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PARAQUAT POISONING IN THE UNITED KINGDOM

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PARAQUAT POISONING IN THE UNITED KINGDOM

Introduction

Paraquat, a bipyridilium compound, was first put on the U.K. market as a contact herbicide by I.C.I. in 1962 (fig 1). By the late 1960's there were a significant number of fatal paraquat poisonings occurring each year (fig 2).

In the early 1970's a large amount of publicity was given by the press to deaths caused by paraquat poisonings, some of which involved very aggressive journalism (figs 3 & 4). This and the increased use of paraquat in the U.K. at this time, were probably significant factors in the number of deaths due to deliberate ingestion of paraquat (fig 5). The number of accidental deaths remained low, at about one or two a year.

Regulations following from the Poisons Act of 1972 stated that liquid formulations of paraquat (greater than 5% of paraquat ion, weight to volume) should only be used by professionals (that is, farmers, nursery gardeners and so on). This referred to the liquid concentrates such as Gramoxone and Dextrone. Granular formulations containing less than 5% of paraquat ion weight to volume, such as Weedol and Pathclear, were exempt from these regulations and could be used in domestic gardens.

In 1974, in response to the increasing number of poisoning incidents, I.C.I published a booklet entitled "The Treatment of Paraquat Poisoning" (fig 6). This outlined the toxic effects of the herbicide, and advocated the use of Fuller's Earth, followed by haemodialysis or charcoal haemoperfusion, for the treatment of paraquat poisoning(fig 7). The booklet distribution was followed by the dispatch of Fuller's Earth, the mainstay of treatment, to hospitals throughout the United Kingdom. One year later, a stenching
agent was added to liquid formulations of paraquat in an attempt to prevent the small number of accidental poisonings occurring each year. Subsequently in 1977 an emetic substance was added to paraquat formulations (solid and liquid) in an attempt to reduce the acute toxicity of those formulations, by inducing vomiting before a potentially lethal dose could be absorbed.

Present Study

a) Aims

In 1980 a survey of paraquat poisoning in the U.K. was initiated jointly by the National Poisons Information Service at Guy’s Hospital, London, and I.C.I. Plant Protection Division. There were three main aims of this study (fig 8):

(i) To examine in detail the incidence of paraquat poisoning in the U.K.

(ii) To evaluate treatment methods, especially charcoal haemoperfusion and any new treatments being used for paraquat poisoning.

(iii) To evaluate the efficacy of the emetic added to paraquat formulations in reducing paraquat mortality.

b) Methods

Information about cases of paraquat poisoning was received from three sources (fig 9):

(i) The National Poisons Information Service, including the four regional centres at Belfast, Cardiff, Dublin and Edinburgh.

(ii) I.C.I. Plant Protection Division and Central Toxicology Laboratory.

(iii) Newspaper articles, via I.C.I. Publicity Departments.
I.C.I. and the NPIS were usually contacted in the first instance by doctors requesting advice on the management of poisoned patients or measurement of plasma paraquat levels. Requests to I.C.I. for replenishment of Fuller's Earth stocks also brought several patients to our attention. In each case a note was made of the caller, the hospital, name of the patient and any symptoms present, and this information was filed at the NPIS in London.

Further information on subsequent symptoms, treatment given, results of laboratory analyses, and outcome for each patient was obtained by contacting doctors by telephone, usually between two and seven days after the poisoning incident, if possible. In some cases, for example those brought to our attention by newspaper articles, several months had elapsed before we contacted the relevant doctors.

Finally, questionnaires were sent to doctors to obtain a complete case history for each patient, including name, age and sex of the patient, amount of formulation of paraquat ingested, whether the formulation contained emetic, symptoms, treatment given, laboratory analyses and outcome (figs 10, 11 & 12).

