

# **A comparison of the efficacy of gastric lavage, ipecacuanha and activated charcoal in the emergency management of paracetamol overdose**

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## **SUMMARY**

The aim of this prospective trial was to compare the efficacy of gastric lavage, activated charcoal and ipecacuanha at limiting the absorption of paracetamol in overdose and to assess the significance of the continued absorption of paracetamol following treatment. Patients aged 16 and over who had ingested 5 gms or more of paracetamol within 4 h of admission were entered into the trial. The percentage fall in plasma paracetamol level was used as the measure of the success of a treatment at limiting absorption. The mean percentage fall was 39.3 for gastric lavage, 52.2 for activated charcoal and 40.7 for ipecacuanha, with a significant difference between the treatment methods ( $p = 0.03$ ). Activated charcoal was more effective at limiting the absorption of paracetamol following overdose than either gastric lavage or ipecacuanha induced emesis. In treated patients continuing paracetamol absorption is not significant if more than 2 h have elapsed since ingestion.

## **INTRODUCTION**

Paracetamol taken alone or in combination is now the drug most frequently used in deliberate overdose in Nottingham (Table 1). The management of these patients in the emergency department involves treatment to minimize the absorption of the drug by gastric lavage, ipecacuanha induced emesis or activated charcoal. Paracetamol is rapidly absorbed from the stomach and small bowel and procedures designed to reduce absorption are only worthwhile if carried out within 4 h of ingestion (Prescott, 1983). It is recommended that plasma levels are measured 4 h

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**Table 1.** Principal drug taken in overdose in Nottingham, 1.5.88 to 30.11.88. Total 843 overdoses.

Paracetamol	43%
Benzodiazepines	16%
Antidepressants	8%
Salicylate	7%
NSAID	6%
Major tranquillizers	3%
Antiepileptics	3%
Codeine derivatives	3%
Mefenamic acid	2%
Others	9%
Total	100%

after ingestion and definitive treatment is then commenced if indicated. It is thought that plasma levels taken before 4 h may not reflect the true extent of the overdose because of the possibility of continuing absorption (Prescott, 1983).

Controversy remains as to which of the three methods used to prevent drug absorption is the most effective. The aim of this prospective trial was to compare the three methods by monitoring the plasma paracetamol levels in the clinical situation. Previous studies in humans have investigated the recovery of drugs following gastric emptying procedures or the absorption of drugs in volunteers.

## SUBJECTS AND METHODS

The trial was run concurrently in the Accident and Emergency Departments of the Derbyshire Royal Infirmary and the University Hospital, Nottingham, between April and October 1988. Ethical committee approval was obtained at both hospitals and the inclusion of a group who did not receive absorption limiting treatment was also approved at Derby.

Patients aged 16 and over who had ingested 5 or more grams of paracetamol within 4 h of attendance were entered into the trial. Patients were randomly allocated into one of four treatment groups: (1) Gastric Lavage (36 FG tube); (2) Activated Charcoal (Carbomix to drug ratio of 10:1); (3) Ipecacuanha Syrup 30 mls. (repeated after 30 min if no response); and (4) No Treatment to limit absorption (Derby only). Any patient with a depressed conscious level or with a condition such as previous gastric surgery that might preclude the use of any one of the treatment methods was excluded from the trial.

Plasma paracetamol levels were measured on samples taken from an indwelling cannula prior to any treatment, and following treatment at 60, 90 and 150 minutes after the first sample. The sample which corresponded most closely to the 4 hourly specimen was sent for urgent analysis. In no patient did treatment with intravenous acetylcysteine overlap with the trial period.

Additional information documented on arrival included the patient's estimate of

the amount of paracetamol ingested and the time of ingestion, whether alcohol or other drugs had also been taken and whether the patient had vomited before arriving at the department. Following treatment the amount of charcoal swallowed by the patient and the time taken for the emetic to act were also recorded, as were any complications of the procedures.

The percentage change between the first and last plasma levels was used as a measure of the effectiveness of the different procedures at limiting absorption. The intermediate levels served to confirm the trend and to record the time of the maximum plasma level. Statistical evaluation of the results was by Analysis of Variance using the SPSS-X statistical package (Prescott, 1983).

## RESULTS

Sixty patients were included in the study, 44 women and 16 men. The age range was 16 to 62 years with a mean of 25.7. The age and sex distribution was similar for each treatment group. Forty-eight patients took paracetamol alone and the additional drugs taken by the remainder are listed in Table 2. Twenty-one patients reported consuming alcohol with the tablets and seven had vomited prior to arriving at the Department. Patients presented to the department between 30 and 240 min after ingestion with a mean delay of 123 min.

The mean paracetamol levels versus the mean times post ingestion for each treatment group are shown in Figure 1. There was a steep rise in the paracetamol levels in the group who did not receive any absorption limiting treatment when compared to the three treatment groups, but this group did present earlier. If a similar graph is plotted for patients presenting within 120 min of ingestion (Figure 2) it can be seen that the difference is due to the effect of treatment rather than the time of presentation.

