



# Rapid lethal intoxication caused by the herbicide glyphosate-trimesium (Touchdown)

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Two cases of rapid lethal intoxication with the herbicide glyphosate-trimesium (Touchdown) are presented. A 6-year-old boy who accidentally ingested a mouthful of glyphosate-trimesium died within minutes. The same happened to a 34-year-old woman who intentionally ingested approximately 150 ml of glyphosate-trimesium. The post-mortem examination revealed gastric content and oedema of the mucus membranes of the airways, erosion of the mucus membranes of the gastrointestinal tract, pulmonary oedema, cerebral oedema, and dilated right atrium and ventricle of the heart. The speed of which death occurs is much more rapid than lethal intoxications with the herbicide glyphosate (isoprophylamine), also

known as 'Roundup'. It is suggested that the lethal mechanism between the two herbicides may be different. The component, trimethylsulfonium, of the glyphosate-trimesium may facilitate the absorption after oral ingestion. This difference can be crucial in the treatment of human intoxication. We propose that containers with glyphosate-trimesium must be labelled because of the apparent effect of lethal intoxication.

**Keywords:** glyphosate-trimesium; touchdown; herbicide; intoxication

## Introduction

Glyphosate-trimesium (Touchdown) is a herbicide with similar effect as glyphosate (isoprophylamine), also known as 'Roundup'. Although glyphosate is considered to be rather harmless to humans, cases of lethal intoxication have been reported.<sup>1-4</sup> Until now, there are no reports of lethal intoxication with glyphosate-trimesium in the literature. The data presented here suggest that glyphosate-trimesium is more toxic to humans than glyphosate (isoprophylamine).

## Case 1

A 6-year-old boy died after drinking herbicide from a bottle used for sodawater. The boy's father, who had received the herbicide in a bottle from a neighbour, was working in the garden spraying weed with a dilution of the herbicide when he saw that his son walked into the house and collapsed. He noticed that the bottle containing the herbicide which he had placed in the middle of a table in the garage now stood on the edge, and he concluded that his son had drunk from the bottle.

When the father reached the house the boy did not breathe and had no pulse. Cardiac massage and artificial respiration was administered. An emergency call was placed at 5:33 PM, and the boy reached the hospital at 6:04 PM. During the transport the boy's heart rate was four per minute and there was no respiration. At the hospital, resuscitation was attempted until 6:50 PM with no result. A 6-year-old friend of the deceased told that they had both gone into the garage where the deceased had been drinking from the bottle. Because of the bad taste he had spat almost all of it out again and only swallowed a small amount. Then they went into the hall of the house where the deceased drank some water. He expressed that it was hurting, and he could not see. Then he vomited and collapsed. The neighbour did not know which herbicide the bottle contained.

The post-mortem examination demonstrated a brownish gastric content with a faint 'metallic' smell, severe irritation of the mucus membranes of the stomach and the airways, gastric content present in the trachea and the bronchi, pulmonary and cerebral oedema, and dilated right atrium and ventricle of the heart.

The microscopical examination showed acute stasis and inflammation of the gastric mucus membrane.

The chemical analysis concluded that the bottle contained the herbicide glyphosate-trimesium

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(Touchdown) in a concentration of 326 g/l (33%). The chemical analysis of the gastric content revealed the concentration of pure glyphosate to be 7.2 mg/ml.

In conclusion, intoxication with glyphosate-trimesium was established as the cause of death.

## Case 2

A 34-year-old, furious and jealous woman had an argument with her husband in a barn. She left the barn, but returned shortly after with a bottle of herbicide out of which she claimed to have been drinking. Immediately after, she gasped for her breath and collapsed. Her husband placed her in recovery coma position and ran to make an emergency call. When he returned the wife was lying on her back without breathing and with no pulse. The ambulance arrived after 20 min, and the woman was given cardiac massage and artificial respiration. After an additional 18 min the ambulance arrived at the hospital where the woman was declared dead. The bottle from which the woman had ingested the herbicide was labelled 'Touchdown'. As to the remaining herbicide and information from the husband it was concluded that the woman had ingested approximately 150 ml.

The post-mortem examination showed a brownish gastric content with a 'metallic' smell. The mucus membranes of the pharynx, the oesophagus, the duodenum, the trachea, and the bronchi had a brownish colour. Furthermore, there were stasis and oedema of the mucus membrane in the pharynx and the lungs.

The microscopic examination revealed severe pulmonary oedema and caustic changes of the mucus membranes of the pharynx, the oesophagus, and the duodenum.