Presence or absence of the emetic in the paraquat formulation involved had to be confirmed in each case as there are still significant amounts of old formulations (not containing the emetic) in stock. This could be done by:

i) examination of the container (the presence of the emetic is indicated by a red chevron on the packets of Weedol and Pathclear, and by two black flashes on the Gramoxone label (fig 13).
ii) analysis of urine samples for the emetic metabolites.

iii) analysis of the original product for emetic parent compound.

Ideally, confirmation of the presence or absence of the emetic could be obtained by more than one of these methods.

c) Results and Discussion

i). Recovery of information

About 70% of the questionnaires sent out were returned with complete information. For a further 15% of patients, complete or almost complete information was obtained by telephone, leaving 13% about whom incomplete details were obtained, and 2% where hardly any information could be obtained at all (fig 14).

There were two main problem areas in the survey. The first was in estimating the amounts of paraquat taken: doctors could only report what they had been told by patients, and symptoms and laboratory analyses did not always confirm their report.

The second, and major difficulty of the study has been in confirming the presence or absence of the emetic in paraquat formulations. There are several reasons for this. Often the containers are not available for doctors to examine, and so there can be no positive identification of emetic formulations from the label or from analysis of the original product. For a urine analysis to detect the emetic metabolites a sample needs to be taken within 48 hours of ingestion of paraquat; a number of cases were notified after this time period. When urine samples were requested from hospitals they were not always sent, and, if sent, did not always arrive. We were able to confirm either presence or absence of emetic in only 39% of the cases in the survey.
ii) **Mortality Statistics**

Between the beginning of January 1980 and the end of February 1982, 262 cases of paraquat poisoning were reported. The two main formulations involved were Weedol (47% of cases) and Gramoxone (32%) (fig 15). The majority of patients were adults (94%) (fig 16), and male (76%) (fig 17). 83% of the poisonings were deliberate, 11% were accidental, and for 6% no intent was specified (although for most of the latter deliberate ingestion was implied at the time of the original call) (fig 18). 94 patients died, 143 survived, and for 25 the outcome was unknown (fig 19).

The commonest symptoms reported were spontaneous vomiting (in 55% of patients whose symptoms were specified) – in half of these patients vomiting occurred within half an hour of paraquat ingestion; irritation or ulceration of the fauces (47%); nausea (42%); renal damage (32%) and pulmonary damage (32%) (fig 20).

As would be expected, mortality increased as the reported amount of paraquat ingested increased. The mortality of patients who had ingested 2g to 5g of paraquat ion as Weedol or Pathclear was lower than that of patients who had taken equivalent amounts of the concentrates Gramoxone or Dextrone (figs 21 & 22). The reason for this apparent difference in relative mortalities is unclear. It may be that it is harder for patients to estimate the dose ingested of liquid formulations than for the sacheted solid products. The overall mortality from taking Weedol or Pathclear was 16%, while that from taking Gramoxone or Dextrone was 78%.

When the cases were analysed according to intent (that is, deliberate or accidental ingestion of paraquat) it was found that out of 208 patients about whom these details were known, there were five deaths reported as being accidental in origin (fig 23). All of these patients were adults.
No deaths of children under 12 were reported, either accidental or deliberate.

Monthly variation of paraquat poisonings was also studied (fig 24). It was thought that there may be a seasonal pattern to poisonings with Gramoxone and Dextrone, with peak numbers during the months when these products are most used, that is late August to October. However, no such pattern could be found during the two years of the study. Weedol and Pathclear are used by amateur gardeners most of the year, and no seasonal pattern of poisonings was expected or found with these.

