

## Special Article

### THE DIPHTHERIA EPIDEMIC IN HALIFAX\*

BY ALLAN R. MORTON, M.D.

*Commissioner of Public Health and Welfare,  
Halifax*

Early in September, 1940, some cases of diphtheria were admitted to the City Infectious Diseases Hospital which, on even the first preliminary clinical examination, showed that we were dealing with a strain not seen in this area for some years.

Clinically, the cases were, on the whole, much more toxic and severe than I had ever seen, and in conversation with older practitioners they could not recall when they had seen so many cases of this severe type. The patients frequently showed a marked œdema of the whole pharynx and swelling of the superficial glands of the neck, giving a bull-neck appearance. The membranes were very extensive and often covered not only the tonsils but came forwards over the anterior pillars, backwards over the posterior pharyngeal wall, and upwards over the uvula which often was so œdematous as almost to block the entrance to the pharynx. This membrane, in some cases, spread forward over a considerable area of the roof of the mouth; it was heavy, thick, and of typical greyish colour; could not be removed without causing bleeding, and, depending upon the length of the illness, it was darker and in some instances, where several days had elapsed, it was almost black. Frequently, these patients also had trouble in breathing through the nose, and on examination here more membrane could be found.

Frequent attacks of epistaxis, as well as bleeding from raw areas of the throat where membrane had been coughed away, commonly occurred. Laboratory examination and culture of swabs showed a definite "gravis" strain of diphtheria.

We have had diphtheria in endemic form in Halifax, and as recently as July, 1940, had an outbreak of "mitis" diphtheria in one of the summer camps for underprivileged children. This outbreak I was able to control very quickly, and immunized all the children in camp and all others who subsequently went to camp. In this group of 200 or more children so protected none developed diphtheria during the epidemic months of the winter; whereas, other members of their families, brothers and sisters not protected, did develop clinical cases.

On my appointment to a full-time position with the city on October 1, 1940, I was confronted immediately with this epidemic and had

57 cases of diphtheria admitted during the first month. Immediately I began an intensive program of immunization, especially directed towards the school and pre-school children. We ran clinics three days a week and had attendances at these clinics up to 1,800 on a single day. It was during this busy month that I lost a personal friend and colleague, the late Dr. Allan MacLean, who was so interested in all public health activities and was connected with the Department of Preventive Medicine at Dalhousie. His loss just at this time was a double blow, as his help was sorely needed and his counsel as a trained public health man was greatly valued. He had operated clinics for immunization at the University Health Centre for many years, and his work was valuable and prevented a more serious outbreak. No city organization was set up for preventive medicine, and I had to organize, with the help of Dr. H. G. Grant, the staff at the clinic, in which task I was also greatly assisted by voluntary help given by the Junior League, the Daughters of the Empire, and many nurses, whose husbands were in the Forces, offered gratuitously their services. Dr. J. J. MacRitchie and Dr. G. G. Simms, as well as nurses from the Provincial Health Department, also assisted at these clinics. In all, some 14,378 people passed through the clinic and of these 10,198 finished their immunization or were found with a primary negative Schick test. One of our biggest problems was to get people back to the clinic at the proper time, and even with considerable daily newspaper advertising and numerous news notes, we found the following:

TABLE I.  
DELINQUENCY AT DIFFERENT STAGES OF IMMUNIZATION

	<i>Male</i>	<i>Female</i>	<i>Total</i>
Schicks not read . . . . .	5.4	6.2	5.8
First toxoid only . . . . .	8.8	9.7	9.3
Second toxoid only . . . . .	7.7	8.0	7.9
Third toxoid only . . . . .	29.6	29.4	29.5
Percentage still positive after re-Schick . . . . .	0.7	1.7	1.2

Five and eight-tenths per cent of the total tested did not return to have their Schick test read; 9.3 per cent who were given the first toxoid did not return for their second dose; and 7.9 per cent of those given the second dose failed to return for their third; while 29.5 per cent, supposedly completely immunized, failed to return for re-Schicking. I might point out here that in the number who have completed the program we have found that only 1.2 per cent showed a positive re-Schick after a full three-dose series was given. Thus, 98.8 per cent of those who completed the program we believe, or

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as far as we can tell, are immune to the disease.

