Urine Blood Alcohol Ratios

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DR. MORGAN (1965)1 has examined the relationship of a blood alcohol concentration derived by calculation from a random sample of urine and the actual concentration of alcohol in the blood by examining 224 "drunk-in-charge" cases in which simultaneous samples of blood and urine were taken in the medical examination and referred to the laboratory for analysis. He came to the conclusion that it is an unsatisfactory procedure to calculate the alcohol content of the blood from a random sample of urine as there is a possibility of the calculated result being prejudicial to the defendant.

Drs. Dunnet & Kimber (1968)2 considered 151 cases and their conclusions were in agreement with those of the British Medical Association that the ratio of 1.33 : 1 is fair and no injustice has been caused by converting urine-alcohol to blood alcohol.

Since the views expressed by the 2 groups of workers were contradictory further investigations to ascertain whether the ratio is valid or not were carried out. In this case local subjects were studied under controlled conditions and the results were compared with that of routine case figures of samples submitted by the Police and Medical Authorities to this laboratory for analysis.

In routine cases, when a man is apprehended by the police, he is taken to the nearest general or district hospital and the medical officer examines him. If the medical officer feels that a chemical analysis is necessary (which is almost always so in routine cases) then he takes samples of blood and urine if available. The blood samples are collected in oxalated bottles prepared and supplied by our Department to the various hospitals but the urine samples have no preservative in them or their containers. The samples are sealed and sent to us by police escort. In the laboratory they are stored in a refrigerator. Routine analysis in this laboratory (so far) has always been done by the Kozelka and Hine method. The results of the alcohol analysis are sent to the police and the medical officer.

There is no law in this country as yet whereby a driver of a motor vehicle is obliged to give a sample of his blood or urine for testing, and he can refuse to give any sample if he wishes. Recently there has been a suggestion in the press that the breath alcohol test be applied as a screening test and then the blood alcohol be determined. The law may have to be amended to make it obligatory for the driver of a motor vehicle to give samples of blood and urine for alcohol tests. A 'fixed' alcohol figure may be introduce beyond which it will be an offence to drive a vehicle.

With this in view a paper was published in the Malayan Medical Journal (June 1968)3 where observations of Alcohol Intoxication in local subjects, who were given fixed amounts of alcohol to drink and underwent clinical testsand also submitted blood and urine samples at various intervals of time after consumption of the drink. The conclusion was that if and when a 'fixed blood alcohol figure' is adopted for this country it should be 50 mgs/100 mls of blood. This conclusion was based on the fact that the symptoms of intoxication were observed even in the regular drinkers at around the 50 mgs/100 ml range. Further since temperate countries

like United Kingdom has fixed 80 mgs/100 ml and the populace there are more regular drinkers of alcohol than here, principally because the former drink to keep themselves warm. Furthermore their diet contains more meat (for warmth), it was thought that 50 mg/100 ml was fair for this country. With the possibility of this new law being introduced we now investigated the urine-blood alcohol ratios on the results of the investigations carried out earlier on and compared them with routine case figures of samples where a blood and urine were submitted to the laboratory. In those cases where the blood sample would not be available for one reason or another, and only a urine sample was available, we could have two alternatives:-

(i) Convert the urine alcohol figure to blood alcohol using 1.33

or (ii) A "urine alcohol figure" incorporated in the legislation in addition to a fixed blood alcohol fugure. It has been reported that in the United Kingdom some problems arose where the suspected drinker driver refused to give a venous sample of blood and only allowed a finger prick or ear-lobe prick. It is recommended that if a blood sample is necessary then a venous sample be obtained.

Procedure adopted

Twenty-five (25) volunteers were invited to drink (after the bladder had been emptied) known amounts of alcohol in a specified time (usually 20-30 minutes). Samples of venous blood were collected every one (1) hour starting from the first hour after the drink had been consumed, and the urine samples were collected every half-hour (½) hour starting from the same time as the first blood sample. Altogether for one volunteer two (2) blood samples and four (4) urine samples were collected. All the volunteers had approximately the same amount of food in the stomach. Drinking started at about 8.30 a.m. and each person had two slices of bread and two cups of coffee/tea for breakfast which was taken approximately one hour earlier. The volunteers included all the various races in this country (i.e. Malays, Chinese, Indians and Eurasians). The alcoholic beverages used were those locally consumed viz. Beer, Brandy, Whiskey, Vodka and Chinese samsoo.

Results obtained

Table I shows the results obtained from blood and urine taken at the same time i.e, within approximately 10-15 minutes of each other. Altogether 49 samples of blood and 49 samples of urine figures are reported. The average urine-blood alcohol ratio is 1.28.

Table I

Blood & Urine Samples taken under Controlled Conditions

No.	Blood Alcohol (mg/100 ml.)	Urine Alcohol (mg/100 ml.)	Urine Alcohol/ Blood Alcohol
1.	55	73	1.32
2.	34	44	1.29
3.	48	51	1.06
4.	103	124	1.20
5.	103	139	1.35
6.	89	102	1.15
7.	89	92	1.03
8.	33	39	1.18
9.	18	27	1.50
10.	55	66	1.20
11.	43	63	1.46
12.	106	149	1.41
13.	91	127	1.39
14.	91	100	1.09
15.	91	109	1.19
16.	50	74	1.48
17.	59	71	1.20
18.	114	176	1.54
19.	127	158	1.24
20.	127	152	1.19
21.	127	138	1.09
22.	25	28	1.12
23.	22	28	1.27
24.	51	81	1.58
25.	51	71	1.39
26.	100	143	1.43
27.	119	124	1.04
28.	119	143	1.20
29.	119	161	1.35
30.	94	118	1.25
31.	94	150	1.38
32.	85	115	1.35
33.	73	94	1.29
34.	97	131	1.35
35.	97	137	1.41
36.	85	92	1.43
37.	82	127	1.54
38.	99	130	1.37
39.	99	127	1.28
40.	99	106	1.07
41.	44	53	1.20
42.	59	86	1.45
43.	59	75	1.27
44.	62	71	1.14
45.	55	76	1.38
46.	55	59	1.07
47.	103	136	1.32
48.	103	117	1.35
49.	37	46	1.24

