The Medical Misprudence of Muriatic Acid

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The subject of the following pages, has been selected, as affording an opportunity of recording the particulars of a case of poisoning with this acid, which has come under our own observation. This, so far as we are aware, being the first case of the kind which has occurred in Scotland; and considering moreover, that so few cases have yet been put upon record, where Muriatic Acid has been the agent employed, we considered that it might not altogether be without some amount of interest.

In thus briefly reviewing the medico-legal history of Muriatic Acid, we would consider:

I. The General History of the Acid.

II. The Symptoms, Post-mortem appearances, and Treatment necessary in cases of poisoning by it.

III. The Chemical Analysis requisite for its detection, whether derived from the contents of the stomach, or from articles of clothing.
1. General History.

This acid has received a variety of names at different periods. The London College has introduced the term Hydrochloric Acid; the Edinburgh and Dublin Colleges, retained the original name given it; while in French works it is generally known under the name of Chlorhydric Acid. In commerce it is commonly known as Muriatic Acid, and popularly by the name of Spirit of Salt.

The true acid is a gas, and is of interest as such only to the chemist. It exists naturally in the vicinity of volcanoes; it is composed of equal volumes of Hydrogen and Chlorine, and is prepared by pouring strong Sulphuric Acid on dry common salt, or by distillation from the strong acid of the shops. It is a transparent and colourless gas, of an intensely acid and suffocating odour; but less offensive than that of Chlorine. It is liquefied by a pressure of about 40 atmospheres. When brought in contact with the air, it forms dense white fumes owing to its attraction for water;
which at 40° absorbs according to different writers, from 1.20 to 2.80 times its volume of the gas, accompanied by the evolvement of considerable heat. Owing to this power which water possesses of absorbing it, the pneumatic trough cannot be employed in its collection; but this may be effected either over mercury, or on account of its weight by displacement. It has a density of 1.269. The solution, formed by the absorption of the gas by water, constitutes the ordinary liquid Huriatic Acid, which is met with in the shops in three forms.

1. Pure. 2. Commercial. 3. Dilute.

1. Pure.

In the preparation of this for the sake of convenience, a larger quantity of the Sulphuric Acid is employed than is required to decompose the whole of the salt; but by this means, a more soluble compound is left behind in the retort. In preparing it great attention must be paid, not only to the quality of the salt, but also of the Sulphuric Acid employed; the former being liable to contain more or less Nitrate.
of Soda; while the latter requires to be freed of the Nitrous Acid which it met frequently contains. To remove the Nitrate of Soda which the salt may contain, it is necessary to expose it for some time to a full red heat, or more conveniently, as now recommended by the Edinburgh College, the salt should be recrystallized, and the crystals washed before they are dried.

This acid should be perfectly transparent and colourless; leave no residue on evaporation; and give no precipitate or milky mess with a solution of the Chloride of Barium. It has no action on gold leaf, and though when strong, by disengaging a little gas, it fumes when exposed to the air, it does not do so as strongly as the commercial acid. When kept for some time it acquires a slight yellow tinge from the decomposition of the acid and the formation of Chlorine.

2. Commercial.

This form is not recognised either by the London or Dublin College. It is obtained on a large scale, by condensing in water the gas disengaged during the
conversion of sea salt into Sulphate of Soda, preparatory to the preparation of Black ash and Carbonate of Soda.

