^{51}Cr-EDTA vs ^{99m}Tc-DTPA for GFR measurement: is there a systematic difference?

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Declaration of Financial Interests or Relationships

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I have no financial interests or relationships to disclose with regard to the subject matter of this presentation.

Aims

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- Is there a systematic difference between ^{51}Cr-EDTA and ^{99m}Tc-DTPA for GFR measurement?

Methods

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Cohort 1

- In Oct 2012 the Royal Free Hospital switched from ^{51}Cr-EDTA to ^{99m}Tc-DTPA
- Live renal donors – population of normal subjects; distribution of GFRs should be the same for both tracers
- Compare GFR distribution for live renal donors measured with ^{51}Cr-EDTA to those measured with ^{99m}Tc-DTPA

Cohort 2

- Oncology patients attending Leeds Teaching Hospitals Trust
- Simultaneous GFR measurement with both tracers as part of research trial

Methods – cohort 1

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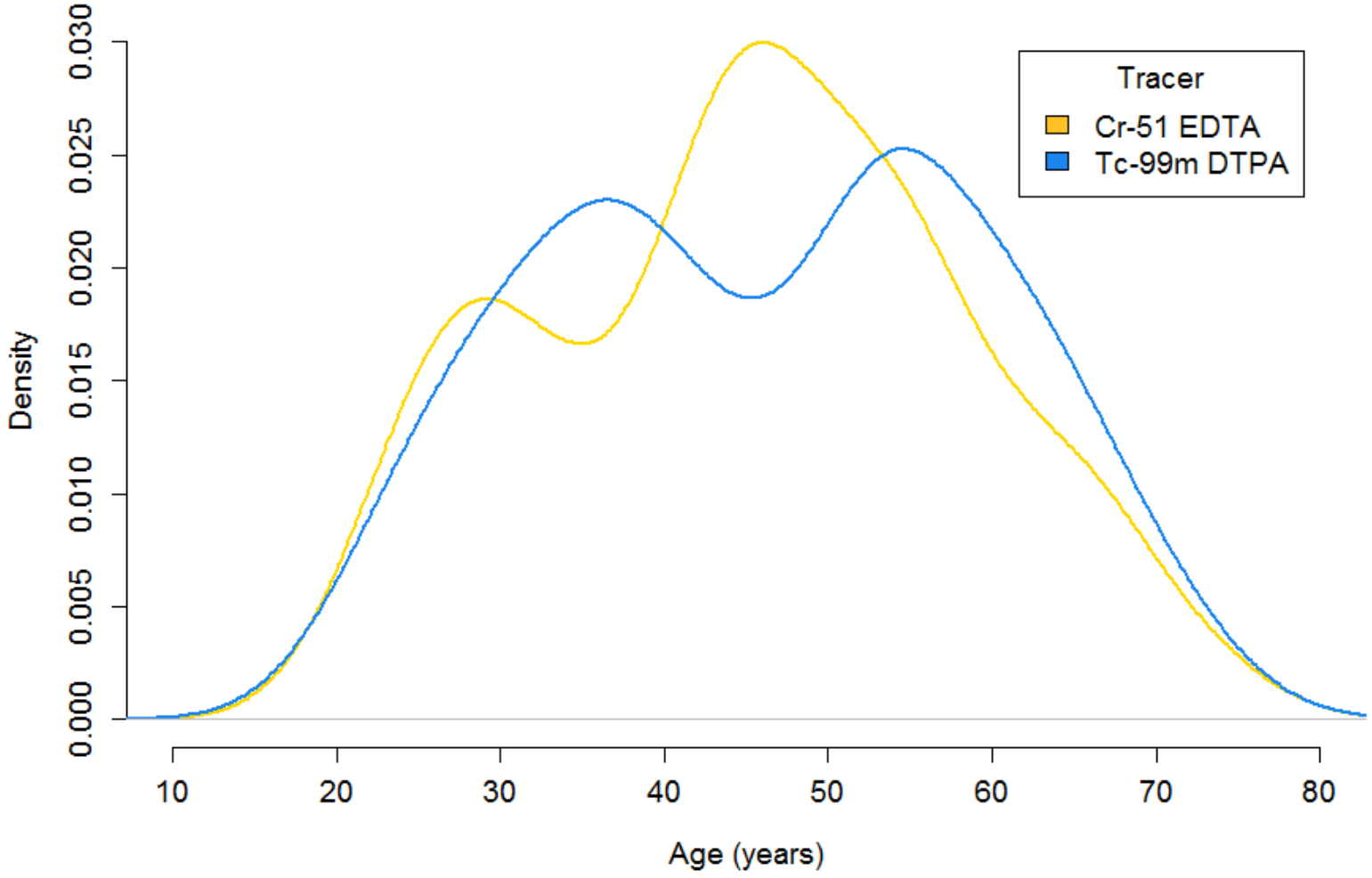
- 3-sample (2h, 3h, 4h) GFR measurement
- Slope-intercept calculation, BSA normalised, Brochner-Mortensen corrected as per previous BNMS GFR guidelines[1]
- ^{51}Cr-EDTA GFR measurements: 184
- ^{99m}Tc-DTPA GFR measurements: 154
- Problem: age distribution of patients is different, GFR declines with age…