Towards the end of 1981 when it became apparent that there were a large number of poisonings occurring involving Gramoxone, which legally should only be sold to professional users, an effort was made to determine the occupation of patients. The majority of patients taking Gramoxone seemed to be, or to have some connection with legitimate users, such as farmers, farm labourers or garden nursery workers.

iii} Treatment

Early treatment of paraquat poisoning is considered essential, because plasma paraquat concentration may reach a peak relatively quickly from the time of ingestion (certainly within six hours). In this study, this concept appears to be true for those cases involving 'Weedol' or 'Pathclear', but not for those involving 'Gramoxone' or 'Dextrone' (fig 25). As the solid formulations tend to be associated with relatively low doses of paraquat, this observation supports the one made by Dr Keir Howard in a previous meeting of this association, in which he concluded that early treatment is of benefit in cases swallowing between 1g and 6g of paraquat ion.
For several years now, the mainstay of treatment of paraquat poisoning has been the use of gastric lavage, followed by oral administration of Fuller's Earth and a suitable purgative. It is reassuring to see that 69% of the patients considered received Fuller's Earth as a treatment and 51% of patients received gastric lavage (fig 26). Unfortunately, due to the small number of patients not treated with Fuller's Earth and the large number of variables present, such as the time lapse between ingestion and treatment, the amount of paraquat taken and the amount of Fuller's Earth given, it is not possible to determine whether or not either of these methods influence the outcome.

Haemoperfusion through a charcoal column has been used for some time now for the treatment of paraquat poisoning, but has been received with a very much mixed response. In this study, 15% of the patients were haemoperfused. Most cases involved the use of haemoperfusion on one occasion only and for a period of up to 22 hours. The time lapse between ingestion of paraquat and the start of haemoperfusion varied greatly, from about four hours to over sixty hours. All cases were confirmed, by urine and plasma analysis, as involving paraquat. Although the number of patients haemoperfused was relatively small, the figures shown seem to indicate that this method is not associated with lower mortality, and may, in fact, have an adverse effect (fig 27).

During the period of this study only one significant new treatment emerged — the use of ethacrynic acid. This treatment was used by intravenous injection at Ninewells Hospital, Dundee. Although initial success was claimed, further use of the drug in other patients did not succeed. Interest in this form of treatment has now largely subsided.
iv) Emetic

Despite the introduction of an emetic to paraquat formulations on the U.K. market in 1977, old stock not containing the emetic is still being involved in poisonings. Of the 103 cases in the study where emetic was identified as being present or absent, it was present in 62% and absent in 38% (fig 28). Of the 39 of these cases which involved Gramoxone, 20 (51%) were not emetic formulations. Weedol, which has a higher rate of stock turnover, was involved in 45 cases, only 13 (29%) of which were not emetic formulations (fig 29).

Although it is not possible to reach definite conclusions about the effectiveness of the emetic addition in reducing toxicity of paraquat formulations, the evidence clearly shows that this addition has increased the incidence of early spontaneous vomiting following ingestion of a paraquat formulation (fig 30).

Summary

Between January 1980 and January 1982, the number of fatal paraquat poisonings has been between 42 and 46 per annum, and has therefore remained fairly constant over the past six years (fig 2). Also over the last six years the majority of fatal poisonings have been associated with suicidal intent (approximately 95% in the last two years).

Statistics published by the Office of Population Censuses and Surveys show that the total number of deaths from suicide has remained fairly constant over the last decade, as have the number of deaths from suicide
associated with chemical poisonings. The latest figures, published for 1980, show that there were 4,321 deaths from suicide by any method and 4,572 deaths from suicide associated with chemical poisoning. Suicidal deaths involving paraquat, therefore account for approximately 1% of all suicidal deaths and 2.5% of suicide deaths involving chemical poisoning. Fatal accidental poisoning with paraquat accounts for about 0.3% of all accidental fatalities involving chemicals.

The majority of patients involved with paraquat poisoning were male and adult. No children were involved in any fatal paraquat incidents. There appears to be no set monthly variation in the number of paraquat poisonings involving either liquid or solid formulations and most of the patients involved with 'Gramoxone' poisoning were reported to have connection with legitimate use of the product.

