

manner as before. It is not the intention of this paper to discuss the action, uses and polytherapy of iodids in medicine.

The technic employed for the quantitative analysis was the following:

1. A fiftieth normal solution of sodium thiosulphate ($\text{Na}_2\text{S}_2\text{O}_3$) was prepared and carefully standardized against a definite quantity of potassium iodid. The standardization was performed as follows:

An exact 10 per cent. solution of potassium iodid is used. One c.c. of this 10 per cent. solution is diluted up to 100 c.c. with distilled water and introduced into a separating funnel. To this is added 5 c.c. of a mixture composed of strong nitric acid plus 5 per cent. of nitrous acid, and well shaken. Allow to stand five minutes and then add 10 c.c. of chloroform. Agitate well to wash out the liberated iodine. Let stand for five or ten minutes and drain off the purple colored chloroform from the bottom of the separating funnel into a beaker. The iodine extraction is continued and repeated with several fresh, smaller portions of chloroform and the whole of the chloroform used for the washing is collected in the same beaker. The washings should be continued until the returning chloroform is colorless.

2. Next carefully titrate the chloroform-iodine contents with the fiftieth normal sodium thiosulphate solution until the purple chloroform becomes completely colorless. Having thus determined the amount of sodium thiosulphate solution necessary to decolorize the iodine of 1 decigram of potassium iodid, calculate its equivalent for 1 c.c. of $\text{Na}_2\text{S}_2\text{O}_3$ and use

50

the obtained figure as the standard.

For the urine determination, 100 c.c. of a twenty-four-hour specimen of urine is used and treated exactly as described above in the standardization. Having determined the potassium iodid elimination per 100 c.c. of urine, calculate therefrom the total excretion in the twenty-four-hour specimen.

REMARKS

It is to be noted that the major portion of the eliminated potassium iodid is excreted in the first twenty-four hours, from 5 to 10 per cent. is given off in the second twenty-four hours and by the third day only a trace or no potassium iodid is excreted.

As is to be expected, the amount of potassium iodid recovered never equaled or even approximated the amount introduced, indicating that other avenues of elimination (skin, saliva, etc.) excreted a considerable portion, and perhaps part may be utilized in thyroid-protein molecularization.

Patients who spit up a great deal excreted less potassium iodid in the urine.

The total elimination of potassium iodid in nephritic cases, as compared with other diseases in the chart, is the lowest and serves as a hint of poor renal function.

When the potassium iodid was given per rectum in the nephritic cases there was a more notable elimination, due probably to slower absorption and the proctoclysis acting as a renal stimulus.

Observe the peculiarity of the four pneumonia cases in excreting in the first day all excretable potassium iodid with no traces on subsequent days. Possibly this fact bears some relation to the low total chlorine elimination in pneumonia, as both are halogens.

The blood pressure seemingly has no material relation to the excretion index.

Potassium iodid can be given by rectum to comatose patients with the same result as when given by mouth (Patient A. E. being in coma when brought to the hospital, later regaining consciousness).

On the same case a lumbar puncture was made and a trace of potassium iodid was found in the spinal

fluid. In two other instances, however, no potassium iodid could be discovered in the spinal fluid.

Whether those that excrete little through the urine are the ones that suffer from toxic and skin symptoms could not be ascertained, as experiments on the same patients were limited. Some patients could not retain proctoclysis and therefore only mouth determinations were possible.

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QUININ AND UREA INJECTIONS IN HYPERTHYROIDISM

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Since my preliminary report,¹ I have used quinin and urea injections over two hundred times in fifty cases of goiter, with no unpleasant effects.

I recommend the method only to relieve hyperthyroidism and not to remove the goiter. It is often true that in small toxic and atoxic goiter the inflammatory reaction following the injection is sufficient to cause the disappearance of the tumor; but the process is slow, usually covering several months, and when used for this purpose alone, the results are liable to be disappointing.

The injection must be employed with discretion; I have used it two years; the length of time being too short, and the number of cases too limited to draw final conclusions. It is suitable for use only in a hospital by men skilled in goiter work. One inexperienced is liable to inject too deeply, or to make the injection within the trachea. The indiscriminate use of quinin and urea, in the hands of one not familiar with the low threshold to stimuli possessed by the average case of toxic goiter, is liable to produce alarming symptoms of hyperthyroidism which might result disastrously.

