

ESTIMATED GFR VERSUS CREATININE CLEARANCE FOR EVALUATION OF RECOVERY FROM AKI

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INTRODUCTION

Discharge serum creatinine or the derived eGFR are often used to evaluate recovery of acute kidney injury (AKI)¹. However, muscle wasting, which is most pronounced in patients with prolonged ICU stay, will alter the relationship between serum creatinine and GFR. In addition, eGFR has shown to underestimate true GFR at higher levels². The aim of this study is to quantify the impact of using eGFR instead of measured creatinine clearance (Clcr) on the evaluation of recovery from AKI. The analysis will be performed in subgroups with different ICU length of stay (LOS) and with different discharge Clcr.

METHODS

From a large RCT's database³ we excluded patients with end-stage renal disease (n=56), kidney transplants (n=15) and incomplete data (n=9). In the remaining 4560 patients 1296 (28%) developed AKI (KDIGO criteria). After exclusion of ICU non-survivors (n=229), patients on dialysis at ICU discharge (n=77) and patients for whom Clcr on the last day of ICU was not available (n=206), 784 patients were included in this analysis. We compared eGFR (MDRD equation) with measured Clcr (based on 24h urine collection and corrected for BSA) at ICU discharge for all patients and for subgroups with different ICU LOS and different Clcr at ICU discharge. We also evaluated the impact of using the two GFR measurements on the estimation of complete recovery relative to baseline eGFR. Parameters were compared with the paired t-test, Bland-Altman analysis and McNemar's test.

RESULTS

Amongst the 784 patients with AKI, 456 (58%) reached stage 1, 143 (18%) stage 2 and 185 (24%) stage 3. Agreement between discharge eGFR (76±55 ml/min/1.73m²) and Clcr (54,5±28 ml/min/1.73m²) was poor with bias of 21.6±65.3 and limits of agreement of -106 to 150. eGFR was not significantly different from Clcr in patients with ICU stay below 7 days. However, bias increased and the limits of agreement widened with increasing ICU LOS (Fig 1,2). Agreement between Clcr and eGFR with regard to estimation of complete recovery was poor and differed according to ICU LOS (Table 1). Bias between eGFR and Cl creat was also significant for patients with high or low discharge Clcr with eGFR overestimating Clcr at lower levels of Clcr and underestimating it at higher levels (Fig 3). This also resulted in significantly different estimation of complete recovery (Table 2).

	All patients	ICU 1-7d	ICU 8-14d	ICU >14d
n	784	399	158	227
Discharge Clcr ± SD*	54.5 ± 28	64 ± 31	48.5 ± 20	42.6 ± 20
Discharge eGFR ± SD*	76 ± 55	60 ± 36	79 ± 51	102 ± 70
P value	<0.0001	0.13	<0.0001	<0.0001
Mean diff (bias) ± SD*	21.6 ± 65.3	-3.7 ± 50	30.9 ± 53.8	59.7 ± 75.6
Complete recovery by Clcr n (%)	225 (28.7)	160 (40)	33 (21)	32 (14)
Complete recovery by eGFR n (%)	227 (35.3)	76 (19)	73 (46)	128 (56)
P value	0.007	<0.0001	<0.0001	<0.0001

Table 1: (Dis)agreement between Clcr and eGFR at ICU discharge and the derived estimation of complete recovery for all patients and subgroups with different ICU length of stay.

