= Exit dose evaluation of organic phantom as an equivalent material in human body tissue

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Abstrak

Fantom merupakan material ekuivalen jaringan tubuh yang berfungsi untuk menyimulasikan interaksi radiasi yang terjadi. Keberadaan fantom di bidang medis menjadikan proses quality assurance (QA), quality control (QC) dan treatment planning system tidak perlu mengekspos jaringan tubuh asli. Tujuan dari penelitian ini adalah menentukan komposisi fantom organik (berbahan dasar lilin dan karbon aktif) juga memperoleh nilai exit dose fantom organik melalui variasi ketebalan serta korelasinya terhadap koefisien atenuasi. Komposisi fantom tersebut didapatkan melalui kesesuaian terhadap nilai CT number (dalam satuan HU) jaringan tubuh manusia. Komposisi bahan organik penyusun fantom berdasarkan penelitian ini untuk material ekuivalen lemak adalah 10% lilin cecek, 10% karbon dan 80% lilin parafin, otot 10% lilin cecek, 10% karbon dan 80% gondorukem, otak white matter 16% lilin cecek, 16% karbon dan 68% gondorukem, otak grey matter 20% lilin cecek, 20% karbon dan 60% gondorukem dan hati 40% tepung beras, dan 60% lilin cecek. Pengukuran exit dose dilakukan pada ketebalan fantom mulai dari 6 cm hingga 10 cm serta ukuran lapangan 20 cm × 20 cm dan 25 cm × 25 cm. Persentase penurunan nilai exit dose di ketebalan 10 cm relatif terhadap ketebalan 6 cm pada ukuran lapangan 20 cm x 20 cm menunjukkan nilai sebesar (29,1% ± 4,4%); (43,7% ± 2,7%); (43,0% ± 1,2%); (41,4% ± 0,4%); (51,2% ± 5,7%) untuk material ekuivalen jaringan lemak, otot, otak white matter, otak grey matter, dan hati secara berturut – turut. Sedangkan pada ukuran lapangan 25 cm × 25 cm menunjukkan nilai sebesar (30,0% ± 2,3%); (41,2% ± 2,6%); (41,9% ± 2,1%); (40,4% ± 1,1%); (47,5% ± 4,7%). Berdasarkan hasil tersebut menunjukkan bahwa, nilai exit dose berkurang seiring dengan bertambahnya ketebalan fantom. Hal serupa ditunjukkan oleh pengurangan ukuran lapangan yang menyebabkan berkurangnya nilai exit dose. Sementara itu, nilai dosis serap dan buildup factor menunjukkan hasil yang bertolak belakang dengan nilai exit dose, di mana penambahan ketebalan fantom menyebabkan naiknya dosis serap.

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Phantom is an equivalent body tissue material that has always been used to simulate radiation interactions. the needs to expose human body with radiation in the process of QA, QC, and treatment planning system is no longer needed since the existence of phantom in the medical field. The purpose of this study is to determine the composition of organic phantom (wax and activated carbon) and also obtain the value of the exit dose of organic phantom through variations in thickness and its correlation to the attenuation coefficient. The phantom composition was obtained through conformity to the value of the CT number (in HU unit) human body tissue. The composition of the organic phantom for fat is 10% cecek wax, 10% activated carbon and 80% paraffin wax, muscle 10% cecek wax, 10% activated carbon and 80% gondorukem, brain white matter 16% cecek wax, 16% activated carbon and 68% gondorukem, brain gray matter 20% cecek wax, 20% activated carbon and 60% gondorukem and liver 40% rice flour, and 60% gondorukem wax. Exit dose was measured with phantom thickness variations ranging from 6 cm to 10 cm and field sizes of 20 cm × 20 cm and 25 cm × 25 cm. The decrease in percentage of exit dose based on

thickness increment of the size of the field 20 cm x 20 cm were (29,1% ± 4,4%); (43,7% ± 2,7%); (43,0% ± 1,2%); (41,4% ± 0,4%); (51,2% ± 5,7%) for equivalent material fat, muscle, white matter brain, gray matter brain, and liver respectively. Whereas the size of the field 25 cm × 25 cm were (30,0% ± 2,3%); (41,2% ± 2,6%); (41,9% ± 2,1%); (40,4% ± 1,1%); (47,5% ± 4,7%). Based on these results it showed that the value of the exit dose decreases with increasing thickness of the phantom. The same results were showed by the reduction in the size of the field which causes a decrease in the value of exit dose. Meanwhile, the absorption dose value and buildup factor showed the opposite results with the exit dose value, where the phantom thickness increment.