Hydrogen Sulphide Poisoning in Swine

by J. G. O'Donoghue*

A case of hydrogen sulphide poisoning in swine exposed to liquid manure fumes is reported in the veterinary literature (1). Also, the gas has been suspected of being responsible for illness in livestock in certain oil and gas field situations. Investigations conducted in Alberta regarding the toxicity of certain sulphur gases would tend to refute this belief. Experimental work, involving the exposure, under controlled conditions, of young swine, rabbits, and guinea pigs, to H_2S and SO_2 fumes was carried out at the Veterinary Laboratory. A summary of the H_2S portion of the investigation is presented herewith.

Hydrogen sulphide is a colourless gas with an odour of rotten eggs at low concentrations. It is produced when organic material containing sulphur decays and is encountered in some industrial processes. While there are minor discrepancies in reported toxic properties for man, they may be summarized as follows:

1 P.P.M. or less—detectable odour.
30—50 P.P.M.—sense of smell is lost.
50 P.P.M.—above this some individuals may show symptoms.
200 P.P.M.—poisonous concentration.
500 P.P.M. or above—rapid developing symptoms and death.

The Maximum Allowable Concentration (M.A.C.) for industry is 20 P.P.M., i.e. a healthy adult exposed for eight hours (2). Fatalities in humans have occurred following sudden exposures to high concentrations in industry or in wells or cesspools. Chronic poisoning is debated but not substantiated. Diagnosis is based on a history of known exposure to gas. (3) (4) (5). Ahlborg has provided an excellent review of hydrogen sulphide poisoning in man. (6)

Procedure

Animals were exposed in a specifically designed chamber. Both air and hydrogen sulphide were introduced through calibrated flowmeters, and the concentration of the gas in the chamber was continuously recorded by a titrolog instrument. For safety, it was necessary to place animals in the chamber before introducing the gas. This resulted in the sudden accidental exposure of a pig and three rabbits that is of interest. The exposures are summarized in Table I. Control animals were used throughout.

Symptoms

In immediate deaths, sudden tetanic convulsion with rigidly extended legs and neck were observed.

Symptoms seen, in order of appearance with rising gas concentrations, were discomfort, slight eye irritation and salivation with periodic swallowing proceeding into a semicomatose state. There followed intermittent muscular spasms, shallow breathing, and a developing cyanosis, but death was sudden and accompanied by tetanic convulsion. Dyspnea was not a prominent feature.

There were no after effects in animals subjected to non-lethal exposures.

Lesions

There was no significant pathology in immediate deaths. In others, there was a superficial cyanosis, most marked on dependent portions, but absent in areas where the body was in contact with the floor. Minor haemorrhages were observed in the lungs, but hypostatic congestion of ventral lung was the most striking feature.

In the rabbit, dying two hours after exposure, the hypostatic effect was not so well marked. Severe pulmonary haemorrhage with epitaxis and distention of right ventricle were the prominent features.

In no case was there a discernible odour of hydrogen sulphide to the carcass. Animals were posted within four hours of death and no discoloration of viscera or organs was observed. Such findings have been reported (4).