In all cases of hyperthyroidism, I have obtained the best results by keeping the patient in bed in a hospital several weeks while giving the injections, the length of time depending on the severity of the symptoms and response to treatment.

PRELIMINARY TREATMENT

The necessity of minimizing pain from any injection by the use of local anesthesia cannot be too strongly emphasized.

To raise the patient's threshold to stimuli, thereby preventing an acute attack of hyperthyroidism which might otherwise follow the slight pain of the first quinin and urea infiltration, all cases of toxic goiter receive at one to three day intervals, preliminary injections into the most prominent portion of the goiter, of a few minims of sterile salt solution followed by injections of sterile water.

After two to four preliminary injections, the nervous reaction is so diminished that the quinin and urea can be given with only slight discomfort and no increase in symptoms; as soon as there is no hyperthyroidal reaction following the water injections, their usefulness is at an end.

I have observed in giving these injections that if the same point is always used, the reaction is less

1. Watson, L. F.: Quinin and Urea Hydrochlorid Injections in Hyperthyroidism, THE JOURNAL A. M. A., Jan. 10, 1914, p. 126.

than if each is given at a different place. For this reason I give the preliminary injections and the first quinin and urea infiltration at the same site.

TECHNIC

A study of thyroids removed after infiltration has demonstrated the difficulty of destroying even a small portion of the gland by injections through the skin. As one becomes experienced in the technic, it is possible to give each injection into tissue that has not been previously infiltrated; thus destroying the greatest amount of thyroid with the smallest number of injections.

For the injection I use an all glass syringe of 1 or 2 c.c. capacity, fitted with a slip needle so that the syringe can be readily attached and detached without traumatizing the thyroid. I prefer a fine platinum needle $1\frac{1}{2}$ inches long.

After the usual aseptic precautions, the site of the injection is anesthetized with a 0.1 per cent. cocain or 0.25 per cent. novocain solution infiltrated into the skin, subcutaneous tissues and muscles, down to the gland. The syringe is now detached and the needle is thrust carefully into the body of the goiter. After ascertaining that there is no fluid in the thyroid and that no blood or air comes through the needle, the syringe is attached and the infiltration slowly made.

In cases of hyperthyroidism, I usually give from 1 to 4 c.c. of a from 30 to 50 per cent. quinin and urea solution at a treatment, repeating the injections about every third day, depending on the progress of the patient. Eight to fifteen infiltrations are usually necessary to produce a marked improvement in the general symptoms and the disappearance of the bruit over the superior thyroid arteries.

In cases of recent cystic goiter with moderate symptoms of hyperthyroidism, I aspirate the fluid and make one to three injections. Although the action of quinin and urea on the cystic type is uncertain, in the five cases I treated early in 1914, the tumor has disappeared and has not recurred.

EXPERIMENTAL RESULTS

The report of two severe toxic goiters removed after injection may be of interest:

CASE 1.—Six months after the usual injections through the skin, one case of toxic goiter was not relieved of hyperthyroidism, although the tumor was reduced one half. A partial thyroidectomy disclosed only isolated areas of necrosis—thus demonstrating that I had failed to destroy a sufficient amount of thyroid tissue to relieve the symptoms.

CASE 2.—A vascular goiter was exposed as for operation and one half of the gland thoroughly injected. Prompt relief from hyperthyroidism followed this extensive infiltration. Three weeks later, for cosmetic reasons, a partial thyroidectomy was done, revealing a complete necrosis of the injected area.

In each of these cases there was a noticeable absence of adhesions around the gland; the operation was not made more difficult because of the previous treatment.

The injection of weak quinin and urea solutions into thyroid tissue is productive of only a temporary fibrinous exudate which is rapidly absorbed with more or less accompanying hyperemia; the reaction following the strong injections is more intense and results in extensive inflammation with round-cell infiltration, connective-tissue proliferation and necrosis of the thyroid cells with a loss of staining properties of colloid and thyroid.