Early treatment of paraquat poisoning (up to 12 to 24 hours) appears to have some benefit when the dose of paraquat ingested is relatively low. We would recommend that although we cannot demonstrate an improvement in mortality with the use of Fuller's Earth or gastric lavage, these measures should be employed at the earliest opportunity, and are unlikely to be effective 24 hours or more after the time of ingestion. The results of using haemoperfusion through a charcoal column do not appear to be encouraging and it is unlikely that this method will be effective if used for single short periods of time. We would recommend that, if this method is to be used, it should be done within 24 hours of ingestion and should involve a different modus operandi.
We have not yet been able to evaluate fully the effectiveness of an emetic formulation in reducing mortality, but addition of the emetic significantly increases the incidence of early spontaneous vomiting. We are planning to continue to follow up paraquat poisoning cases, particularly those involving emeticised formulations. This continued follow-up will also attempt to study more cases involving early treatment with Fuller's Earth, and to evaluate any new treatment methods which may arise.

Finally, it is recommended that measures to prevent accidental paraquat poisoning are maintained and, if possible, improved upon. Widespread publicity of paraquat poisonings should be discouraged, because of its possible stimulus of suicide attempts with the chemical.
Paraquat Dichloride
Fig. 2

Paraquat Poisonings - U.K. (1964-81)

No. of Cases

Year

1964 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

Total

Fatal
Not suicide, says jury

SHOCK VERDICT IN PARAQUAT CASE

THE death of paraquat victim was still a mystery last night.

For all the fatal accident inquiry jury decided that did NOT commit suicide.

That was the unanimous verdict of the four women and three men.

At the end of the inquiry Mr [Redacted - EU PII] and [Redacted - EU PII] solicitors for [Redacted - EU PII] and her family made a formal statement.

They said: "We point out that the clear implication of the verdict was that while the jury did not believe the death to be suicidal, it could well be accidental.

"Even if it were neither suicide nor accidental, it was not proved who might have been responsible for his death."

There was no stir at [Redacted - EU PII] Sheriff Court as the foreman of the jury read out the verdict after two hours and 50 minutes deliberation.

The foreman said:

"We believe that [Redacted - EU PII] did not commit suicide."

"And we believe [Redacted - EU PII] sat impassively, the manufacturers are taking all reasonable precautions against the misuse of Gramoxone."

In the front row of the public benches, [Redacted - EU PII] widow, [Redacted - EU PII] sat impassively with her son and her married daughter.

CONT/....
Irish Independent
September 17, 1974

Paraquat: Most deadly killer since atom bomb

A COUNTY physician last night called on the Government to put strict controls on "the most deadly killer since the invention of the atomic bomb"—paraquat.

Earlier, Monaghan County Physician had tried to raise the subject at the North Eastern Health Board, but the chairman, Senator D. Farrelly, asked him to put the item on the agenda for next month's meeting.

But said that more people could die from paraquat poisoning and he wanted to warn the general public about the effects of using it. He suggested that the manufacturers should insert "a foul-smelling substance" into paraquat so that people would not mistake it for soft drinks.

He said: "I had the sad duty recently in Monaghan of sitting at the bedside of a perfectly healthy man who had taken paraquat. He asked when he was going home and I knew that he was going to his permanent home in about four days and that there was nothing I could do about it."

cc Mr. J. S. L. Babor
K.D. Hughes
Legal Dept.
Pub. Relations.
Mrs. J. A. Whitaker
Dr. E. G. Schumacher
Mr. J. Swadley
THE TREATMENT OF PARAQUAT POISONING

1979

This supersedes all previous editions
TREATMENT OF PARAQUAT POISONING FOLLOWING INGESTION

First Aid
Induce vomiting if not already occurring and send patient to nearest hospital immediately.

Hospital Treatment
1 Give stomach washout and at the same time test both urine and gastric aspirate for the presence of paraquat (see Appendix 1).

2 It is important to purge the gastro-intestinal tract immediately; within four hours if possible. Give up to one litre of 15% Fuller’s Earth (Surrey Finest Grade), including 200 ml 20% mannitol in water. Alternatively, sodium or magnesium sulphate can be used as the purgative. Administration should normally be orally but, if this is not tolerated, stomach or duodenal intubation can be used. Continue purgation until the stools are seen to contain adsorbent.