Methods – cohort 1 age distribution



Methods – cohort 1

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- Age matching

Age group	^{51}Cr-EDTA		^{99m}Tc-DTPA	
	n	Av. GFR (ml/min/1.73m^2)	n	Av. GFR (ml/min/1.73m^2)
20-29	22	94.3	22	102
30-39	23	94.2	23	101
40-49	22	90.9	22	90.3
50-59	42	78.8	42	84.8
60-69	21	75.5	21	81.0
70+	4	66.8	4	60.8

- Age scaling model from British Transplantation Society 2018 guidelines[2]:
  - Decline of 0.66 ml/min/1.73m^2/year from age 40 for men, 0.77 ml/min/1.73m^2/year for women
  - Averaged since missing gender info: 0.72 ml/min/1.73m^2/year

Methods – cohort 2

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- Simultaneous measurement GFR with ^{51}Cr-EDTA and ^{99m}Tc-DTPA, injections ~1 minute apart, n = 50 patients
- 9-sample (5, 10, 20, 60, 120, 180, 240, 360 and 480 min) GFR measurement
- Samples counted on ^{51}Cr and ^{99m}Tc window, correction made for crosstalk
- 9-point AUC GFR calculated for both tracers: trapezium rule with monoexponential functions fitted between time points, BSA normalised
- 3-point (2, 3, 4h) SI-GFR also calculated for comparison with cohort 1

