SHORT REPORT

Determination of the prevalence of drug misuse by meconium analysis

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In a pilot study to determine the local prevalence of maternal drug misuse, meconium from 400 infants was analysed for metabolites of eight controlled drugs. Cannabinoids were found in 13.25%, cocaine in 2.75%, and amphetamine in 1.75%. The prevalence of opiate and benzodiazepine misuse was masked by the presence of prescribed drugs so was undeterminable.

Drug misuse in pregnancy is difficult to quantify. UK government statistics of the general population are estimated from police, health service, and social work databases.[1] Analysis of maternity records in 2002 gave an estimated prevalence of 4.4 per 1000 pregnancies affected by drug misuse in Scotland.[1] This is probably an underestimate because of the illicit and episodic nature of drug misuse.

Meconium analysis offers an alternative, more accurate method of quantifying the level of drug misuse in pregnancy. It was developed in the United States of America for several screening studies.[2 3] It is a better indicator than maternal history, and maternal and neonatal hair and urinalysis.[3–6] Drug metabolites accumulate in fetal meconium after 16 weeks gestation.

We aimed to pilot the meconium analysis technique to determine levels of drug misuse in the local pregnant population.

Infants studied were those born in Glasgow Royal Maternity Hospital between October and December 2001. This hospital is in an area with a high prevalence of social deprivation and drug misuse. It also receives mothers with drug problems from outside this area. One meconium sample was obtained per infant. We aimed to sample all infants so there were no exclusion criteria. Each sample was anonymised, and no information on individual mothers or infants was recorded. The local ethics committee concluded that the anonymous use of human waste could be carried out without obtaining informed consent, although we informed mothers of the study and there were no objections.

Samples were batch analysed in the forensic medicine department, University of Glasgow. They were screened by enzyme immunoassay followed by confirmatory gas chromatography/mass spectrometry (GC/MS) for specific metabolites of eight controlled drugs. The target analytes chosen were the most commonly misused drugs in the Glasgow area, known from the casework of the forensic medicine department. The technique was validated locally, and the reproducibility documented by Azzim.[7] Table 1 shows the numbers confirmed positive by GC/MS for each drug group.

Morphine, codeine, methadone, diazepam, and temazepam are controlled drugs that can be legitimately prescribed during pregnancy, so the presence of their metabolites in meconium could not conclusively imply illicit use. A small number of samples were selected to be analysed further for opiate impurities (a more specific marker of illicit use), as outlined below. Cannabinoids, cocaine, and amphetamine are not prescribed in pregnancy. Their presence in the samples was therefore assumed to be due to illicit maternal use. Methadone is prescribed during pregnancy to stabilise the opiate dependent woman, so is an indicator of dependence. Table 2 shows the results of the 15 samples found to be positive for methadone. All positive results were quantifiable, and comparison in a Mann-Whitney U test showed significantly higher concentrations of morphine in these samples than in the remaining 385 samples ($p<0.001$, z score 5.1). The methadone positive samples were also separately analysed by GC/MS for the following metabolites found in street heroin and not in prescribed diamorphine: acetylcodeine, 6-monoacetyl morphine, dihydromorphine, papaverine, and thebaine. The presence of these markers therefore indicates illicit use. Nine samples (60%) were found to contain one or more of these markers. The presence of methadone in a sample was also associated with multiple drug detection; 12 (80%) of the methadone positive samples contained more than three of the eight drug groups. This was true of only 26 (6.5%) of the remaining 385 samples, which are assumed to reflect the non-dependent population.

Several weaknesses were outlined by this pilot study which need to be addressed in future. Samples were not collected from all infants born in the study period (400 samples from 1031 live births). This could be improved by focusing on the organisational aspects of collecting the meconium from newborns. The method of taking a single sample rather than the entire meconium that a neonate passes may have caused under-detection of the drugs in question; improving the method of collection would also address this.[5] We could not distinguish between prescribed or illicit morphine and codeine by the basic eight drug screen. Pharmacy records show a 45% incidence of opiate prescription to mothers in labour during the study period, so it is likely that most of the morphine and codeine in the samples had a legitimate origin. The more detailed GC/MS, which we performed on only a small selection of samples for financial reasons, could be incorporated more widely in future to allow a conclusive statement on the origin of any opiates detected, without breaking anonymity. It is currently not possible to determine the origins of benzodiazepines in an anonymous sample of meconium. The local practice of prescribing benzodiazepines for night sedation is likely to account for many of our positive results.

In conclusion, meconium analysis appears to be a feasible method for assessing prevalence and pattern of drug misuse in the 2nd and 3rd trimesters, but in anonymised screening the frequent use of prescribed drugs can mask this. It appears that pregnant women on the methadone programme often misuse heroin and other controlled drugs in the 2nd and 3rd trimesters.

The overall prevalence of misuse of benzodiazepines and opiates could not be concluded from this pilot study, but for drugs that can only be procured by the illicit route, prevalences of 2.75% for cocaine, 1.75% for amphetamine, and 13.25% for cannabinoids were found in this population.

Table 1 Gas chromatography/mass spectrometry analysis of 400 meconium samples

Drug metabolite	No of positive samples	% of total
Morphine	154	38.5
Codeine	122	30.5
Methadone	15	3.75
Diazepam	70	17.5
Temazepam	48	12.0
Cannabinoids*	53	13.25
Cocaine†	11	2.75
Amphetamine	7	1.75

*Tetrahydrocannabinol and/or tetrahydrocannabinol-9-carboxylic acid.
†Cocaine and/or benzoylecgonine.

Table 2 Gas chromatography/mass spectrometry analysis of the 15 samples containing methadone

Drug metabolite	No of positive samples	% of total
Morphine	14	93.3
Codeine	8	53.3
Methadone	15	100.0
Diazepam	11	73.7
Temazepam	6	40.0
Cannabinoids*	9	60.0
Cocaine†	2	13.3
Amphetamine	1	6.7

*Tetrahydrocannabinol and/or tetrahydrocannabinol-9-carboxylic acid.
†Cocaine and/or benzoylecgonine.

We believe that, with the modifications suggested, this technique will give meaningful and reproducible results in a defined population.

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