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Blood cotinine, carboxyhaemoglobin, and thiocyanate concentrations and cigarette consumption

It is important that doctors should be aware of the correlation between patients' blood concentrations of tobacco products, reported cigarette

Concentrations of cotinine, carboxyhaemoglobin, and thiocyanate

Smoking state	No	Cotinine (nmol/l)		Carboxyhaemoglobin (%)		Thiocyanate (μmol/l)	
		Mean	SD	Mean	SD	Mean	SD
Non-smokers	198	23	76	0.93	0.5	33	15
Light to moderate smokers* (at entry)	56	1430	1090	3.47	1.8	98	40
Heavy smokers† (at entry)	132	2107	1304	4.85	2.1	114	47
Abstainers (at 6 months)	34	60	181	1.03	0.5	44	18

*1-19 Cigarettes daily.

†≥20 Cigarettes daily.

Conversion: SI to traditional units—Cotinine: 1 nmol/l≈17.6 ng/100 ml. Thiocyanate: 1 μmol/l≈5.8 μg/100 ml.

consumption, and success in stopping smoking. We report these correlations as part of a study of patients attending a stop smoking programme administered by general practitioners.¹ In that study smokers were randomly allocated to either a treatment (n=100) or control group (n=100) and baseline data collected on 200 non-smokers. The structured personalised programme is described elsewhere.² At three years 36% of the treated smokers were abstinent, self reports being validated biochemically by salivary cotinine estimations.¹

Patients, methods, and results

Of the 200 smokers and 200 non-smokers studied, 188 and 198 respectively had blood tests at entry. At six months only the smokers at entry had a second blood test, assays being performed on 34 abstainers and 81 continuing smokers. The remaining 73 subjects comprised 25 continuing smokers who refused to give blood and 48 participants lost to follow up. An abstainer was a previous smoker who had not smoked for at least three months before the visit at six months, and a continuing smoker a regular or occasional smoker or dropout from the study.

A 10 ml blood sample was obtained from each participant, 2 ml being stored as whole blood for carboxyhaemoglobin assay. Plasma cotinine estimations were by gas chromatography, carboxyhaemoglobin estimations by automated spectrophotometry, and plasma thiocyanate estimations by ion chromatography. Methods of analysis were as reported.² Plasma thiocyanate analysis at six months was performed with a different resin from the initial assay, giving higher values than at entry.

At entry the blood concentrations of cotinine, carboxyhaemoglobin, and thiocyanate in non-smokers were significantly less than those in smokers ($p<0.0001$ in each case; table). Moreover, the concentrations of all three analytes in smokers were related to their cigarette consumption, heavier smokers having significantly higher concentrations than light to moderate smokers ($p<0.0001$, $p<0.0001$, and $p<0.05$ respectively). Abstainers at six months, who came from both groups of smokers at entry, had concentrations of analytes that were not significantly different from those of non-smokers. Smokers who became abstainers generally had lower concentrations of these components at entry than those who continued to smoke.

Comment

Among the abstainers at six months there was a significant reduction in blood concentrations of the three analytes compared with those of the non-smokers. In the continuing smokers, however, blood concentrations remained unchanged from measurements at entry. The blood tests were particularly useful in identifying false reporting of cigarette consumption. Two of the group reporting abstinence at six months had concentrations suggesting continued smoking and subsequently admitted to false reporting.

When cigarette consumption at entry was categorised into heavy and light to moderate we found that heavy smokers had significantly higher blood concentrations of the three analytes than light to moderate smokers. These results, however, were aggregations of data based on broad categories, and other workers have found low correlations between reported numbers of cigarettes smoked and biochemical measurements.^{3,4}

In addition to actual cigarette consumption, blood concentrations of tobacco products vary with depth of inhalation, frequency of puffing, proportion of each cigarette consumed, time between smoking and blood sampling, absorption, rates of transfer in the tissues, and metabolism and excretion of tobacco products.^{4,5} In our study time of blood sampling from the last cigarette made minimal contribution to the blood concentrations (13% for carboxyhaemoglobin, 1% for thiocyanate, 10% for cotinine).

We emphasise that in our study the relation between cigarette consumption and blood concentrations was examined retrospectively. This should be explored more carefully in a prospective study with larger numbers of smokers categorised into smaller groupings of cigarette consumption.

Interestingly, we found that subjects with lower cigarette consumption and lower blood concentrations were more successful at stopping smoking. Though nicotine in cigarettes is regarded as the main component of dependence, the blood concentrations of all three analytes in our study were related to outcome.

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Correction

Exposure of midwives to nitrous oxide in four hospitals

We regret that in this paper (25 October, p 1063) three lines were misplaced. The first two sentences of the second paragraph of the discussion should read: "Workload does not appear to be a contributing factor as hospitals A and B exceed hospital D in this respect (table). The smaller proportion of deliveries performed under epidural analgesia in hospital D than in hospital A or C is a possible factor."