During the winter volunteer nurses, as well as one full-time public health nurse, supplied by Dr. Grant at the clinic, attempted to follow up and get these delinquents in for completion of their tests. These figures I have just quoted are the results after this follow-up was made, showing that a greater use of field nurses is necessary in order to obtain optimum results.

#### THE EFFECT OF THE TOXOID

We had 66 cases admitted to hospital with diphtheria who had some degree of immunity, either measured by Schick test or by having received one or more doses of toxoid or antitoxin. Of these 66 some 46 had not received the required amount for complete immunization, or sufficient time had not elapsed following the third dose to develop full immunity.

Only 15 cases of diphtheria developed in persons who were supposedly immuné on the basis of previous negative Schick tests. Of these 9 cases developed in less than three months from the time the test was carried out, while the remaining 6 had been negative a year or more previously. Five cases had previously had antitoxin inside of a period of two months.

The clinical cases developing in those with only partial immunity were less severe and toxic, and none of them developed any complications.

At the present time I believe that 90 per cent of our school children are immunized, and in the hospital since March it was rare to see a child of school age as a patient. Most of our patients during this latter period were adults or pre-school children, and this picture has continued right through to the date of this paper. The whole idea that diphtheria is a disease of early childhood, in my opinion, must be discarded, as I will now attempt to show.

Table II shows cases of diphtheria and percentage distribution by age groups.

TABLE II.  
TABLE OF PERCENTAGE AGE DISTRIBUTION

<i>Ages</i>	<i>Civilian</i>	<i>Forces</i>	<i>Percentage of civilian</i>	<i>Percentage of total</i>
0 to 14	274		46.5	30.8
15 to 29	232	303	39.5	} 69.2
30 +	82		14.0	
Total	588	303	100.0	100.0

From these you can see that 274, or 46.6 per cent of the civilian patients were under 15 years of age. When one adds to the civilian total the number of cases in the Forces, who were all 18 years of age or more, a total of 891 cases, then we find that the percentage under 15 years of age is 30.8. In most of the older books on Public Health, and in fact on General Medicine, one finds that only from 20 to 25 per cent of the cases occur in this older age-group.

How then can we explain such a high number in the older population? I grant that the population of the city in the age-group has increased by reason of the influx from the country areas due to war conditions, but in turn to some extent our male population has decreased slightly owing to the men being in the Forces. These facts alone possibly do not prove that diphtheria morbidity is changing, but are definite indications which must be further studied. In comparing the incidence rate in this epidemic with the incidence rate in other centres and with the rate over the past few years here in Halifax, one finds a definite trend towards the higher age-group.

Schick tests also, in my opinion, bear out to some extent this fact. Diphtheria susceptibility measured by the Schick test was found in adult groups in different sections of both Halifax and the province to run as high as 80 per cent Schick test positive, or in other words there was little difference between the susceptibility rate amongst children and adults. Without a sufficient time to make a complete study of this, I do not wish to do anything more than hypothesize. I believe that immunization, general public health measures and better living conditions, have brought about a reduction in the last few years of the number of cases as well as the number of carriers. This, in turn, has meant that fewer people have had contact with cases and carriers and thus have not developed a natural immunity. Therefore, today the whole population shows a higher rate of susceptible people in the older age-group where previously natural immunity was found. Again a few adults who may have been immune some years ago may have lost that immunity because again of the lack of contact doses which tend to keep the antibody production rate high enough in their own systems. These arguments are to me logical, and I pass them on for your consideration.

It was because of this high rate of susceptibility in the older age-group that the Provincial Department of Health urged through the Department of Pensions and National Health that the Forces in the epidemic area be immunized, but it was not until late in March that any work was begun amongst them and we will have to wait until next winter before any value can be appraised on that campaign.