It is a transparent liquid, of a pale straw colour, varying in density from 1.20 to 12.16; that at 7.00 containing about 1/2 p.c. of the anhydrous acid. It freezes at 60°, and at 110° it appears to boil, but in reality merely gives off hydrochloric acid gas, and continues to do so until its density falls as low as 10.44; when it boils in the proper acceptation of the term, and distils over unchanged. When exposed to the moisture of the air, it forms fumes like the pure acid already described. It possesses an intense acid taste, and has a peculiar pungent and irritating odour, which if it be attempted to be inspired, immediately causes spasm of the glottis, but if it be moderately diluted it may be inhaled. With the aid of heat it commonly dis- poles gold leaf. It dissolves some metals, and nearly all the metallic oxides, but some peroxides e.g. Manganese, are themselves decomposed, and at the same time
decompose the acid; chlorine being given off, and a hydrochlorate formed, with a metallic oxide of a lower degree of oxidation. It stains and corrodes organic matters, though less powerfully than Sulphuric and Nitric Acids. It is distinguished from the former by its colour, and from the latter by not giving off red or orange-red fumes upon the addition of Copper, and also by evolving Chlorine upon adding the Peroxide of Manganese; the rationale of which has already been explained.

3. Dilute.

A dilute acid is recognised by all the Colleges for internal administration; but they differ in strength. That of the London, Edinburgh, and Dublin Colleges being convenient for that purpose, while that of the Dublin College is much too strong.

A general description of the actions and uses of one of these three different forms will suffice, as one is merely a modification of the others. For this purpose, the Commercial
Acid being most extensively used, may be taken as the type.

It was first obtained in the form of gas by W. Cavendish; but he was totally unacquainted with its composition. Subsequently, however, its properties were carefully examined by Priestly and Scheele. It has long been known as an important and useful acid, mentioned in the writings of Basil Valentine, as early as the fifteenth century, and has since been employed for various economic and other purposes.

In medicine, it has been successfully employed in the treatment of various local diseases; in phlegmonous phagedena, in cancerous ulcers, in syphilis and mercurial syphilitic ulcerations of the gums, tongue, and throat, and in the dilute form as a gargle in scarlatina maligna, aphtha, and diphtheria. It has the power of dissolving various animal substances, e.g. coagulated albumen, fibrin of blood, boiled meat &c. and effecting a kind of artificial digestion, very similar to the natural process. Hence, the great success which attends its administration.
tration, in those cases of dyspepsia which are accompanied by, or are dependent on, a diminished quantity of the gastric fluid. It also acts as a tonic, and exists naturally as an important constituent of the gastric juice. Of the chemical physicians of last century, it was employed as an antiseptic, in all those diseases which were supposed to be connected with a putrescent condition of the fluids; as in putrid fevers, scurvy, malignant scarlatina, and ulcerated sore throat. It has long been generally employed in phosphatic gravel, in which case it acts as a general tonic and promoter of digestion. Guinon Morveau first proposed to employ the gases of air for purifying crowded and ill-ventilated apartments, and though, not now used for that purpose, it would doubtless be useful, were it not too irritating for the lungs. For this purpose however, it would appear that Chlorine and Nitric Acid are more powerful. It has also been used extensively, for removing the stains of iron from linen; for this purpose, the cloth is wetted with
The acid in a diluted form, and washed immediately after to prevent it injuring its texture. It acts very energetically as a poison to vegetable life, completely destroying the foliage of plants exposed even for a short time to its influence.