The chemical analysis showed that the bottle contained glyphosate-trimesium in a concentration of 0.28 g/l (indicated by pure glyphosate). The glyphosate concentration of the gastric content was 0.08 g/l. Additionally, an insignificant concentration of Bromazepam was detected in the blood.

It was concluded that the death was caused by intoxication with glyphosate-trimesium; the manner of death was suicide.

## Discussion

The herbicide glyphosate-trimesium (Touchdown) is a herbicide with a similar effect as glyphosate (isoprophylamine), also known as 'Roundup'. In plants the absorption of glyphosate-trimesium is ostensibly more effective than the absorption of glyphosate. As with glyphosate, the toxic effect on plants is due to a competitive inhibition of the 5-

enolpyruvyl-shikimic-3-phosphatesynthase. This enzyme is essential for the synthesis of carotenoids, chlorophyll, and aromatic amino acids in plants.<sup>5,6</sup> Though the 5-enolpyruvyl-shikimic-3-phosphate-synthase enzyme is absent in mammals, and, therefore, is considered to have low toxic effect to humans numerous cases of intoxication, and some deaths due to glyphosate, have been described.<sup>1-3,5</sup> The glyphosate herbicide contains a small amount of surfactant, which facilitates the absorption in plants. The role of the surfactant in cases of human intoxication is questionable.<sup>3</sup> There seems to be no reports of intoxication or deaths due to glyphosate-trimesium in the literature.

The symptoms of intoxication with glyphosate are oral and throat pains, vomiting, diarrhoea, metabolic acidosis, pulmonary oedema and shock (hypotension), and cardiac arrhythmias depending on the amounts of ingested glyphosate; usually, death occurs after some time (hours/days).<sup>1-3</sup> The average time from ingestion of glyphosate herbicide to death is 26.4 h (3.7–38.5 h) in Talbot's material (seven deaths).<sup>1</sup> The immediate cause of death is thought to be pulmonary oedema or hypotension.<sup>1</sup> Hung reports that laryngeal injury and subsequent aspiration may be an important cause of death.<sup>4</sup>

The symptoms, the onset of symptoms, and the rapidity of death in the two cases presented here differ from those of lethal intoxications with glyphosate. Death occurred rapidly after ingestion of glyphosate-trimesium. Such rapid deaths have not been described in fatal toxications with glyphosate. In Talbot's seven fatal cases two were dead on arrival at the emergency room, but both of them had also ingested other poisons (Paraquat and Parathion). Ingestion of large amounts (up to 500 ml) of glyphosate did not necessarily cause serious symptoms. Severe symptoms (death) only resulted from oral ingestion of undiluted herbicide in amounts of 85 ml.<sup>1</sup>

In the cases presented here the amount of ingested herbicide is not exactly known, but was in case 1 believed to be 50 ml (a mouthful), and in case 2 approximately 150 ml.

The post-mortem examination revealed gastric content and oedema of the mucus membranes of the airways, erosion of the mucus membranes of the gastrointestinal channel, pulmonary oedema, cerebral oedema, and dilated right atrium and ventricle of the heart. Considering the findings of the post-mortem examination and the rapidity of death the cause of death may be due to cardiac failure.

The pharmacokinetics and the toxic mechanism of glyphosate-trimesium and glyphosate are not fully known. The rapid course is similar to the intoxication by organophosphate compounds with cholinesterase inhibiting, but glyphosate has no cholinesterase inhibitory activities.<sup>7</sup> The cholinesterase levels were normal in our cases. **The**

mammalian toxicity as indicated by acute oral LD 50 are for rats 5600 mg/kg for glyphosate, but only 748 mg/kg for glyphosate-trimesium; for mice the similar values are 11300 mg/kg and 1250 mg/kg.<sup>8</sup> This suggests that glyphosate-trimesium is much more toxic than glyphosate. The absorption of glyphosate-trimesium is reported to be considerably greater than that of glyphosate after oral ingestion. The trimethylsulfonium ion may facilitate the absorption. Due to the molecular weight concentrations of glyphosate-trimesium and glyphosate are not directly comparable.

When considering the difference in the rapidity with which death occurs between glyphosate-

trimesium and glyphosate it is possible that the lethal mechanism is different. This conclusion is speculative and needs to be confirmed with appropriate experimental studies. However, the difference may be of crucial significance in the treatment of acute intoxications, and we suggest that physicians and toxicologists should be aware of the possibility that glyphosate-trimesium is markedly more toxic than glyphosate. Containers with glyphosate trimesium should be clearly labelled to warn of the apparently rapid lethal effect.

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