3 CONTACT NEAREST POISONS INFORMATION CENTRE FOR FURTHER ADVICE ON TREATMENT.

4 Maintain and monitor fluid and electrolyte status on a daily basis.

5 Carry out haemodialysis or haemoperfusion (using a charcoal column) to remove paraquat from the plasma (Refs 2, 3). This will only be of use if carried out within 48 hours of ingestion. In some cases renal failure may necessitate the use of haemodialysis at a later stage.

6 In the event of respiratory difficulties, delay the use of oxygen as long as possible as it enhances the toxicity of paraquat.

7 In severe cases, particularly where shock has supervened, consider additional supportive therapy such as the use of steroids.
AIMS OF U.K. PARAQUAT POISONING SURVEY (fig 8)

1 To examine in detail the incidence of paraquat poisoning in the U.K.

2 To evaluate treatment methods.

3 To evaluate the efficacy of the emetic in reducing paraquat mortality.

Sources of information about paraquat poisonings (fig 9)

1 National Poisons Information Service.
   - London
   - Belfast
   - Cardiff
   - Dublin
   - Edinburgh

2 I.C.I. Plant Protection Division
   Central Toxicology Laboratory

3 Newspaper articles via I.C.I. Publicity Departments.
PARAQUAT QUESTIONNAIRE

A. PATIENT DETAILS
1. Name .............................................................................
2. Age .............................................................................
3. Sex .............................................................................
4. Hospital No. ...................................................................
5. Name of Doctor ............................................................
6. Hospital ........................................................................

B. PRODUCT INGESTED
1. Formulation
   - Liquid:
     - Gramoxone ..............................................................
     - Dextrose .................................................................
     - Other (please state) ...................................................
   - Solid:
     - Weedol ....................................................................
     - Pathoear ..................................................................
     - Other (please state) ...................................................
2. Amount ingested ............................................................
3. Time and date of ingestion ............................................
4. Time and date of admission ...........................................
5. Ingestion
   - Accidental  □ □
   - Suicidal □ □
   - Other □ □
6. Did product contain emetic? YES/NO
7. If yes, how was this ascertained
   a) from original container .............................................
   b) from gastric aspirate analysis .................................
   c) from urine analysis ...............................................
### Symptoms and Symptoms

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irritation/ulceration of mucous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epigastric pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nausea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vomiting - spontaneous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot; - after treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhoea</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Disturbances in:

- Renal function
- Hepatic function
- Pulmonary function

### Treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yes</th>
<th>No</th>
<th>Time After Ingestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric lavage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emetic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuller's earth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haemodialysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haemoperfusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forced diuresis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steroids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Outcome

1. Survival (date of discharge)...
2. Fatal (date of death)...
3. If fatal - cause of death...
4. Is (3) based on clinical judgement? post-mortem result?
## TOXICOLOGICAL ANALYSIS

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Date &amp; Time</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastric aspirate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serum/plasma</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## CONCLUSIONS

- ...
- ...
- ...
- ...
- ...
Light brown granules in 56g sachets.
(Paraquat 2.5% w/w; Diquat 2.5% w/w; Simazine 5% w/w.)

End the work of weeding

Light brown granules in 56g sachets.
(Paraquat 2.5% w/w; Diquat 2.5% w/w.)
FORMULATIONS INVOLVED IN PARAQUAT POISONING: U.K. 1980-82