II. Symptoms, Post-mortem appearances, and Treatment necessary in cases of poisoning by it.

This species of poisoning is very rare, and perhaps more so in Britain, than on the Continent: consequently its medico-legal history must be very imperfect. Dr. Chavors, in his work, on the "Medical Jurisprudence of the Bengal Presidency," reports but a single case of poisoning by an inorganic acid—Sulphuric Acid. From the reports which have been furnished, it would appear, that the symptoms closely resemble those produced by Sulphuric and Nitric Acids. The symptoms come on suddenly, immediately after the injection of the poison. When thrown into the veins of the lower animals, it causes coagulation.
of the fluid and speedy death. Given by
the stomach to dogs, Orfita says death
is almost always preceded by very violent
convulsive movements, especially in the
muscles of the neck and spine. In cer-
tain cases these muscles are so strongly
contracted, that the head is turned very
much backward, and forms with the
spine a curve, the concavity of which is
very decided. In man, the following
symptoms have been observed. At the
angles of the mouth, and even upon the
neck, may be found stains of a yellow
colour; but in the case of children, more
especially when the poison has been adminis-
tered with criminal intent, we must re-
member that it is likely to be given by
a spoon or other means, so as at once to
throw it to the back of the throat, and
hide all external traces of it. Hence in
some cases these signs may be entirely
wanting. Orfita mentions the escape
of acid pungent vapours from the mouth
and nostrils, as one of the earliest symp-
toms; but it very soon disappears, and
probably this is the reason why it has not been observed by other writers. The mouth is excoriated, and of a fiery red colour, the lips red, sometimes pale, the tongue swollen and dry, there is great thirst. There is great difficulty of deglutition, each effort being accompanied by severe pain, and any matter which is taken into the stomach is speedily ejected; thus rendering the administration of remedies a matter of great difficulty. The tonsils and throat are highly inflamed, and severe burning pain is felt in the throat and gullet, extending downwards to the stomach attended by violent retching, and vomiting of dark coloured, and highly acid matter having shreds of mucus mingled with it. The abdomen is found tender on pressure, but occasionally the pain is not so severe in this region, but is principally referred to the throat. The skin is cold, the pulse is small, frequent and irregular. The breathing is laboured, owing to the swelling of the throat, and in some cases the immediate action of the irritant on the larynx. There is obstinate constipation, and occasionally
suppression of urine. The intellect always remains unaffected even to the last. In some cases, it has been observed that the symptoms seem for a time to remit, but this is only temporary, and is quickly followed by a sudden aggravation of them all, and death speedily ensues.

As regards the quantity of the poison required to destroy life, and the period at which the case proves fatal, the medical jurist must be content to draw an inference, based upon the analogy which exists between the effects of this, and the other two inorganic acids. Of the cases before us we find, that in one, two ounces destroyed life in thirty-three hours; in a second, the same quantity proved fatal in eight days; and in a third, reported by Mr. Crawford (Lancet, March 1840) a similar quantity proved fatal in five hours and a half. This is the most rapidly fatal case on record. In a case, the particulars of which will be given subsequently, two drachms, taken by a child proved fatal in thirteen hours. Again, recoveries have followed after as large a dose as two ounces.
Death may take place by the immediate action of the acid on the larynx, or the mucous membrane of the oesophagus may have suffered most; and if the patient survives the primary effects of the poison, staphylococcus and death from starvation follows as a consequence. Or again, both the larynx and oesophagus may have suffered but little, and the virulence of the poison be principally confined to the stomach; in these cases, more especially, the administration of remedies, or of food, greatly increases the severity of the pain and causes violent vomiting. Dr. Crollas thus describes a case of poisoning by it in the case of a Farmer, Simvagos, c. 28. The patient was sitting up in bed; he could not lie on his back; he had no convulsive movements; his head was turned very much backward; when questioned, he brought it forward again by a rather sudden motion; but as this position seemed to fatigue him much, he threw it rapidly back; the mouth, which was half open, exhaled no disagreeable odour; the respiration was frequent, and were accompanied by an isochronous moan; there was neither pain nor eschar on either the
lips or the skin of the face. The gums were
pale; the teeth presented no ab-
normal disposition; the tongue was large,
and had lost its colour; at its centre, and a
little to the left, was observed a furrow denud-
ed of its epithelium, commencing close to the
root, and ending near the root, at the bottom
of which the papillae of the organ stood up quite
red. The skin was cold; the pulse very small
and very quick. The epigastric region was tender
to the touch; no urine had passed since the
evening before: there was no diarrhoea. The
patient vomited neither the soup and water
given him nor half a drachm of calcined mag-
nesia. Immediately after taking the poconc
he was seized with vomiting, and the vomited
matters spewed on the ground; but when
seen by Dr. Collas this had ceased.

