NEPHROLOGY - LETTER TO THE EDITOR

Choosing an equation for glomerular filtration rate in decompensated cirrhosis: "Royal Free Hospital" formula is able to predict short-term mortality

Pedro Costa-Moreira[1,2] · Rodrigo Liberal[1,2] · Rui Gaspar[1,2] · Patrícia Andrade[1,2] · Rosa Coelho[1,2] · Hélder Cardoso[1,2] · Susana Lopes[1,2] · Guilherme Macedo[1,2]

Editor,

We read with great interest the article by Ren et al. [1] about the adequate selection of a mathematical equation for measure kidney function in patients with liver disease due to hepatitis B virus infection. This work focuses on renal function in patients without cirrhosis or compensated cirrhosis. However, the role of GFR formulas in patients with decompensated cirrhosis (despite etiology of liver disease) remains poorly validated.

For example, in the recently developed Royal Free Hospital (RFH) Cirrhosis Glomerular Filtration Rate [2], clinical and analytical data were derived of stable patients being evaluated for liver transplantation.

Herein, we report the results of a retrospective analysis of a prospectively collected database including consecutive adult patients admitted for decompensated cirrhosis from 2010 to 2015. We excluded the cases of decompensation characterized by acute kidney injury according to the new definition of the International Club of Ascites [3]. For each case, the glomerular filtration rate at admission was calculated based on the classical GFR formulas [MDRD with four variables (MDRD-4) and six variables (MDRD-6), Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI)] and based on the newest RFH formula. The impact of each formula on the outcome (mortality in the first 50 days after admission) was evaluated by Cox proportional hazards function.

A total of 418 acute decompensation events were evaluated [78.7% men ($n = 329$), mean age 66.3 ± 11.8 years]. At admission, ascites was present in 66% of the cases and regular use of diuretic therapy in 54.1% of the cases. The 50-day post-admission mortality rate was 12%. The use of this temporal cutoff for mortality evaluation was derived from the administrative records of the hospital when this study was conducted.

Despite the significant differences between the median creatinine levels (male: 1.47 ± 1.42 mg/dL, female: 1.01 ± 0.66 mg/dL, $p < 0.01$), gender differences were not significant between the GFR formula. Bivariate Bland–Altman analysis between "conventional" formulas and the newest RFH formula showed a better agreement with MDRD-6 [MDRD: 31.33 ± 25.32, $- 18.30$ to 80.97; MDRD-6: 7.09 ± 10.90, $- 14.27$ to 28.46; RFH: 18.08 ± 14.99, $- 11.30$ to 47.46 (mean bias $\pm$ SD, CI 95%)].

In Cox proportional hazard model, only RFH was able to predict a lower survival at 50 day post-admission (RFH: HR 0.989; CI 95% 0.979–0.998; $p = 0.02$)—Table 1. However, even RFH formula had a modest capacity for prognostic estimation based on 50-day mortality (AUC 0.40, $p = 0.03$).

The RFH formula has been developed in a broad spectrum of patients with stable liver disease. However, our sample data were obtained from a population of cirrhotic patients hospitalized with acute liver decompensation without acute kidney injury. This may explain the modest (but statistically significant) effect of the RFH formula in survival function.

In conclusion, we consider that the work developed for the creation and validation of GFR formulas complements a knowledge gap in the stratification of renal function in liver disease. However, more data are needed on its applicability in patients with acute decompensation.

✉ Pedro Costa-Moreira
    pedromoreira.med@gmail.com

1   Gastroenterology Department, Centro Hospitalar São João, Al. Prof. Hernâni Monteiro, 4200-319 Porto, Portugal

2   Faculty of Medicine, University of Porto, Al. Prof. Hernâni Monteiro, 4200-319 Porto, Portugal

Table 1 Impact of Glomerular Filtration Rate (GFR) formulas in 50-day survival after acute decompensation hospital discharge

GFR formula	Mean GFR "survival group" (mL/min/1.73 m^2)	Mean GFR "death group" (mL/min/1.73 m^2)	Hazard ratio (95% CI)	p
RFH	60.3 ± 33.2	49.6 ± 29.1	0.989 (0.979–0.998)	0.02*
MDRD-4	91.9 ± 56.0	78.4 ± 50.9	0.996 (0.990–1.002)	0.17
MDRD-6	67.3 ± 40.5	57.4 ± 37.9	0.994 (0.986–1.003)	0.18
CKD-EPI	78.1 ± 35.5	69.2 ± 74.0	0.993 (0.986–1.001)	0.22

GFR glomerular filtration rate, *MDRD* modification of diet in renal disease, *RFH* Royal Free Hospital, *CKD-EPI* chronic kidney disease epidemiology collaboration, *CI* confidence intervals

*$p < 0.05$

Compliance with ethical standards

Conflict of interest The authors who have taken part in this study declared that they do not have anything to disclose regarding funding or conflict of interest with respect to this manuscript.

References

1. Ren S, Chang Y, Zhang Q, Wang X, Niu H, Chen L, Lv C, Zhang Z, Xiang X, Zhu L, Li H (2019) How to estimate renal function in patients with liver disease: choosing the most suitable equation. Int Urol Nephrol. https://doi.org/10.1007/s11255-019-02110-8
2. Kalafateli M, Wickham F, Burniston M, Cholongitas E, Theocharidou E, Garcovich M, O'Beirne J, Westbrook R, Leandro G, Burroughs AK, Tsochatzis EA (2017) Development and validation of a mathematical equation to estimate glomerular filtration rate in cirrhosis: the royal free hospital cirrhosis glomerular filtration rate. Hepatology (Baltimore, MD) 65(2):582–591. https://doi.org/10.1002/hep.28891
3. Angeli P, Gines P, Wong F, Bernardi M, Boyer TD, Gerbes A, Moreau R, Jalan R, Sarin SK, Piano S, Moore K, Lee SS, Durand F, Salerno F, Caraceni P, Kim WR, Arroyo V, Garcia-Tsao G (2015) Diagnosis and management of acute kidney injury in patients with cirrhosis: revised consensus recommendations of the International Club of Ascites. J Hepatol 62(4):968–974. https://doi.org/10.1016/j.jhep.2014.12.029

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.