904	Gy/GBq	
Predicted Blood TIAC for the next I-131 fraction	4.20	h	normalised to **A**o
Predicted maximum safe Marrow absorbed dose per #	1.113	Gy	constrained by dose rate
Predicted cumulative lifetime Marrow I-131 tolerance	10.66	GBq	

PREDICTIVE I-131 PRESCRIPTION BY MARROW CONSTRAINT

Predicted tolerance per # by marrow dose rate (Gy/h)	**6.59**	GBq per #
Predicted remaining lifetime Marrow I-131 tolerance	**6.90**	GBq

PREDICTIVE I-131 PRESCRIPTION BY LUNG CONSTRAINT

Predicted tolerance per # by marrow dose rate (Gy/h)	**6.59**	GBq per #
Predicted remaining lifetime Lung I-131 tolerance	**9.53**	GBq



Date of I-131	1 January 2023	
Age at I-131	21.0	years old
I-131 fraction	First fraction	
Preparation	Thyroid Hormone Withdrawal	(use list)
I-131 Administered	3.76	GBq

BLOOD VOLUME ESTIMATE		
Height	148	cm
Weight	43	kg
if Male	3,450.1	ml
if Female	2,567.5	ml
Blood Vol	2,567.5	ml

MARROW DOSIMETRY

% of Whole Body Residence Time attributed to Blood: 16.0 % (see Technical Guidance)

x-axis	Time (h)	0	23	47	71	1680
	I-131 exposure rate (µSv/h@3m)					(10 week)
	1st measurement	1.04	0.47	0.30	0.07	
	2nd measurement	0.91	0.54	0.31	0.09	
	Average rate (µSv/h@3m)	0.98	0.51	0.31	0.08	
y-axis	Retained I-131 activity (GBq)	3.76	1.95	1.18	0.31	1.0E-20

1 µSv/h of I-131 @ 3m represents 3.86 GBq

Whole Body Decay Constant, **λ**	0.028209934	h^{-1}	i.e. from Curve equation
I-131 Effective Half-Life, T_e	24.6	h	i.e. ln2 / **λ**
Whole Body Residence Time, τ	35.45	h	i.e. τ = 1 / **λ**
Whole Body Cumulative Activity, **Ã**	133,286	MBq.h	i.e. **Ã** = A_0 x τ
Whole Body self irradiation S value	4.2E-06	Gy/MBq.h	
Residence Time per ml of Blood	0.00221	h/ml	
Blood Absorbed Dose per GBq	0.22214	Gy/GBq	
Marrow Absorbed Dose	0.835	Gy	assuming blood as marrow surrogate
Whole Body Absorbed Dose	0.559	Gy	assuming WB as marrow surrogate

LUNG DOSIMETRY

Lung safety threshold, scaled by height (cm)	x-axis	48	h
	y-axis	2.7	GBq at 48h
Whole Body Decay Constant, **λ**	0.028209934		h^{-1}
Whole Body Activity at 48h		1.0	GBq at 48h
Remaining lung tolerance after 1st fraction		1.7	GBq at 48h
Predicted Whole Body Residence Time for next fraction		28	h
Predicted Whole Body Decay Constant for next fraction	0.035714286		h^{-1}
Predicted I-131 prescription contrained by lung		9.53	GBq

TECHNICAL GUIDANCE

FOR EDUCATION, TRAINING AND RESEARCH PURPOSES ONLY. ALL SUGGESTED I-131 ACTIVITIES ARE ONLY ESTIMATES AND MUST BE CONSIDERED IN CONJUNCTION WITH ALL OTHER CLINICAL, IMAGING AND BIOCHEMICAL INFORMATION, DOSIMETRIC AND REAL LIFE UNCERTAINTIES.

1. Only key into the YELLOW boxes.
2. Low activity I-131 administrations for diagnostic whole body scans are assumed negligible and excluded from dosimetric analysis.
3. Zero hour is the time of I-131 administration. Set the y-intercept to the administered I-131 activity.
4. See Tables 1 and 2 for guidance on predicted whole body TIAC and % of whole body TIAC attributed to blood.
5. Consider the contraints by marrow, lung and dose rate and select the **LOWEST** activity to prescribe.

References:

[1] Kao YH. Asia Ocean J Nucl Med Biol. 2023;11:158-167

[2] Lassmann et al. Eur J Nucl Med Mol Imaging. 2008;35:1405-1412

[3] Hanscheid et al. Endocr Relat Cancer. 2009;16:1283-1289

[4] Taprogge et al. Eur J Nucl Med Mol Imaging. 2023. doi: 10.1007/s00259-023-06295-0.