Group 4 (no treatment group, Derby) was stopped for ethical reasons when the serum paracetamol levels increased between the first and last samples in four out of five patients. The paracetamol levels for those patients in groups 1, 2 and 3 fell (except patient No. 59, *vide infra*). The mean percentage fall between the first and

**Table 2.** Additional drugs taken with paracetamol.

Drugs ingested with paracetamol	
No additional drug	48
Dextropropoxyphene	4
Codeine Phosphate	1
Aspirin	2
Diazepam	2
Caffeine	1
Quinine Sulphate	1
Ferrous Sulphate	1
<b>Total</b>	<b>60</b>

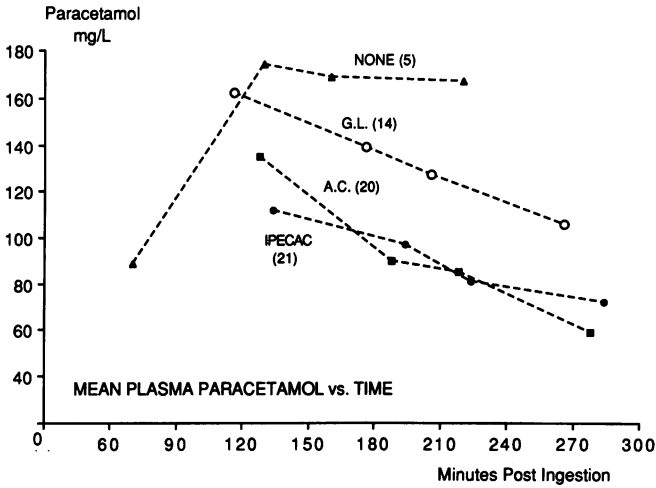


Fig. 1. Mean plasma paracetamol levels versus mean times following ingestion for all patients according to treatment group. G.L.-gastric lavage, A.C.-activated charcoal, None-no absorption limiting treatment.

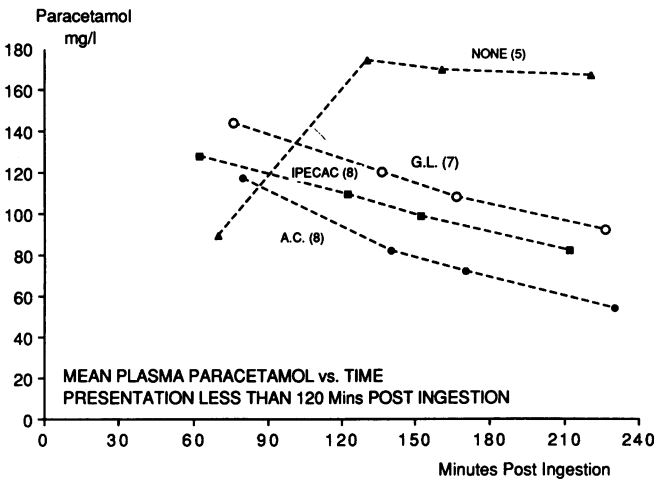


Fig. 2. Mean plasma paracetamol levels versus mean times following ingestion according to treatment group for patients presenting within 120 min of ingestion.

last plasma paracetamol levels was 39.3 for gastric lavage, 52.2 for activated charcoal and 40.7 for ipecacuanha (Table 3). Activated charcoal was more effective in lowering plasma paracetamol levels than either gastric lavage ( $p = 0.013$ ) or ipecacuanha ( $p = 0.027$ ). The difference between gastric lavage and ipecacuanha was not significant ( $p = 0.81$ ).

The plasma levels for patients in groups 1, 2 and 3 were greatest on admission

**Table 3.** Comparison of treatment methods.

Group	no.	mean % fall	St. deviation
(1) Gastric Lavage	14	39.33	14.67
(2) Activated Charcoal	20	52.25	13.55
(3) Ipecacuanha	21	40.70	18.26

and fell throughout the study period following treatment except for patient No. 59. In this case the level rose to a maximum at 60 min after being seen, (110 min after ingestion), and was still 20% higher than the initial value at 150 min. The patient presented 50 min after ingesting 15 grams of paracetamol and vomited 15 min after treatment with ipecacuanha. All those patients who presented and were treated within 2 h of ingestion had maximal plasma levels at or before 2 h after ingestion. Patients presenting between 2 and 4 h after ingestion had maximal plasma levels at the time of presentation providing that they received absorption limiting treatment.

The time to emesis in those patients given ipecacuanha ranged from 5 to 50 min with a mean of 20 min. Of the 20 patients given activated charcoal, 16 managed to swallow the recommended amount (10 times the amount of drug ingested), two consumed half the recommended amount, one patient refused to swallow more than 20 grams and the amount of charcoal taken by one patient was not recorded.