In a case described by Dr. Guérard,
where the patient, a female aged 70, did not die
for a period of eight weeks, after taking more
than two ounces of the acid, the immediate
symptoms were: severe pain with a sense of
burning in the tongue, back of the mouth and
gullet, as far as the stomach; a feeling of
suffocation, escape of white vapours, and vomiting of a liquid which effervesced as it fell on
the pavement. In three hours she was brought to the Hôtel Dieu, and it was found that
the vomited matter had a brown and bloody appearance. Vomiting continued throughout the
night to the extent of four quarts of a reddish liquid with solid masses of a red-brown colour.
These vomited matters had no acid reaction; on the next morning, the tongue and throat
were covered with a white pellicle, and in parts the membrane was removed, as if by the corrosive
action of the acid. The inner surface of the cheeks, the roof of the mouth, and under part
of the tongue, presented no change. There was a severe burning pain in the throat, extending
to the stomach, increased by pressure; but the acid did not appear to have reached the in-
testines. There was a copious discharge of saliva, with shreddy masses of mucous, and any at-
ttempt to swallow was followed by spasms in the throat. The voice was feeble and hoarse,
breathing quiet, pulse 96, regular and full, skin warm and dry, urine scanty; — no evacuation from the bowels. On the second
day there was delirium followed by paralyses of the limbs and collapse. During the eight weeks that the patient survived, there were variable symptoms chiefly referable to the throat, lungs, and stomach.

**Appearances after death.**

After death the throat, larynx, and esophagus are found highly inflamed, the mucous membrane corrugated, entirely or partially detached, or even in a state of slough. Though perforation of the stomach has been observed, it is not an invariable appearance: when it does take place, it is usually situated at the cardiac extremity of the great curvature. Where the severity of action has not been sufficient to produce this result, the mucous membrane has been found more or less corroded and sometimes entirely destroyed; and in one case all the coats had suffered, the peritoneal investment alone remaining. When death does not take place till after the lapse of several days, the mucous membrane lining the throat and esophagus is found thickened, injected, and purulent; the coats of the stomach of a dark colour,
softened and highly inflamed; and should perforation have previously taken place, it will be found adherent to the neighbouring viscera.

In a case referred to by Dr. Gallier, which was the subject of a criminal trial in 1846, the stomach was entirely disorganised, softened, and presented posteriorly, several perforations of different diameters, with rounded, thickened, and inflamed margins, adhering to the adjoining viscera by slight albuminous deposits. The pyloric orifice was thickened, as well as the mucous membrane of the small intestines. The large intestine was healthy. The mucous membrane of the throat was thickened, injected, and in pressure, purulent matter escaped from it. The bullet was thickened throughout its whole extent, and its mucous membrane in a state of suppuration. The patient in this case, died eight weeks after she had taken the poison.

In Dr. Collus's case, death took place in about twenty-four hours, and the post-mortem examination was made thirteen hours after. Although the mean temperature was about 84° F., the body did not exhaust any
colour, nor did it present any sign of putrefaction; the cadaveric rigidity was extreme, and continued to the end of the examination. All the organs, except the digestive tube, were in the normal state. The gums and the arch of the palate were pale, without any alteration of tissue; the epidermis of the tongue, reduced to a grayish pulp, and was easily removed; the epithelium of the soft palate was in the same state; the esophagus was rough and corrugated. The upper and lower portions of the tube were dark coloured, but not charred; while the middle portion was pale. The stomach was distended, and presented externally red, green, and black discolations. It contained about seven ounces of a black turbid liquid. The duodenum was healthy, contrasting strongly with the condition of the stomach.

In the case described by Dr. Guirard in which death did not take place for eight weeks, the mucous membrane of the esophagus was swollen and softened throughout. At the upper part, the lining membrane was entirely removed: at the
lower, it had a pale colour. The mucous membrane of the stomach was softened and gelatinised with a brownish discoloration at the greater end: the muscular coat was laid bare in several places. The pylorus was hardened, contracted, and of a brown colour. The peritoneum was covered with some false membranes. The small intestines were slightly injected. All the parts about the larynx, epiglottis and trachea, were highly injected, and of a brown colour.