Results – cohort 1, age matched

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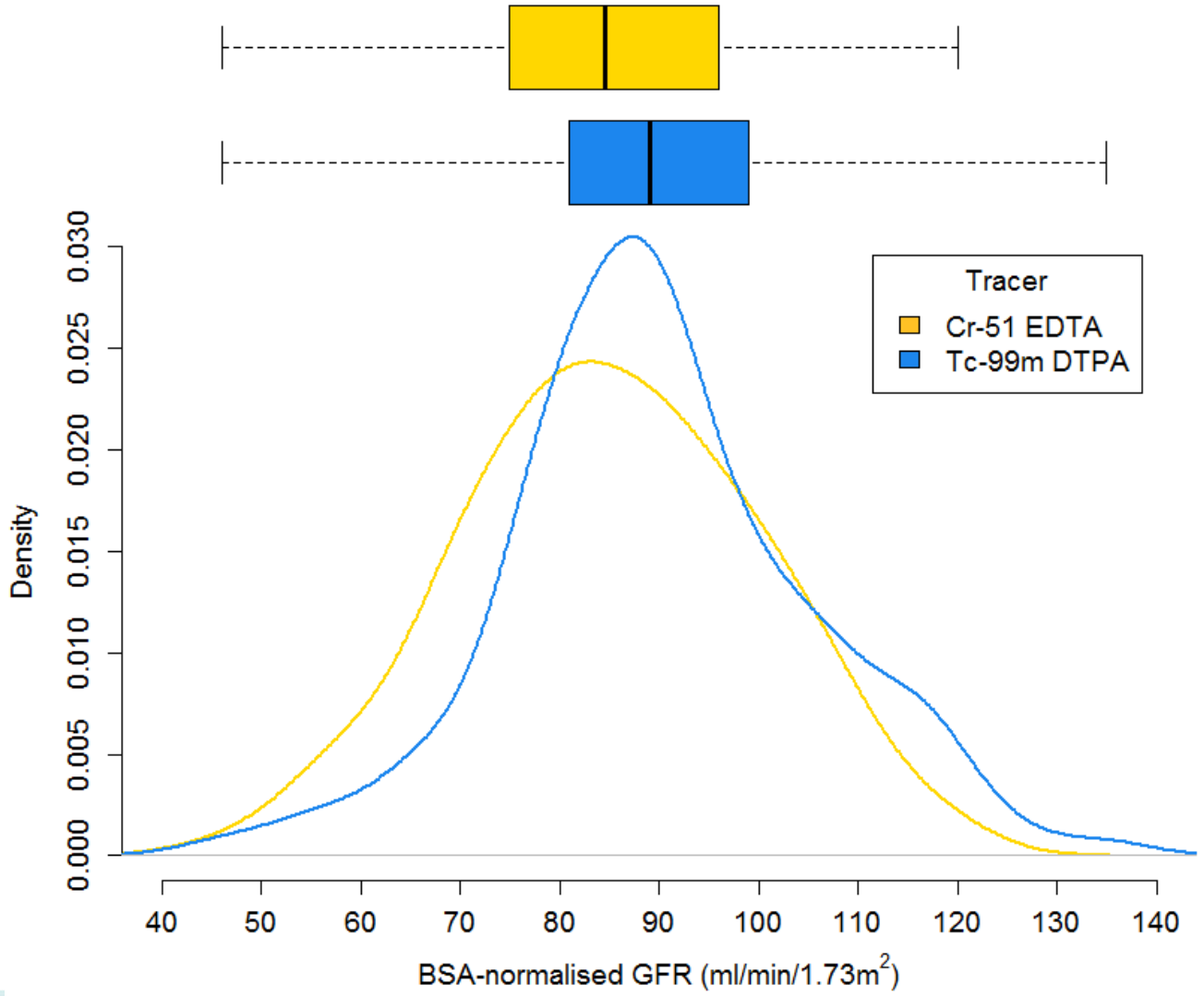

Results – cohort 1

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- Statistically significant difference?

Mean difference (^{99m}Tc-DTPA - ^{51}Cr-EDTA)	5.6% (95% conf. int. 1.5 to 9.8%)
t-test p-value	0.008
Mann-Whitney U-test p-value	0.01

- Yes! GFR is 5.6% higher with ^{99m}Tc-DTPA than ^{51}Cr-EDTA
- Large confidence interval on mean difference: includes underlying variability in normal population GFR

