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Estimasi Volume Hippocampus Pada Tikus Model Penuaan Induksi D-Galaktosa
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INTISARI

Latar belakang: Penuaan ditandai oleh peningkatan stres oksidatif dan inflamasi yang memicu kerusakan serta kematian neuron *hippocampus*, sehingga menyebabkan perubahan volume *hippocampus* yang berhubungan dengan gangguan kognitif. Hingga saat ini, belum ada laporan data estimasi volume *stratum pyramidalis cornu ammonis* (CA)1, CA2/3, dan *stratum granulosum gyrus dentatus* (GD) pada model tikus penuaan yang diinduksi D-galaktosa.

Tujuan: Mengkaji karakteristik neuron dan mengestimasi volume stratum *pyramidalis* CA1, CA2/3 dan *stratum granulosum* GD pada tikus model penuaan oleh D-galaktosa.

Metode: Dua belas ekor tikus jantan *Sprague Dawley* dibagi menjadi kelompok kontrol (n=6) dan kelompok D-galaktosa (n=6). Kelompok kontrol menerima saline 0,9%, sedangkan kelompok D-galaktosa menerima D-galaktosa 300 mg/kgBB secara intraperitoneal setiap hari selama 8 minggu. Jaringan *hippocampus* diproses menjadi blok parafin, diiris setebal 3 µm menggunakan *systematic uniform random sampling*, dan diwarnai dengan biru toluidin.

Hasil Penelitian: Estimasi volume telah memenuhi kriteria optimum dengan 8–12 irisan, 160–312 titik terhitung, dan rerata *coefficient of error* (CE) sebesar 2,0–2,3%. Kelompok D-galaktosa menunjukkan neuron dengan karakteristik *dark neuron*. Volume *stratum pyramidalis* CA1 pada kelompok kontrol dan D-galaktosa berturut-turut adalah 0,39±0,02 dan 0,34±0,07 mm^3, CA2/3 sebesar 0,73±0,04 dan 0,70±0,07 mm^3, serta *stratum granulosum* GD sebesar 0,44±0,03 dan 0,44±0,06 mm^3. Tidak terdapat perbedaan volume yang bermakna pada ketiga subregion hippocampus antara kedua kelompok (p>0,05).

Kesimpulan: Induksi D-galaktosa menyebabkan perubahan karakteristik morfologi neuron yang mengarah pada *dark neuron*, tetapi tidak mengubah volume *stratum pyramidalis* CA1, CA2/3, maupun *stratum granulosum* GD *hippocampus.*

Kata kunci: *Cavalieri, cornu ammonis, gyrus dentatus,* penuaan, *sprague dawley,* volume.

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ABSTRACT

Background: Aging is characterized by increased oxidative stress and inflammation that trigger hippocampal neuronal damage and cell death, leading to changes in hippocampal volume associated with cognitive impairment. To date, no study has reported volume estimates of the stratum pyramidalis of cornu ammonis (CA)1 and CA2/3, and the stratum granulosum of the gyrus dentatus (GD), in a D-galactose-induced aging rat model.

Objective: To evaluate neuronal morphology and estimate the volumes of the *stratum pyramidale* in CA1 and CA2/3, and the *stratum granulosum* of the dentate gyrus in a D-galactose-induced aging rat model.

Methods: Twelve male *Sprague Dawley* rats were allocated to a control group (n=6) and a D-galactose-treated group (n=6). The control group received 0.9% saline, whereas the D-galactose-treated group received D-galactose (300 mg/kg body weight) by intraperitoneal injection once daily for 8 weeks. Hippocampal tissues were processed into paraffin blocks, sectioned at 3 μm using systematic uniform random sampling, and stained with Toluidine Blue.

Results: Volume estimation met the optimal stereological sampling criteria, based on 8–12 sections, 160–312 counted points, and a mean coefficient of error (CE) of 2.0–2.3%. Neurons in the D-galactose-treated group exhibited morphological features consistent with *dark neurons*. The mean volumes of the *stratum pyramidale* in CA1 were 0.39 ± 0.02 mm^3 and 0.34 ± 0.07 mm^3 in the control and D-galactose-treated groups, respectively. The corresponding volumes for CA2/3 were 0.73 ± 0.04 mm^3 and 0.70 ± 0.07 mm^3, while those of the *stratum granulosum* of the dentate gyrus were 0.44 ± 0.03 mm^3 and 0.44 ± 0.06 mm^3. No significant differences were observed in the volumes of the three hippocampal subregions between the two groups ($p > 0.05$).

Conclusion: D-galactose-induced aging altered neuronal morphology toward a *dark neuron* phenotype but did not significantly affect the volumes of the *stratum pyramidale* in CA1, CA2/3, or the *stratum granulosum* of the dentate gyrus.

Keywords: Aging, cavalieri, cornu ammonis, gyrus dentatus, sprague–dawley, volume.