NO. OF PATIENTS

PARAQUAT FORMULATION

WEEDOL
GRAMOXONE
PATHCLEAR
DEXTRONE
DEXURON
GRAMONOL
UNKNOWN
INTENT

NO. OF PATIENTS

DELIBERATE

ACCIDENTAL

NOT KNOWN

OUTCOME

NO. OF PATIENTS

NON-FATAL

FATAL

NOT KNOWN

ACCIDENTAL

DELIBERATE

fig 18

fig 19
### AMOUNT OF PARAQUAT TAKEN V. MORTALITY

**Sedol/Pathclear (Fig. 21)**

<table>
<thead>
<tr>
<th>Amount (g. p. ion)</th>
<th>Total</th>
<th>Fatal</th>
<th>Non-Fatal</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2</td>
<td>82</td>
<td>12</td>
<td>70</td>
<td>15%</td>
</tr>
<tr>
<td>2 - 5</td>
<td>12</td>
<td>1</td>
<td>11</td>
<td>8%</td>
</tr>
<tr>
<td>5 - 10</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10+</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>96</strong></td>
<td><strong>15</strong></td>
<td><strong>81</strong></td>
<td><strong>16%</strong></td>
</tr>
</tbody>
</table>

**Gramoxone/Dextrone (Fig. 22)**

<table>
<thead>
<tr>
<th>Amount (g. paraquat)</th>
<th>Total</th>
<th>Fatal</th>
<th>Non-Fatal</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; .2</td>
<td>5</td>
<td>-</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>2 - 5</td>
<td>11</td>
<td>7</td>
<td>4</td>
<td>64%</td>
</tr>
<tr>
<td>5 - 10</td>
<td>14</td>
<td>12</td>
<td>2</td>
<td>86%</td>
</tr>
<tr>
<td>10+</td>
<td>28</td>
<td>26</td>
<td>2</td>
<td>93%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>58</strong></td>
<td><strong>45</strong></td>
<td><strong>13</strong></td>
<td><strong>78%</strong></td>
</tr>
<tr>
<td>Outcome</td>
<td>Total</td>
<td>Suicide</td>
<td>Accidents</td>
<td>Adults</td>
</tr>
<tr>
<td>---------------</td>
<td>-------</td>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
</tr>
<tr>
<td>Fatal</td>
<td>82</td>
<td>77</td>
<td>5</td>
<td>82</td>
</tr>
<tr>
<td>Non-Fatal</td>
<td>119</td>
<td>105</td>
<td>14</td>
<td>109</td>
</tr>
<tr>
<td>Not Known</td>
<td>7</td>
<td>7</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>208</td>
<td>189</td>
<td>19</td>
<td>198</td>
</tr>
</tbody>
</table>
MONTHLY VARIATION OF PARAQUAT POISONINGS

PATIENTS

1980: JUN  JUL  AUG  SEP  OCT  NOV  DEC  JAN  FEB  MAR  APR  :  1981

1981: MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  JAN  FEB  :  1982

- WEEDOL / PATHCL.
- GRAMOXONE / DEXTRONE
### TIME UNTIL TREATMENT VERSUS MORTALITY

#### Weedol/Pathclear

<table>
<thead>
<tr>
<th>Time until treatment (hrs)</th>
<th>Fatal</th>
<th>Non-Fatal</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 6</td>
<td>6</td>
<td>32</td>
<td>16%</td>
</tr>
<tr>
<td>6 - 12</td>
<td>2</td>
<td>13</td>
<td>13%</td>
</tr>
<tr>
<td>12 - 24</td>
<td>1</td>
<td>3</td>
<td>25%</td>
</tr>
<tr>
<td>24 - 48</td>
<td>3</td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

#### Gramoxone/Dextrone

<table>
<thead>
<tr>
<th>Time until treatment (hrs)</th>
<th>Fatal</th>
<th>Non-Fatal</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 6</td>
<td>23</td>
<td>8</td>
<td>74%</td>
</tr>
<tr>
<td>6 - 12</td>
<td>4</td>
<td>3</td>
<td>57%</td>
</tr>
<tr>
<td>12 - 24</td>
<td>2</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>24 - 48</td>
<td>2</td>
<td>1</td>
<td>61%</td>
</tr>
</tbody>
</table>
% OF PATIENTS