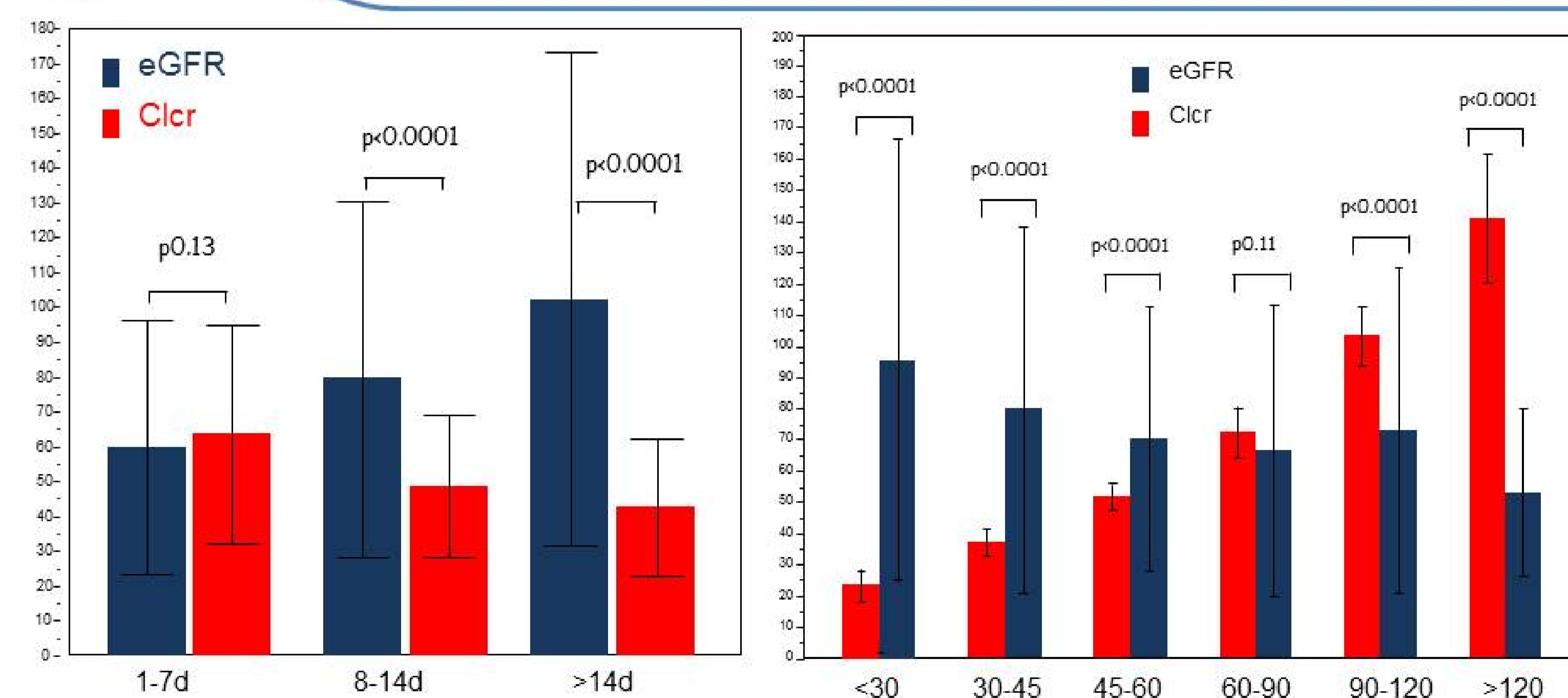


Fig 1. Clcr and eGFR (in ml/min/1.73m²) at ICU discharge in subgroups defined by ICU length of stay.