CLINICAL RESULTS

Sixteen patients with recent toxic goiter, treated before June 1, 1914, have been free from symptoms of hyperthyroidism for one year. In four of these patients, the goiter has entirely disappeared; in eight, the gland has perceptibly decreased in size; in two, the thyroid has slightly enlarged; and in two others there has been no appreciable change in the size of the tumor. Two patients with severe toxic goiter are free from symptoms of hyperthyroidism eighteen months after the last injection. Ten of these patients, who were emaciated at beginning of treatment, have shown a marked increase in weight, some gaining as much as 40 pounds during the treatment and the four months following; and so far as I can learn at this time none have lost the weight they gained.

Late in 1913, two injections were given in each of three cases of toxic goiter. The first patient was free from hyperthyroidism for seven weeks; the second was relieved for two weeks; both of these patients later went from under my care and had a partial thyroidectomy. The third patient, who had hysteria complicating hyperthyroidism, was relieved for two months; when the symptoms recurred she refused further treatment, and I am informed that now, a year since I saw her, she is improving at home without any treatment whatever.

Nine cases of recent atoxic (simple) goiter treated before June 1, 1914, are under observation. In two of these cases the goiter is undiminished in size; in three, it has entirely disappeared; and in four, it is slowly diminishing.

Twenty-five cases of toxic and atoxic goiter which have been under observation since June 1, 1914, will be the subject of a future report.

CONCLUSIONS

1. The study of the quinin and urea treatment is based on fifty cases of goiter in which I have used the injection more than two hundred times with no unpleasant effects. The method is recommended only to control the symptoms of hyperthyroidism in cases of toxic goiter, and is not recommended to remove the tumor in atoxic (simple) goiter for cosmetic reasons alone.

2. The injection will not relieve the symptoms of advanced toxic goiter when the vascular and nervous systems have been permanently damaged.

3. In summarizing, I believe the following observations may be ventured: Much depends on a proper selection of cases; the necessity of preventing pain from any injection, by the use of local anesthesia, is of vital importance; if acute attacks of hyperthyroidism are to be prevented, the use of preliminary injections into the most prominent portion of the goiter, of a few minims of sterile salt solution given at one to three day intervals, followed by injections of sterile water, will be found indispensable; the result of the quinin and urea injection depends on the amount of tissue destroyed.

4. The quinin and urea injection in experienced hands is a harmless procedure; it is almost painless, and there is no postinjection discomfort. It is suitable for use only in a hospital by men skilled in goiter work.

5. The gradual improvement of the exophthalmos in certain patients following the quinin and urea treatment points to a nerve control exerted by the thyroid

on the exophthalmos, through the sympathetic nervous system, as first suggested by Landström.²

6. I believe the greatest field of usefulness for the injection will be found in those cases of beginning hyperthyroidism not severe enough to justify operative treatment, and as a preparatory measure to partial thyroidectomy in chronic cases of toxic goiter in which the patient is too ill to warrant any form of immediate operative procedure.

THE PRACTICAL USE OF COPPER SULPHATE IN SWIMMING POOLS

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Since the publication of a paper on "The Use of Copper Sulphate in the Purification of Swimming Pools" in the *Journal of Industrial and Engineering Chemistry*,³ and the editorial comment in *THE JOURNAL*,⁴ I have received many inquiries from physicians who are interested in the practical side of this subject. As the first paper was primarily an attempt to show, by scientific reasoning and fact, the advantages of copper sulphate as a disinfectant in pools, no attempt was made to describe the actual method of using it, that is, the method of charging the water, the amount of disinfectant to use, frequency of application, and practical workings of the system. In this paper an attempt will be made to give minute directions for the use of copper sulphate by a person in charge of a pool.

Of course it must be understood that no means of purification is of itself sufficient when the ordinary laws of sanitation are not obeyed. Moreover, the efficacy of a disinfectant depends to a greater or less degree on the chemical contents of the water used in the pool, and no definite amount of the disinfectant can be recommended with the statement, "This will make your pool water pure." If possible, frequent bacteriologic analyses should be made, at least during the first week or two of the treatment. This will show better than any other means whether or not the proper amount of the disinfectant is being used.