In the following case the patient, a child between two and three years of age, presented when seen an hour after the poison had been swallowed, the following symptoms.

The child was lying on the mother’s knee, with the head thrown back so that the body formed a curve. As each attack of vomiting came on, he suddenly raised his head forwards as if it were by a jerk; but so soon as it abated, he again fell back into his former position. The matter ejected from the stomach was of a dark brown colour, highly acid, and contained streaks of mucous mingleth with it. There was no stain or eschar, either upon
the lips, angles of the mouth, or the neck. The lips were pale; the teeth and gums were sound and presented no discoloration. The tongue was red at the tip and around the margins; towards the centre it was stripped of its membrane, presented a brownish colour and in some places yellow spots. There was no disagreeable odour exhaled either from the mouth or nostrils. The breathing was difficult; the pulse was small, weak, and irregular. The abdomen was slightly swollen and was tender on pressure. The extremities, and skin generally were cold.

Upon enquiring, I ascertained that the child had held both of a bottle containing as was subsequently found by analysis, a quantity of commercial muriatic acid; and, placing the neck of the bottle within its mouth, had swallowed a portion of its contents. Immediately after, it was seized with violent vomiting. Previously to my seeing him, the friends had applied to a druggist, who recommended the administration of a dose of castor oil. I immediately ordered calcined Magnesia suspended in milk, to be given
freely in successive portions. At first there was great difficulty of deglutition, and the remedy was ejected so soon as taken. In a little while, the symptoms abated and the mixture was retained. This treatment, along with mucilaginous drinks was persisted in during the afternoon, and in the evening the symptoms seemed to have abated. Towards night however, the patient suddenly became worse, and panted about 12 o'clock, exactly thirteen hours after the poison had been taken. The mental faculties were unaffected to the last; there were no convulsive movements; there was suppression of urine, and the bowels were constipated.

Upon dissection, made thirty-six hours after death, the following post-mortem appearances were found.

The lips and gums were pale, but presented no abnormal discolouration; the tongue was red at the point, and around the margins; towards its centre it was stripped of its membrane, of a brownish colour, interspersed with yellow spots; posteriorly and at the root it was highly inflamed, but presented no discoloration. The upper aperture
of the larynx was considerably narrowed. The tonsils were of large size, inflamed, and presented yellow spots on their surface. The esophagus throughout its whole extent presented longitudinal corrugations, at its upper part it was highly inflamed; but towards the middle and lower portion it was pale. Upon opening the stomach, it presented at the pyloric extremity of the great curvature, an aperture of sufficient size to admit the thumb. The margins of the perforation, were charred of a deep black colour; and for some distance round it. It had the appearance as if a hot hot iron had been pushed through it. The peritoneum was covered with false membranes. The other systems were healthy.

The accompanying drawing was made immediately after the examination, and represents the appearance which were found. In Fig. 2, is shown the external surface, of that portion of the stomach which was perforated.
III. The Chemical Analysis requisite for its detection, whether derived from the contents of the stomach, or from articles of clothing.

The characters already mentioned as characteristic of the various forms of Muriatic Acid, will be sufficient to distinguish them, should they be presented to us uncombined and not much diluted. Should the acid however, be added to a considerable quantity of water, the property of evolving Chlorine upon the addition of Peroxide of Manganese will be lost.