The largest number of cases developed during November, 1940, when 126 were reported in the city; December 69; January 88; February, March, April and May an average of 61; or a total for the eleven month period July 1, 1940, to June 1, 1941, of 588 cases in the civilian population; in addition to this there were 303 in the Forces. The civilian population being five times that of the Forces, one may see that on a population basis the incidence rate in the Forces was much higher than it was in the civilian population. This to me is another argu-

ment that diphtheria must be regarded today as a disease of all ages and not only of childhood.

Besides these actual cases, some 200 cases of carriers were detected and treated either in their home or hospital. The carrier rate in the civilian population, including the schools, in February was found to be about 10 per cent. In a recent check-up of school children carried out in June this rate has now dropped to less than 4 per cent.

TABLE III.  
PERCENTAGE OF CASES IN EACH AGE-GROUP  
CIVILIAN CASES

Ages	Male	Female	Total	Percentage female
0 to 14	135	139	274	50.7
15 to 29	80	152	232	65.5
30	36	46	82	56.1

In regard to sex, it is found that in the age-group 0 to 14 years of age there were 135 male and 139 female cases, or an equal distribution; whereas, from 15 to 29 years of age, exclusive of the Forces, we had 80 male and 152 female cases, and in the age-group over 30 years the distribution was again roughly even. This middle group with 152 female cases showed a large number of wives of members of the Forces, girls in domestic service, and waitresses in restaurants, whose contact with the Forces was easy to trace.

When one finds almost double the number of cases in one sex in a civilian epidemic that is normally equally divided between both sexes, some reason must be forthcoming. The incidence rate as stated before amongst the Forces was high, and it was this age-group of females, 15 to 29 years, whose contact was more intimate with the Forces than the younger and older age-groups.

A number of cases were found where the throat was only red; the patient was hoarse, and had already coughed up, or subsequently did, a large piece of membrane from the larynx. One of these patients seen by a local physician, saved the long string of membrane and asked if it were a piece of tapeworm, which it resembled very closely in colour and appearance. On laboratory examination direct smears and cultures of the Klebs-Loeffler bacillus were obtained.

In all, it was necessary to do four tracheotomies and three of the patients recovered. The fourth was only in hospital a couple of hours and died on the table while having the operation performed. One other patient died fifteen minutes after admission who might have been saved if seen earlier. In still another case in which tracheotomy was considered, in consultation with other practitioners, it was decided to wait and use only antitoxin and a croup tent, the child very suddenly developed marked dyspnoea and died in a few minutes before aid

could be summoned and after only two hours from the time of our consultation. The big lesson to be learned here is that in any case where the breathing is laboured at all, then the earlier tracheotomy is done, the better the end-result.

*Antitoxin.*—The routine of the hospital was that children on admission were given 20,000 units if membrane was present on one tonsil, and 40,000 units if present on both. Frequently the dose was increased later. The largest dose given to any child was 120,000 units. In adults the routine was 40,000 units if membrane on one tonsil; 60,000 units if on both, and 80,000 units if the membrane was also on the soft palate. Additional doses were given if necessary, depending on the condition of the patient. The largest dose given to an adult was 180,000 units. All of this was administered intramuscularly.

We had four patients who were subject to acute attacks of asthma and on investigation skin tests showed no reaction to horse serum. These were treated very conservatively, and we began with 0.5 c.c. of antitoxin and doubled this dose at half-hour intervals until the required amount was given. All cases were discharged from hospital after two negative nose and throat cultures were obtained, taken 24 hours apart.