Table II shows 120 routine cases submitted to this laboratory where both blood and urine samples were sent, both having stated to have been taken at the same time. The average urine-blood alcohol ratio is 1.29.

Table II

Routine Cases with one Blood and one Urine Sample submitted to the Laboratory.
(Blood, Urine stated to have been taken at same time i.e. within 10 – 15 mins of each other)

No.	Blood Alcohol (mg/100 ml.)	Urine Alcohol (mg/100 ml.)	Urine Alcohol/ Blood Alcohol
1.	127	154	1.21
2.	29	40	1.38
3.	133	180	1.35
4.	107	137	1.28
5.	218	277	1.27
6.	261	296	1.13
7.	224	308	1.38
8.	210	313	1.49
9.	223	278	1.25
10.	184	235	1.28
11.	272	336	1.24
12.	110	151	1.37
13.	87	110	1.26
14.	143	197	1.38
15.	136	187	1.38
16.	318	427	1.34
17.	257	333	1.29
18.	178	212	1.19
19.	157	184	1.17
20.	244	317	1.30
21.	150	206	1.37
22.	315	463	1.47
23.	195	275	1.14
24.	184	253	1.37
25.	204	275	1.35
26.	136	194	1.43
27.	132	178	1.35
28.	214	289	1.35
29.	217	226	1.04
30.	208	291	1.40
31.	62	77	1.24
32.	170	224	1.32
33.	132	187	1.42
34.	239	325	1.36
35.	187	233	1.25
36.	138	181	1.31
37.	164	198	1.21
38.	190	236	1.24
39.	269	359	1.34
40.	173	235	1.36
41.	217	299	1.38
42.	198	250	1.26
43.	319	427	1.34
44.	139	158	1.14
45.	204	270	1.32
46.	83	109	1.13
47.	167	204	1.22
48.	109	129	1.18
49.	177	238	1.35
50.	186	232	1.25
51.	146	193	1.32
52.	212	294	1.39
53.	138	192	1.39
54.	187	223	1.19
55.	221	299	1.35
56.	195	261	1.34
57.	51	71	1.39
58.	192	232	1.21
59.	133	163	1.23
60.	232	319	1.38
61.	477	575	1.121
62.	150	215	1.43
63.	255	336	1.32
64.	135	181	1.34
65.	170	241	1.42
66.	198	283	1.43
67.	178	241	1.35
68.	281	333	1.19
69.	73	107	1.47
70.	167	196	1.17
71.	131	173	1.32
72.	101	117	1.16
73.	69	89	1.29
74.	129	144	1.12
75.	75	100	1.33
76.	143	204	1.43
77.	85	110	1.29
78.	142	184	1.30
79.	217	292	1.35
80.	109	121	1.11
81.	235	257	1.09
82.	265	315	1.19
83.	146	188	1.29
84.	235	294	1.25
85.	217	261	1.20
86.	287	427	1.49
87.	157	222	1.41
88.	86	106	1.23
89.	340	420	1.26
90.	309	342	1.11
91.	297	400	1.35
92.	212	274	1.29
93.	209	257	1.23
94.	153	190	1.24
95.	206	248	1.20
96.	384	418	1.09
97.	347	454	1.31
98.	64	90	1.41
99.	357	446	1.25
100.	84	123	1.46
101.	115	147	1.28
102.	153	214	1.40
103.	265	333	1.26
104.	281	361	1.28
105.	258	346	1.29
106.	104	119	1.14
107.	168	217	1.29
108.	326	396	1.21
109.	260	316	1.22
110.	297	341	1.15
111.	153	205	1.34
112.	176	235	1.34
113.	81	105	1.30
114.	136	187	1.37
115.	105	141	1.34
116.	80	94	1.18
117.	105	144	1.37
118.	239	260	1.09
119.	271	324	1.20
120.	199	239	1.20

Discussion of Results

In any alcohol and driving law it should be an indisputable right of the defendant to give either blood or urine whichever he pleases and in addition to any fixed blood-alcohol figure there should also be a fixed urine-alcohol figure and the method of test should be specified. The breath alcohol test should only serve as a means of screening for subsequent blood or urine alcohol determination.

It is our opinion that since the conversion of 1.33 refers only in cases where the 'peak' of alcohol in urine has been reached which is slightly after the 'peak' of alcohol in blood (provided drinking has ceased), in practise, this may not be applicable in all cases, because a driver may be apprehended soon after consumption of drink. The literature shows that the average values of blood-urine alcohol ratios according to various authors varies considerably from 1.25 to 1.35. In our local conditions it has been found to be 1.28 for controlled samples and 1.29 in actual cases submitted. Because the ratio varies considerably between various authors it is recommended that if and when a 'fixed' blood alcohol figure is introduced in this country, in addition a 'fixed' urine alcohol figure should also be legislated.

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