Results – cohort 1, age scaled

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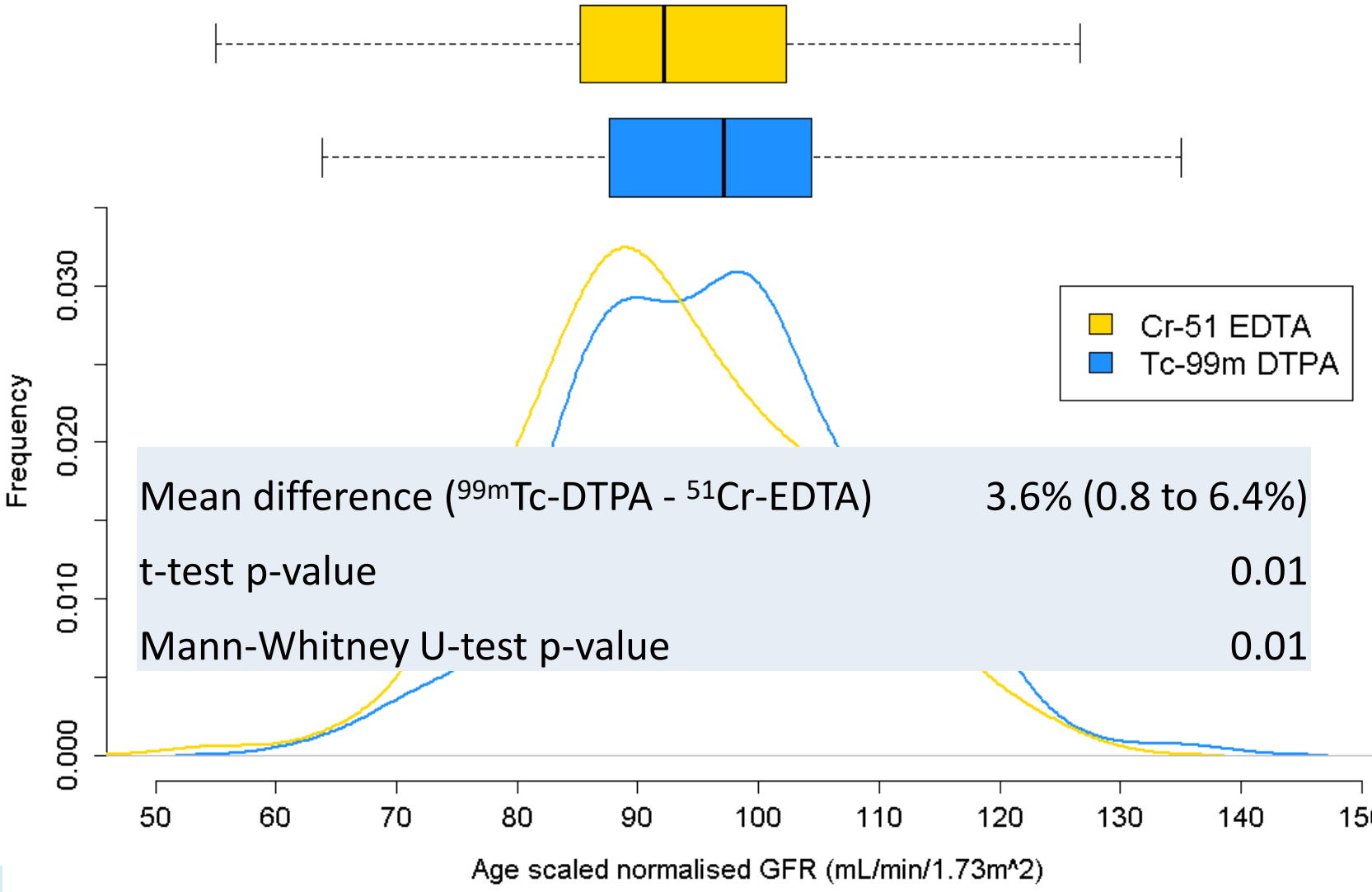
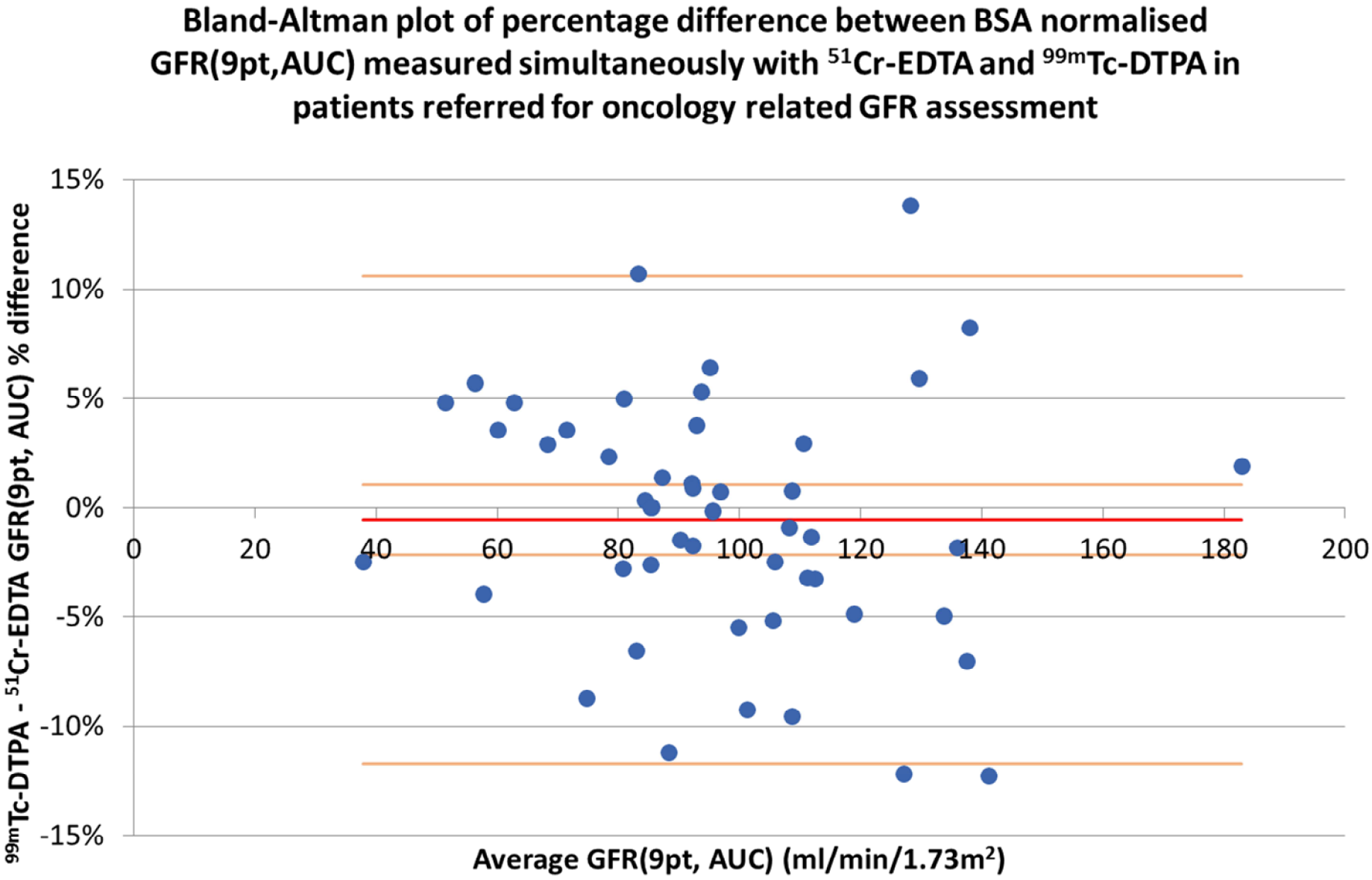


