AMINOACIDURIA AND LENS OPACITY FORMATION*†

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AMINOACIDURIA and lens opacity formation are associated with diseases such as galactosaemia and Lowe's syndrome, but the association is not one of direct cause and effect. Parsons-Smith, Luntz, and Kawerau (1962) found abnormal aminoacid excretion in persons with senile cataracts. The study has been designed to test this relationship further.

Method

The survey was undertaken in two stages:

(1) The lens opacity state of a sample of the general population was assessed on the slit-lamp microscope with full pupillary dilation (Hollows, McGuinness, and Graham, 1965), and four main groups were defined:

Group I—No lens opacities

Group II—Cortical opacities (A)—Senile wedges and plaques (B)—Juvenile clubs

Group III—Nuclear lens opacities

Group IV—Aphakia (excluding traumatic aphakia) or mature lens opacity.

The lenses were also graded according to nuclear colour.

(2) From Group I subjects were selected to match as nearly as possible for age and sex those in Groups II to IV. The resultant sample consisted of 374 persons of the general population of the Rhondda Fach whose age and sex distribution showed a slight excess of older age groups when compared with the M.R.C. census figures for this area (see Table I). 91 per cent. of this sample was examined.

TABLE I
AGE DISTRIBUTION OF POPULATION STUDIED

Sex		Male						Female					
		Census		Sample		Seen		Census		Sample		Seen	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Age (yrs)	40-49	715	33.7	54	32.5	51	33.1	821	32.3	63	30.3	57	30.7
	50-59	726	34.3	59	35.5	56	36.4	789	31.0	59	28.4	53	28.5
	60-69	527	24.9	37	22.3	32	20.8	688	27.0	58	27.9	50	26.9
	70-74	151	7.1	16	9.6	15	9.7	248	9.7	28	13.5	26	14.0
Total		2,119		166		154		2,546		208		186	

The urine was collected in sterile containers and the aminoacids estimated by ascending paper chromatography by the method of Efron, Young, Moser, and MacCready (1964). An amount of urine containing 10 µg. creatinine was chromatographed.

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Results

The excretion pattern was not found to vary for age or nuclear colour of lens; the combined results for each lens opacity group are shown in Table II.

TABLE II
PERCENTAGE OF PERSONS WITH AMINO ACID IN URINE

Sex		Male							Female						
Group		I	IIA	IIB	III	IV	II-IV	All	I	IIA	IIB	III	IV	II-IV	All
Amino Acid	Glycine	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Histidine	94	92	96	89	100	93	94	96	100	95	73	100	95	96
	Alanine	92	89	96	100	100	93	93	86	88	86	91	100	88	90
	Serine	77	78	70	89	67	76	77	68	79	74	64	86	76	72
	Glutamine	65	51	59	33	33	51	58	47	35	43	27	14	40	41
	Threonine	44	46	44	44	67	46	49	40	51	43	36	43	46	43
	Cysteic Acid	44	30	44	33	0	34	39	22	9	19	18	29	16	18
	Tyrosine	9	11	7	11	33	11	10	6	5	7	9	0	6	6
	Phenylalanine	1	0	0	11	0	1	1	1	0	2	9	0	2	2
	Glutamic Acid	9	8	7	0	0	7	8	6	5	19	18	14	13	10
	Aspartic Acid	3	5	4	11	33	7	5	1	5	14	18	14	11	6
	Leucine	1	0	0	0	0	0	1	2	2	0	9	0	2	2
	Taurine	1	0	4	0	33	3	2	0	2	0	0	0	1	1
	Valine	3	19	0	11	0	11	6	0	14	7	9	0	10	5
	Cystine	0	3	0	0	0	1	1	1	2	2	0	0	2	2
	B.A.I.B.*	0	0	4	0	0	1	1	2	0	0	9	0	2	2
	Proline	0	0	4	0	0	1	1	0	0	0	0	0	0	0
	Lysine	0	0	0	0	0	0	0	0	2	0	0	0	1	1
	Basic Amino Acid	0	0	4	0	0	1	1	1	5	0	0	0	2	2
Total Number in Group		78	37	27	9	3	76	154	82	43	42	11	7	103	185

*B.A.I.B. = Beta-aminoisobutyric Acid

Glycine, histidine, and alanine excretion were the most prominent as assessed by the colour intensity of the spots on the chromatograph paper.

The concentration and percentage of the other aminoacids excreted were much less, often in only trace quantities.

No difference was seen in any of the subgroups, except that a significantly higher percentage of females with lens opacities was shown to excrete trace quantities of valine and aspartic acid, compared with females without lens opacities ($P < 0.01$). Males did not show this trend at a significant level.

Discussion

Parsons-Smith and others (1962) and Davies and Kawerau (1965) found a greater excretion of the aminoacids taurine, lysine, phenylalanine, and tyrosine in the urine of patients admitted to hospital for senile cataract extraction compared with a control group. This was not confirmed in the present study, and the mechanism of such an excretion is not known.

Galactosaemia is associated with a generalized aminoaciduria probably as a result of renal tubular cell damage. There is a considerable increase in the urinary excretion of serine, glycine, threonine, and alanine, with a moderate increase in that of glutamine, valine, leucine, and tyrosine (Holzel, Komrower, and Wilson, 1952; Bickel and Hickmans, 1952; Cusworth, Dent, and Flynn, 1955). Lens opacities are commonly seen (Cordes, 1960), but there appears to be no direct relationship between the aminoaciduria and lens opacity formation except for the lack of the enzyme galactose 1—phosphate uridyl transferase.

In Lowe's syndrome there is a marked increase in urinary excretion of histidine, methyl histidine, glutamine, glycine, alanine, threonine, and arginine. Proline, lysine, cystine, leucine, isoleucine, and valine are also present (Richards, Donnell,

Wilson, Stowens, and Perry, 1965). The aminoaciduria is of renal origin and is associated with marked changes in the lens.

Increase in urinary excretion of these aminoacids was not found in the present study, but valine and aspartic acid excretion, although only in trace quantities, was significantly greater in females with lens opacities than in persons without lens opacities. Males did not show this trend.

Valine excretion is associated with maple syrup urine disease (Menkes, Hurst, and Craig, 1954), where there is a block in the oxidative decarboxylation of the branch chain alpha keto aminoacids of leucine, isoleucine, and valine (Menkes, 1959; Dancis, Levitz, Miller, and Westall, 1959). These accumulate in the blood and the aminoaciduria is of the overflow type. No lens opacities have been recorded.

Valine is also excreted in Lignac Fanconi disease as part of a generalized aminoaciduria associated with a characteristic deformity of the proximal renal tubule where it joins the glomerulus (Darmady, 1954).

Valine excretion is associated with lens opacity formation in Lowe's syndrome (Richards and others, 1965), galactosaemia (Holzel and others, 1952), and Wilson's disease (Stein, Bearn, and Moore, 1954) as part of a generalized aminoaciduria.

Aspartic acid excretion is increased in hereditary citrullinuria (Harris and Milne, 1964), but lens opacities have not been recorded in this condition.

It is difficult to assess the significance of the increased excretion of valine and aspartic acid in females with lens opacities compared with those without and further studies of this aspect are obviously required.

Summary

The urine aminoacid excretion pattern is given for 339 persons aged 40 to 74 years of the general population of the Rhondda Fach assessed for lens opacities.

No difference is seen in the excretion pattern between persons with and without lens opacities, except for an increased excretion of valine and aspartic acid in females with lens opacities.

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