The first requisite in the sanitary management of a swimming pool is the proper cleansing of the bathers before they enter the pool. A thorough shower bath with warm water and soap should always precede the plunge. When it is possible, as in the case of Y. M. C. A., school or college pools, no clothing whatever should be allowed. In the case of public pools, girls' pools, Y. W. C. A. pools, etc., in which this provision cannot be carried out, bathing suits of light colored materials should be insisted on, and these should be washed in disinfecting solutions at frequent intervals. Lastly, and this is of prime importance, no person should be allowed in the pool who knowingly is suffering from a communicable disease. This means that a physician should have at least a general supervision over every swimming pool.

That these general precautions, however, do not destroy the danger of transmitting disease through the medium of the pool water is fully realized by sanitarians. Within the last two or three years especially,

this fact has received universal attention by hygienists throughout this country and Europe. Various means of purifying pool water have been proposed. We have seen pools designed with traveling buffers to force out the dirty water for subsequent treatment. Many pools in cities in which water rates are high use refiltering systems, of which there are many excellent types on the market. Ozonation and purification by means of ultraviolet light are receiving commercial attention. Recently the use of bleaching powder or calcium hypochlorite has been advocated. All of these methods insure pure water entering the pool, but they fail in what must be considered the most important particular—they cannot keep the water pure after bathers have been in the pool.

Consider these figures as an example of "before and after using" a swimming tank: On analysis, the pool water in the Taylor Gymnasium at Lehigh University was shown to contain, just after filtration and before any one entered the pool, 10 bacteria per cubic centimeter, and no colon bacilli; after forty men had been in the pool, although all the preliminary sanitary precautions had been taken, the water contained 5,300 bacteria per cubic centimeter, 200 of which were colon bacilli. Bleaching powder introduced into the pool in germicidal quantities is out of the question on account of its disagreeable odor and its irritating effect on the eyes and mucous membrane. Copper sulphate can be used in germicidal quantities without any disagreeable results.

The method of using copper sulphate is very simple. I found as the results of experiments that about one-twentieth (0.04) part of copper sulphate to a million parts of water, used every day, kept the water pure. As stated before, this amount cannot be recommended absolutely for every pool. The chemical contents of the fresh water, the number of bathers, the frequency of refiltration, etc., are factors that should not be overlooked. However, for most pools averaging not more than from 100 to 150 bathers per day, and in which the proper care is taken, this amount will prove the proper one.

In order to determine in pounds the amount of copper sulphate to add, the capacity of the pool must first be determined. In the case in which this is known as a certain number of gallons, the problem simply amounts to multiplying the number of gallons capacity by 8.3 (the weight in pounds of a gallon of water), and dividing the weight of the water thus determined by 2,000,000 (the solution being one-half part per million). The result is the weight in pounds of copper sulphate to be added. For example, suppose the pool contains 90,000 gallons of water:

$$\frac{90,000 \times 8.3}{2,000,000} = 0.37 \text{ pounds, or about 6 ounces, of copper sulphate to be used.}$$

In case the capacity of the pool is not known, it may be determined as follows: Multiply the length in feet by the width in feet, and the result by the average depth in feet. This will give the capacity of the tank in cubic feet. As a cubic foot of water weighs 62.5 pounds, we now have the formula:

$$\frac{\text{length} \times \text{width} \times \text{average depth} \times 62.5}{2,000,000} = \text{weight of copper sulphate to be used}$$

The copper sulphate should be added daily. The method of introduction consists simply in dissolving the required amount, placed in a small bag, such as a 5-cent salt sack, directly in the pool, either by dragging the bag through the pool by means of a pole, or by throwing it into the pool as an object for the bathers

2. Landström: Ueber Morbus Basedowii, 1907.

3. Thomas, S. J.: The Use of Copper Sulphate in the Purification of Swimming Pools, *Jour. Indust. and Eng. Chem.*, 1915, vii, 496.

4. The Practical Disinfection of Swimming Pools, Current Comment, *THE JOURNAL A. M. A.*, July 10, 1915, p. 176.