GASTRIC LAVAGE

EMETIC

FULLER'S EARTH

HAEMODIALYSIS

HAEMOPERFUSION

FORCED DIURESIS

ETHACRYNIC ACID

NONE / SUPPORTIVE ONLY
## HAEMOPERFUSION / MORTALITY (fig 27)

### Patients haemoperfused

<table>
<thead>
<tr>
<th>Amount (g. paraquat ion)</th>
<th>Total</th>
<th>Fatal</th>
<th>Non-Fatal</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2</td>
<td>11</td>
<td>3</td>
<td>8</td>
<td>73%</td>
</tr>
<tr>
<td>2 - 5</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>60%</td>
</tr>
<tr>
<td>5 - 10</td>
<td>6</td>
<td>-</td>
<td>6</td>
<td>100%</td>
</tr>
<tr>
<td>10 +</td>
<td>6</td>
<td>1</td>
<td>5</td>
<td>83%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>28</td>
<td>6</td>
<td>22</td>
<td>79%</td>
</tr>
</tbody>
</table>

### Patients not haemoperfused

<table>
<thead>
<tr>
<th>Amount (g. paraquat ion)</th>
<th>Total</th>
<th>Fatal</th>
<th>Non-Fatal</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2</td>
<td>67</td>
<td>64</td>
<td>3</td>
<td>5%</td>
</tr>
<tr>
<td>2 - 5</td>
<td>15</td>
<td>11</td>
<td>4</td>
<td>27%</td>
</tr>
<tr>
<td>5 - 10</td>
<td>9</td>
<td>2</td>
<td>7</td>
<td>78%</td>
</tr>
<tr>
<td>10 +</td>
<td>19</td>
<td>2(?)</td>
<td>17</td>
<td>89%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>110</td>
<td>79</td>
<td>31</td>
<td>28%</td>
</tr>
</tbody>
</table>
EMETIC PRESENT / ABSENT IN PARAQUAT FORMULATIONS TAKEN

fig. 28

<table>
<thead>
<tr>
<th></th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>60</td>
</tr>
<tr>
<td>Absent</td>
<td>150</td>
</tr>
<tr>
<td>Not Known</td>
<td>90</td>
</tr>
</tbody>
</table>

### Fig. 29

**Emetic - Present or Absent in Formulations**

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Weedol</th>
<th>Pathclear</th>
<th>Gramoxone</th>
<th>Dextrone</th>
<th>Dexuron</th>
<th>Gramonol</th>
<th>Nd Known</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Present +</strong></td>
<td>64</td>
<td>32</td>
<td>12</td>
<td>19</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Absent -</strong></td>
<td>39</td>
<td>13</td>
<td>2</td>
<td>20</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>103</td>
<td>45</td>
<td>14</td>
<td>39</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
### SPONTANEOUS VOMITING AFTER INGESTION OF EMETIC/NON-EMETIC FORMULATIONS OF PARAQUAT

#### Emetic present

<table>
<thead>
<tr>
<th>Amount (g. paraquat ion)</th>
<th>Early Vomiting (&lt;1/2 hr p.i.)*</th>
<th>Late Vomiting</th>
<th>No Vomiting</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2</td>
<td>16 (55%)</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>2 - 5</td>
<td>3 (75%)</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>5 - 10</td>
<td>1 (100%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10+</td>
<td>6 (100%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>26 (65%)</td>
<td>9</td>
<td>5</td>
</tr>
</tbody>
</table>

* p.i. = post ingestion

#### Emetic absent

<table>
<thead>
<tr>
<th>Amount (g. paraquat ion)</th>
<th>Early Vomiting (&lt;1/2hr p.i.)*</th>
<th>Late Vomiting</th>
<th>No Vomiting</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2</td>
<td>1 (10%)</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>2 - 5</td>
<td>1 (25%)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5 - 10</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10+</td>
<td>2 (40%)</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>4 (19%)</td>
<td>4</td>
<td>13</td>
</tr>
</tbody>
</table>