Comparison of different methods for hemodialysis evaluation by means of ROC curves: From artificial intelligence to current methods

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Resumen

Background: The National Kidney Foundation Guidelines (DOQI) and the European Renal Association (ERA) have set standards for adequacy of hemodialysis treatment. They recommended minimum single pool doses of 1.2 (Kt/Vsp DOQI), and 1.4 (Kt/Vsp ERA) and a "standard" urea removal ratio (URR) of 65%. Here, we compare an Artificial Intelligence Method (AIM) based on an Artificial Neural Network (ANN) and the usual methods for hemodialysis treatment follow-up such as Smye, Daugirdas, standard urea reduction ratio (URR using post-dialysis urea concentration) and modified URR [Cheng et al. 2001] against equilibrated Kt/V and URR calculated using a 60 min post-dialysis urea concentration. Methods: We used ROC analysis to evaluate and compare these methodologies. We also propose a method to find a minimum target dose that maximizes the sensitivity, specificity and positive predictive values of the diagnostic tool. Results: From a URR point of view, the ANN, stdURR and mURR perform almost equally well with an area under the curve (AUC) of 0.90, 0.93 and 0.92, respectively, but the ANN achieved the lowest false positive rate (FPR = 7.94%) and error rate (ER = 12.7%). When Kt/V is used as a dose index, the logarithmic single-and double-pool equations perform almost equally (AUC 0.957 and 0.962), and the ANN method achieves an AUC of 0.934. The lowest FPR was for ANN and Kt/Vsp (4.76%), which also achieved the lowest ER of 6.39%. Conclusions: For both cases (URR and Kt/V), the minimum doses required to achieve the lowest FPR and ER for the standard methods (stdURR and Kt/Vsp) were higher than those reported by the DOQI guidelines, being 70% for stdURR and 1.35 for Kt/Vsp, whereas for those methods using the double-pool Kt/V or equilibrated URR, the dose targets were close to those recommended by DOQI and ERA. Our proposed method for target dose selection is easy to understand, and it takes into account both accuracy and confidence of the adequacy tool. We found the ANN method to be superior to the Smye method for estimation of equilibrated urea, and the results presented here suggest that ANN methods could be useful tools in the analysis of nephrology data.

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