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A study of urinary glycosaminoglycans from a stone-prone and stone-free population

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Introduction: In South Africa, stone disease occurs in 15% of the white population but in less than 1% of the black population. Glycosaminoglycans (GAG) have been implicated in playing a role in stone formation. The present study was two-fold. Firstly, to investigate whether there were any differences in the excretion of urinary Gags in the two population groups. Secondly, to test the effects of the extracted GAGs on calcium oxalate crystallisation kinetics and to ascertain whether these molecules provide a more protective mechanism against stone formation in the black group.

Method: Twenty black and fourteen white South African male students each provided 24 hour urine specimens. Urinary GAGs were recovered from individual urines using the salt precipitation method and the uronic acid content was determined. Urinary GAGs from whites (uWG) and blacks (uBG) were also recovered from pooled urines. These GAGs as well as commercially obtained chondroitin sulphate (CS) and hyaluronic acid (HA) were tested at their physiological concentrations in artificial urine (AU) using the mixed suspension, mixed product removal system[1].

Results: The total GAG concentration ranged from 4.7 – 33.9 mg/day and 4.1 – 47.5 mg/day for black and white subjects respectively. There was no significant difference in the average GAG concentration between the two groups (16.8 ± 2.0 vs. 18.4 ± 3.2 mg/day, respectively).

Table 1. Nucleation and growth rates for commercial and urinary GAGs (Mean ± SE)

	Nucleation Rate (particle no./min/ml) x 10^4	**Growth Rate** (µm/min)
AU	11.18 ± 0.30	0.168 ± 0.001
CS	15.50 ± 0.63	0.166 ± 0.002
HA	16.70 ± 1.05	0.161 ± 0.001
uBG	21.26 ± 0.83	0.180 ± 0.001
uWG	19.95 ± 0.82	0.174 ± 0.001

Nucleation rates for all GAGs were significantly higher compared to the AU. Of interest was the higher nucleation rates of urinary GAGs in comparison to the individual GAGs ($p<0.01$). There was no difference in the rates obtained for uBG and uWG. Growth rates were the same for all Gags.

Conclusion: The observation of no difference in the excretion rate of GAGs between the two groups implies that other stone inhibition mechanisms may play a role in the rarity of stone disease in the black group. On the other hand, the role as a nucleation promoter in both groups may be regarded as a mechanism for rapidly reducing supersaturation and suggests that GAGs play a protective role in this disease in general.

References: Poon NW, Gohel MDI. Urinary glycosaminoglycans and glycoproteins in a calcium oxalate crystallization system. Carb Res (2012), 347: 64.

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