Mean difference (^{99m}Tc-DTPA - ^{51}Cr-EDTA)	3.6% (0.8 to 6.4%)
t-test p-value	0.01
Mann-Whitney U-test p-value	0.01

Results – cohort 2



Results – cohort 2

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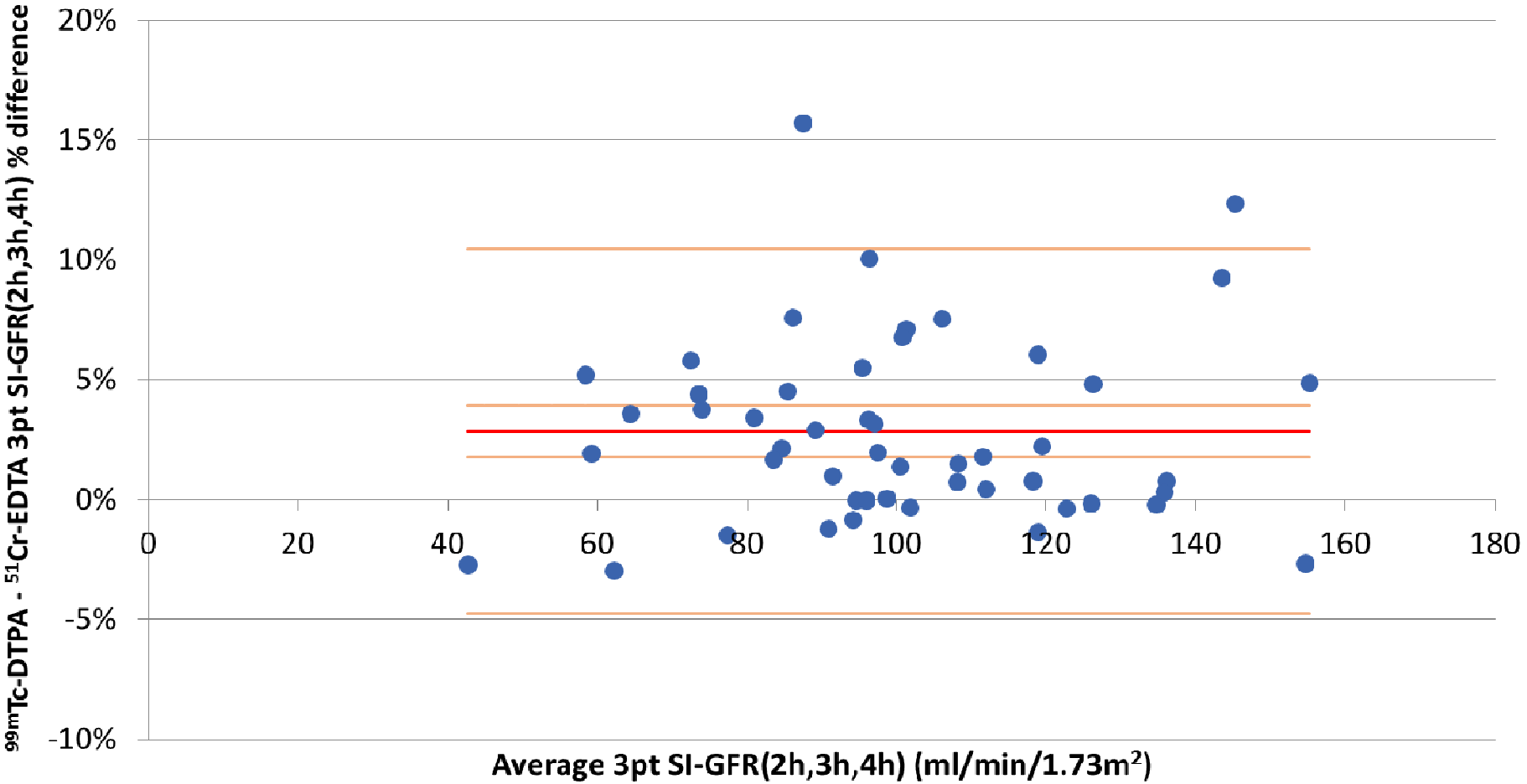
- 9-point AUC GFR: differences not significant, 95% confidence interval around mean either side of 0%

Mean difference (^{99m}Tc-DTPA - ^{51}Cr-EDTA)	-0.5% (-2.1 to 1.0%)
Upper 95% limit of agreement	11%
Lower 95% limit of agreement	-12%
Paired t-test p-value	0.29

- Disagrees with cohort 1? What about 3pt SI-GFR…

Results – cohort 2

Bland-Altman plot of percentage difference between BSA normalised 3pt SI-GFR(2h,3h,4h) measured simultaneously with ^{51}Cr-EDTA and ^{99m}Tc-DTPA in patients referred for oncology related GFR assessment



Results – cohort 2

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- 3pt SI-GFR: small significant difference, GFR is 2.9% higher with ^{99m}Tc-DTPA than ^{51}Cr-EDTA

Mean difference (^{99m}Tc-DTPA - ^{51}Cr-EDTA)	2.9% (1.8 to 3.9%)
Upper 95% limit of agreement	10%
Lower 95% limit of agreement	-4.7%
Paired t-test p-value	1.1e-5

Conclusions

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- There is a small systematic difference between 3-point SI-GFR (2h,3h,4h) measured with ^{51}Cr-EDTA and ^{99m}Tc-DTPA
  - ^{99m}Tc-DTPA gives a result 2.9% - 5.6% higher on average
- There is no significant difference for 9-point AUC GFR
  - Slightly different clearance kinetics of two tracers
- **No clinically significant** difference between GFR measured with ^{51}Cr-EDTA and ^{99m}Tc-DTPA
  - Intra-patient variation in GFR ~10% [3]
  - No exercise restriction ~12% variation[4]
- Avoid undermining perceived reliability of a radionuclide GFR test – **should not attempt to inform referrers**

References

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