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TABLE I

Animal and Nature of Experiment.	Exposure Time	Detail Gas Concentration	Symptoms and Results
Pig (30 lbs)	2 hrs.	50 — 100 PPM	Nothing significant.
Pig (35 lbs)	10:05 a.m.	Start	
Concentration increased	10:10 a.m.	250 PPM	Distress
to 700 PPM in first 10	10:15 a.m.	700 PPM	Semicomatose — profound symptoms
minutes then slowly	11:15 a.m.	950 PPM	"
increased to 1000 PPM	11:30 a.m.	1000 PPM	" — intermittent spasms
and held at this level.	11:40 a.m.	1000 PPM	" — spasms, cyanosis
	12:15 p.m.	1000 PPM	" — convulsive movements, **death.**
			P.M. Superficial cyanosis — marked hypostatic congestion of lungs.
Pig (35 lbs)	1 second	400 PPM	Immediate spasm and **death.**
Accidental exposure.		(highest level recorded)	
			P.M. Nothing significant.
Pig (35 lbs)	2:15 p.m.	Start	
An attempt to produce loss	2:20 p.m.	350 PPM	
of consciousness with	2:30 p.m.	700 PPM	Semicomatose
recovery. (1200 PPM in 40 mins.)	2:35 p.m.	800 PPM	"
	2:38 p.m.	900 PPM	"
	2:43 p.m.	1000 PPM	"
	2:44 p.m.	1200 PPM	" slight cyanosis
	2:54 p.m.	1200 PPM	Spasms, cyanosis
	2:59 p.m.	1200 PPM	Cyanosis — sudden tetanic spasm and **death.**
			P.M. Ventral superficial cyanosis — marked hypostatic congestion of lungs.
Pig (35 lbs)	9:40 a.m.	Start	
An attempt to produce	10:00 a.m.	250 PPM	Distress
severe symptoms with	10:15 a.m.	300 PPM	Animal quiet
recovery. (970 PPM in 1 hr.	10:30 a.m.	375 PPM	Minor sporadic spasms
40 mins.)	10:45 a.m.	500 PPM	Semicomatose
	11:00 a.m.	700 PPM	Little change
	11:10 a.m.	780 PPM	Distress, muscular weakness or inco-ordination, no change
	11:15 a.m.	780 PPM	No change
	11:20 a.m.	900 PPM	Dyspnea — struggling
	11:35 a.m.	970 PPM	Expiratory dyspnea
	11:38 a.m.	970 PPM	Running movements — no cyanosis
	11:40 a.m.	970 PPM	Prostrate, unconscious — H_2S stopped
	1:30 p.m.	970 PPM	Animals removed from chamber immediate recovery.
			No after effects.
Pig (30 lbs)	3:30 p.m.	Start	
An attempt to produce	3:35 p.m.	500 PPM	
symptoms with recovery.	3:39 p.m.	700 PPM	
(1050 PPM in 20 mins.)	3:44 p.m.	800 PPM	
	3:46 p.m.	900 PPM	Semicomatose
	3:55 p.m.	1050 PPM	Cyanosis developing — H_2S stopped.
	4:04 p.m.	100 PPM	Slight muscular spasm
	4:06 p.m.	0 PPM	Immediate recovery.
Rabbits (3) (3½ lbs)	16 hrs.	50 PPM	No symptoms
16 hrs. at 50 PPM			
Accidental valve opening		1000 PPM	Tetanic spasm and unconsciousness.
resulted in a possible			One died two hours later.
1000 PPM.			Survivors — no after effects.
			P.M. of casualty — pulmonary haemorrhage.

Discussion

The impression gained from these experiments was that the toxic effects of hydrogen sulphide were related more to the concentration of the gas than to the length of time of exposure. As evidenced by the one pig and rabbit, the supposition that sudden exposure will reduce the minimum lethal concentration level seems justified. The rapid recovery of animals subjected to high concentration without permanent effects was most striking. There is nothing in these impressions that would be in serious conflict with the literature on hydrogen sulphide.

It would seem most unlikely that hydrogen sulphide poisoning would occur in domestic animals under conditions other than those that have been responsible for such fatalities in man; that is sudden exposure to high gas concentrations (400 P.P.M. or greater).

A confirmed diagnosis would have to be based on a known exposure. Pathology and toxicological examination of tissues or organs will not supply confirmatory evidence.

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Abstract

The exposure of young swine and rabbits to varying concentrations of hydrogen sulphide indicated that toxicity was related more to the concentration of the gas than to the length of time of exposure. Sudden exposure may reduce the minimum lethal concentration. No chronic effects were observed in animals surviving exposures as great as 1000 P.P.M. of the gas.

It is unlikely that hydrogen sulphide poisoning would occur in domestic animals under conditions other than those that have been responsible for such fatalities in man; that is sudden exposure to gas concentration of 400 P.P.M. or greater.

A confirmed diagnosis would have to be based on a known exposure. Pathology and toxicological examination of tissues or organs will not supply confirmatory evidence.

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Plans Completed for New York Veterinary Meeting

Program plans have been completed for the 70th Annual Meeting of the New York State Veterinary Medical Society at Saranac Inn, October 4 through 6, 1961, according to an announcement by Dr. Charles E. Fletcher, New York City, President of the Society. The organization comprises nearly all of the registered veterinarians in New York State.

The October meeting will be a combined session with the American Veterinary Radiology Society, representing veterinarians from nearly every state who specialize in x-ray and radiotherapy techniques.

The program includes a wide variety of scientific and cultural presentations, supplemented with recreational activities. The meeting is one of the principle methods used by the veterinary profession to inform its members on new and improved medical and surgical techniques, new drugs, medicants, and therapeutic agents, as well as new medical and surgical equipment and devices. Some thirty (30) manufacturers and distributors of drugs, medicines and medical supplies will have exhibits at the meeting.