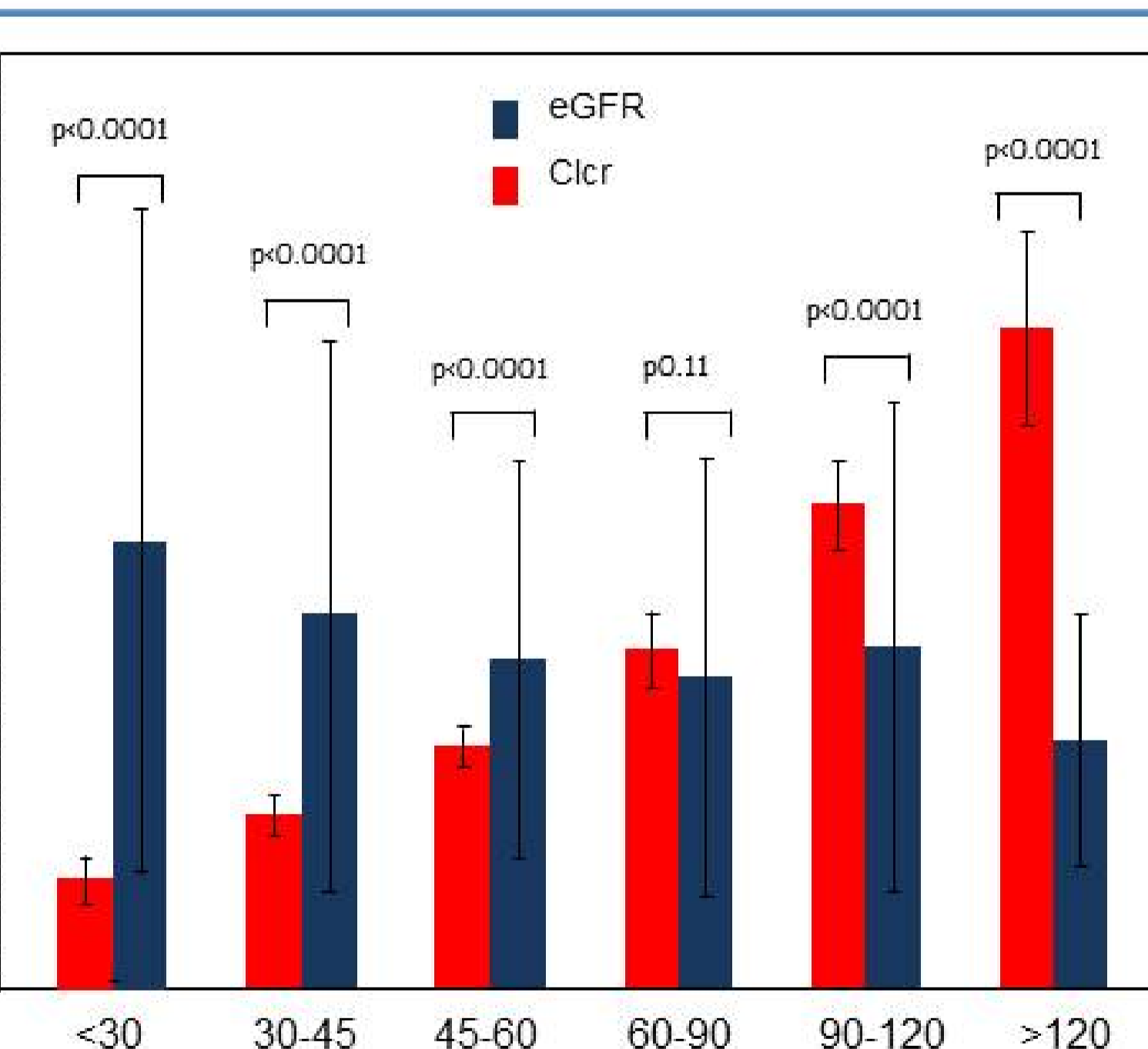


Fig 3. Clcr and eGFR (in ml/min/1.73m²) at ICU discharge in subgroups defined by discharge Clcr.

REFERENCES

1. KDIGO Clinical practice guideline. Kidney Intern Suppl 2012; 2: 19-36
2. Rule AD et al. Ann Intern Med. 2004; 141: 929-37
3. Casaer MP et al. NEJM 2011; 365: 506-17