Of the 21 patients treated with ipecacuanha two did not vomit until 50 min after treatment despite a repeat dose of emetic and a further two patients did not vomit at all. Complications of activated charcoal included vomiting (4 patients, 3 of whom received 100 grams or more of charcoal) and 1 patient refused to swallow more than one mouthful. There were no complications related to gastric lavage in this series.

The ingestion of alcohol at the time of overdose did not significantly alter the efficacy of either gastric lavage ( $p = 0.106$ ) or ipecacuanha ( $p = 0.323$ ). For activated charcoal, however, the mean fall in paracetamol level was reduced from 56% to 43% if alcohol was consumed ( $p = 0.049$ ). Twelve patients ingested additional drugs but the numbers were too small for any conclusions to be drawn. These 12 patients were spread throughout the three treatment groups and the results are similar when these patients are excluded from statistical analysis.

## DISCUSSION

The early management of paracetamol poisoning is said to be well established: Patients presenting within 4 h of ingestion should undergo gastric lavage and the plasma concentration of paracetamol should be measured 4 h or more after overdose (Prescott, 1983; Meredith *et al.*, 1986). The threshold at which treatment should be given is between 5 gms (Prescott, 1983; Edinburgh Poisons Information Service, 1988) and 10 gms (Meredith *et al.*, 1986).

There is now a considerable amount of evidence to suggest that not only are

gastric emptying methods relatively inefficient but that activated charcoal is more effective at limiting drug absorption than either gastric lavage or ipecacuanha. The results of this trial in overdose patients confirm that activated charcoal is significantly more effective than either of the other two methods at reducing the absorption of paracetamol and suggest that providing patients receive treatment promptly plasma levels do not rise if more than 2 h have elapsed since ingestion.

Previous studies may be divided into those that measured the amount of drug recovered following gastric lavage or emesis in overdose patients and trials in volunteers that measured the amount of drug absorbed following absorption limiting procedures. In early trials looking at the recovery of drugs, usually barbiturates, from gastric washings the amount of drug recovered was low and in a significant proportion of patients no drug was recovered at all (Harstad *et al.*, 1942, Allan, 1961; Matthew *et al.*, 1966). Better results have been reported with other drugs with amounts equivalent to 10 therapeutic doses recovered in 50% of patients ingesting salicylate (Matthew *et al.*, 1966) and 33% of patients ingesting amitriptyline (Comstock *et al.*, 1981). When gastric lavage is compared to emesis by measuring the recovery of administered markers it appears that lavage is more effective (Auerbach *et al.*, 1986, Tanberg *et al.*, 1986).

Three trials have compared activated charcoal with either gastric lavage or emesis by measuring the amount of ingested drug absorbed by volunteers (Curtis *et al.*, 1984; Neuvonen *et al.*, 1983; Tenenbein *et al.*, 1987). All three trials showed activated charcoal to be significantly more effective at limiting drug absorption than either gastric lavage or emesis. In one of the studies an emetic given 30 min after ingestion of 1 gm of paracetamol had no significant effect on absorption (Neuvonen *et al.*, 1983).

In a study relating the early management of acutely poisoned patients to clinical outcome (Kulig *et al.*, 1985) the addition of a gastric emptying procedure to treatment with activated charcoal conferred no benefit over treatment with activated charcoal alone.

Complications following gastric lavage include rupture of the oesophagus, aspiration pneumonia, laryngeal injury, arrhythmias and cardiac arrest. In healthy patients lavage causes a rise in heart rate and a fall in arterial pO<sub>2</sub>. The incidence of complications is approximately 3% (Matthew *et al.*, 1966). Lavage takes approximately 30 min to perform and requires at least two members of staff. The disadvantages of ipecacuanha induced emesis are the time before vomiting occurs and the variability in response between patients. The average time to emesis in this study was 20 min and is similar to that quoted by other authors (Curtis *et al.*, 1984, Neuvonen *et al.*, 1983, Tenenbein *et al.*, 1987). Two patients had a delay of 50 minutes and a further two patients did not vomit at all. Complications of emesis include aspiration pneumonia, protracted vomiting and Mallory-Weiss tears (Vale *et al.*, 1986).

Activated charcoal is tasteless but slightly gritty and in general is well tolerated by patients. It is recommended that the amount of charcoal given should be 10 times the amount of drug ingested but in practice giving more than 100 gms of charcoal increases the risk of vomiting, as occurred in three of the seven patients in this trial who swallowed 100 gms or more. The optimum ratio, however, is not

known and *in vitro* the maximum absorptive capacity is about 250 mg paracetamol per gram of activated charcoal (Bainbridge *et al.*, 1977). The absorptive capacity of charcoal is less *in vivo* and a charcoal to paracetamol ratio of 5 to 1 will reduce absorption by about 60% (Dordoni *et al.*, 1973). Patients who have ingested up to 20 gms of paracetamol can be conveniently treated with activated charcoal but clinicians may decide that a gastric emptying procedure is more practical for the larger overdose.

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