In this case there is one most satisfactory and delicate test for its presence— the nitrate of silver. This reagent gives with Muriatic Acid a dense curdy precipitate of Chloride of Silver. The precipitate thus obtained is recognised by the following characters. Like all the other salts of silver, it acquires a dark colour on exposure to light; it is insoluble in nitric acid; it is readily dissolved by aqua ammonia; it is insoluble in caustic potash; but when boiled with it, the brown oxide of silver is produced; when dried and heated on platinum, it melts like a resin, forming a yellowish coloured sectile mass. So this
test it may be objected, that other acids, e.g. Prussic and Oxalic Acids, also form with it white precipitates. Prussic acid however, would be recognised by its odour, and cyanide of silver by evolving on the application of heat a gas, (cyanogen) which burns with a rose coloured flame. A solution of Oxalic Acid upon evaporation would leave crystals of a solid acid; and these, would be entirely dissolved if the heat be continued. The acetate of silver moreover, is recognised by its entire solubility in nitric acid, and when heated on platinum, it detonates slightly. The mixture of any simple acid, such as acetic or tartaric with a solution of common salt, might be pronounced to be muriatic acid from the action of this test, when in reality, no free muriatic acid was present. The difficulty in such a case may be obviated, by resorting to the following process. If we take equal quantities of the acid fluid, and precipitate one portion entirely by the nitrate of silver — then evaporate the other portion to dryness, dissolve the dry chloride in water, and precipitate this solution entirely by nitrate of silver. It is obvious,
that if there be no free muriatic acid present, the precipitate will have exactly the same weight in both instances. While, if free muriatic acid were present, the precipitate obtained in the former case, would exceed in weight that obtained in the latter. In fluids containing organic matter, the nitrate of silver cannot be employed as a test. This arises, either from the presence of chlorides in articles of this description, or from oxide of silver being itself precipitated by certain organic principles. In the latter case, the precipitate is distinguished by being redissolved in nitric acid. Under these circumstances there are three different methods to which we may resort:

1. When the muriatic acid is present in considerable quantity, we may distil the liquid at a low temperature, in a retort fitted with a receiver. Any free muriatic acid will pass over, be condensed, and may afterwards be tested. Before adopting this process, it is well to test the fluid with nitrate of silver baryta to detect sulphuric Acid; as the presence of this acid with a chloride would give the same result and lead us into error.
2. We may evaporate a portion of the liquid, calcine any solids, and observe whether on digestion in water, we obtain a solution of a chloride; if not, we neutralize the acid organic liquid with carbonate of soda, then evaporate and incinerate the residue. We thus obtain all the muriatic acid of the liquid as chloride of sodium, and then precipitate it by the nitrate of silver.

3. Muriatic acid may be separated from some organic substances, and from some alkaline salts, by digestion in alcohol. The alcoholic solution is then filtered, and to it a strong solution of caustic potash is added, and the chloride of potash is precipitated. The precipitate is then collected on a filter, dissolved in distilled water and tested. Alcohol thus enables us to ascertain, whether any free muriatic acid remains in the matter submitted to us for analysis.

To detect the presence of this acid in moistened matters, or in the contents of the stomach. The liquid, should be separated from the solid portions by filtration. If acid, we proceed in the
same manner as directed for its detection in organic fluids. If neutral, as it may be owing to the administration of remedies, the liquid is evaporated, and the resulting alkaline chloride will indicate the quantity of muriatic acid. However accurate and careful the chemical analysis may be, yet from the doubts which may be thrown upon it, it must of necessity fail, unless the acid be found in large quantity and in a free state, in the contents of the stomach; or unless there be at the same time corroborative evidence, derived from the symptoms and post-mortem appearances.

In some cases where other sources fail, chemical evidence may be obtained from stains on the clothing. In a case which occurred during the past winter, in which this acid was thrown upon the person of a catman; owing to the acid being in a dilute form on the skin, the characteristic stains were not produced; but its action was indicated by inflamed and excoriated tracks, not only on the face and hands of the individual upon whom it was thrown, but also by similar results.
upon the hands of another person, caused by anointing the sufferer's face with milk.

In this instance the stains upon the clothing, when digested in distilled water yielded a highly acid liquid, which gave with nitrate of silver a dense curdy precipitate, possessing all the character of the chloride of silver. It must always remember that in such cases, an unstained portion of the material must be examined by way of comparison.