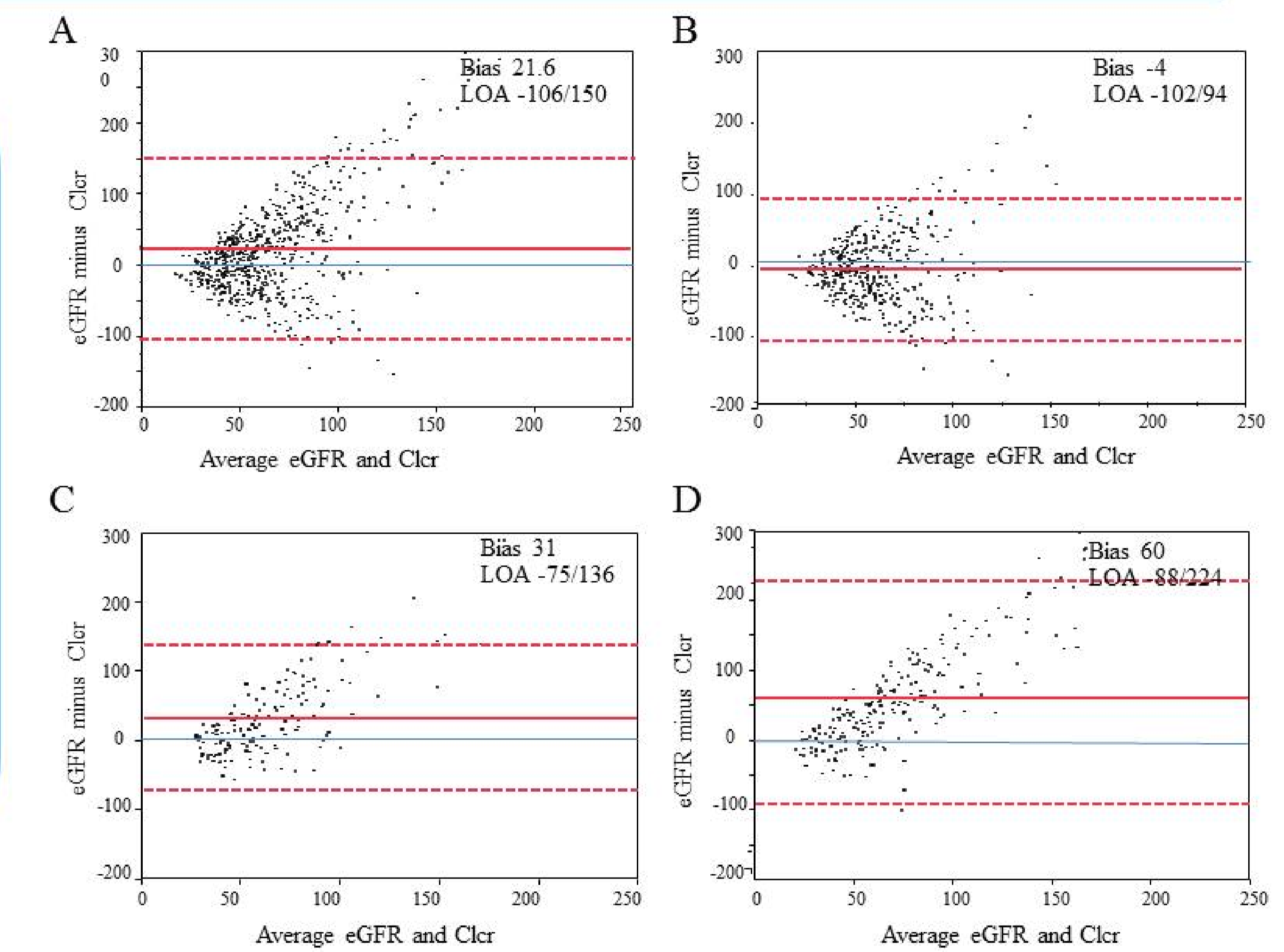


Fig 2. Bland-Altman analysis of the difference between Clcr and eGFR at ICU discharge A. in all patients. B. in patients with ICU stay <7d. C. in patients with ICU stay between 7 and 14d. D. in patients with ICU stay >14d. The red line represents bias and the dashed lines the limits of agreement.

	All patients	Cl <30	Cl 30-45	Clcr 45-60	Clcr 60-90	Clcr 90-120	Clcr >120
n	784	129	213	186	169	63	24
Discharge Clcr ± SD*	54.5 ± 28	23.5 ± 4.9	37.1 ± 4.3	51.7 ± 4.3	72.6 ± 8.0	103.5 ± 9.6	141.1 ± 20.8
Discharge eGFR ± SD*	76 ± 55	95.7 ± 70.8	79.9 ± 58.6	70.6 ± 42.2	66.7 ± 46.6	73.1 ± 52.3	53.5 ± 26.7
P value	<0.0001	<0.0001	<0.0001	<0.0001	0.11	<0.0001	<0.0001
Mean diff (bias) ± SD*	21.6 ± 65.3	72.2 ± 72.7	42.7 ± 59.0	18.9 ± 42.7	-5.8 ± 46.8	-30.4 ± 54.8	-87.6 ± 32.4
Complete recovery by Clcr - n (%)	225 (28.7)	3 (2)	23 (11)	26 (14)	97 (57)	55 (87)	21 (87.5)
Complete recovery by eGFR - n (%)	227 (35.3)	62 (48)	87 (41)	62 (33)	50 (30)	16 (25)	0
P value	0.007	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table 2: (Dis)agreement between Clcr and eGFR at ICU discharge and the derived estimation of complete recovery for all patients and subgroups with different discharge Clcr.

CONCLUSION

Estimated GFR at ICU discharge is significantly higher than measured Clcr in patients with prolonged ICU stay and in patients with lower discharge Clcr. In patients with higher discharge Clcr eGFR underestimates Clcr. These differences can be explained by loss of muscle mass with decreased creatinine production and by poor validation of the MDRD equation at higher GFR levels. eGFR is a poor parameter for assessment of recovery from AKI. By analogy this also accounts for serum creatinine.