Accuracy of Reduced-Time-Point Dosimetry Using the Bayesian Fitting Method for Prostate-Specific Membrane Antigen (PSMA) Therapy = Akurasi dari Dosimetri Reduced-Time-Point dengan menggunakaan Metode Bayesian Fitting untuk Terapi Prostate-Spesific Membrane Antigen (PSMA)

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Abstrak

This study analyzes the accuracy of the estimated time-integrated activity coefficient (eTIAC) in Reduced-Time-Points (RTP) fitting using the Bayesian method with biokinetic data of [177Lu]Lu-PSMA-617 in kidneys. Data were collected at 1,24,48,72, and 168 hours (h) post-injection (p.i.) from 10 metastatic Hormone-Sensitive Prostate Cancer (mHSPC) patients as All-Time-Point (ATP) data. The two-, three-, and four-TP combinations in the RTP method are extracted from ATP. Data were fitted using sum-of-exponential (SOE) functions. ATP fitting provided parameters, and scaled data variance, used to calculate reference TIAC (rTIAC) and prior information for RTP fitting. Three methods were investigated: The effect of variance weighting (absolute [BFa] mean and median estimated fractional standard deviation [eFSD], and relative [BFr] variance weighting); Optimal TP in RTP fitting; The effect of the blood circulation rate parameter (lambda bc) in SOE function. Calculated root-mean-square errors (RMSE) by comparing eTIAC to rTIAC. Results: BFa median eFSD was the best variance weighting. The optimal TP was 48 h p.i. The best RTP fitting combinations were two-TP, three-TP, and four-TP is [1h,72h], [1h,24h,72h], [1h,24h,72h, 68h] with RMSE 3.28%, 1.9%, and 0.89%, respectively. The addition of the lambda bc had RMSE difference below 0.5%. The RTP method with optimal time points accurately calculates eTIAC.
.....Penelitian ini menganalisis akurasi estimasi time-integrated activity coefficient (eTIAC) dalam Reduced-Time-Points (RTP) fitting menggunakan metode Bayesian dengan data biokinetik [177Lu]Lu-PSMA-617 di ginjal. Data dikumpulkan pada 1, 24, 48, 72, dan 168 jam (h) pasca injeksi (p.i.) dari 10 pasien metastatic Hormone-Sensitive Prostate Cancer (mHSPC) sebagai data All-Time-Point (ATP). Kombinasi dua, tiga, dan empat TP dalam metode RTP diekstrak dari ATP. Data di fitting menggunakan fungsi sum-of-exponential (SOE). ATP fitting menghasilkan parameter dan Scaled data variance, yang digunakan untuk menghitung referensi TIAC (rTIAC) dan informasi awal untuk RTP fitting. Tiga metode yang diselidiki: Efek pembobotan varians (absolut [BFa] rerata dan median estimated fractional standard deviation [eFSD], dan Pembobotan relatif [BFr]); TP optimal dalam RTP fitting; Efek parameter laju sirkulasi darah (lambda bc) dalam fungsi SOE. Perhitungan root-mean-square errors (RMSE) membandingkan eTIAC dengan rTIAC. Hasil: BFa median eFSD adalah pembobotan varians terbaik. TP optimal adalah 48 h p.i. Kombinasi RTP fitting terbaik adalah dua-TP, tiga-TP, dan empat-TP adalah [1h, 72h], [1h, 24h, 72h], [1h, 24h, 72h, 168h] dengan RMSE 3,28%, 1,9%, dan 0,89%, berturut-turut. Penambahan lambda bc memiliki perbedaan RMSE di bawah 0,5%. Metode RTP dengan TP optimal dapat secara akurat menghitung eTIAC.