I believe that the best results came when we gave the antitoxin in a fairly large dose to begin with and divided subsequent doses over the next day or two, as some cases developed a secondary membrane where the antitoxin was administered all in one dose. The most common complication I found was pharyngeal paralysis with the usual regurgitation of fluids through the nostrils. I would say that perhaps 5 per cent of our cases showed this distressing complication. We had six cases where we found a much larger and more general paralysis, some following their discharge from hospital. Of these, three patients died. The first was a child of six. Here the paralysis was like Landry's, gradually progressive from the limbs, until the child had respiratory failure and was kept alive in an iron lung for forty odd hours before finally dying of myocardial failure. The second, a man well in his 50's, who came back to hospital two months after his discharge and lived for eight weeks after readmission to hospital with the same progressive paralysis. Massive doses of vitamins were used but to no avail, and finally he died very suddenly of acute myocardial failure from the toxæmia of diphtheria. The third, a child of 8 years of age, returned to the Dalhousie Public Health Clinic some nine weeks after discharge from hospital with marked paralysis, was sent to the Children's Hospital immediately, and lived only three hours after admission there, dying of toxic myocarditis.

The three patients who are still living have shown some slight improvement, but one of these, a man well in his 30's, is a complete invalid, cannot walk nor feed himself, and has double

vision from a squint which so far has not yielded to correction by glasses.

Heart complications were found in a number. In fact, all of the deaths, 22 in number, I believe were due to definite myocardial failure. Occasionally these cases developed a marked bradycardia and in one case the pulse rate dropped to 20. In others a marked irregularity in both rate and rhythm of the pulse was found along with lowered blood pressure, some with a systolic pressure below 100. Aminophylline and coramine were used in treatment of these cases. The former, as a heart stimulant, definitely increases the rate, and the well known coramine, subcutaneously or orally, aided a soft and irregular pulse.

Some of these cases required prolonged bed-rest, and one patient was in hospital for over 70 days and is still confined to her home, even after three months; this was a young girl in her early twenties who was previously of an active athletic type.

Serum reactions were rare, and our routine of giving adrenalin along with the antitoxin may have had some bearing on this. We did not have a single immediate reaction, and the reactions which were found were mostly of an urticarial nature, some with fever coming from the 8th to the 12th day. Calamine lotion and soda applications were of some value in relieving the itchiness.

The average stay in hospital was about two weeks. However, some cases continued as carriers. Here it was found necessary to do a tonsillectomy in order to get a clean throat. Some ten of these were done. In others argyrol, 20 per cent drops in the nostrils, and the throat painted with 50 per cent tincture of metaphen and glycerine was the treatment used twice daily, but a treatment was not given at least twelve hours before taking a swab for examination.

Twenty-two deaths occurred and these were principally found in the youngest age-groups—8 in the group 0 to 4, 7 in the group 5 to 9, and 7 over 10 years of age. It is, therefore, seen that our highest mortality occurs in children, but the highest morbidity is in the older groups.

In conclusion I would stress that toxoiding will control diphtheria, but the adults as well as children must be protected, especially during an epidemic.

I regret that time does not permit me to comment on our experience with scarlet fever of which we had some 576 cases; or on cerebrospinal meningitis where some 97 cases developed during the same 11 months' period. There were many interesting points in regard to both diagnosis and treatment which I hope I may be able to review for publication at some future date.

## Men and Books

### HISTORY OF FRACTURES IN CANADA\*

By J. H. COUCH, M.A., F.R.C.S.

*Toronto*

Whenever the history of medicine is mentioned there is a tendency for the mind of the listener to conjure up a picture of ancient Greece and Rome. This is, no doubt, due to our pernicious habit of looking to the old world for the foundations of nearly all our culture. We might, however, with some advantage, direct attention to Canada's early medical history.

Of all the records to be found in Canada's archives dealing with phases of civilization with respect to evolution, culture, economics, politics and militarism, the history of medicine is probably the least complete of all, and some of the data presented were gathered from personal conversations and communications. The physical components in the structure of bones, however, are such that they have survived the ravages of time and are available for study and historical anno-

tations. We shall, therefore, present briefly a discussion based on a study of the history of fractures in Canada.

The energy of the Mound Builders is attested by hundreds of mounds over this continent, but they have left us scanty information with regard to their surgical practices because they were here so long ago. Even the bones have decayed and crumble as soon as they are exposed. Any well preserved skeletons found in the mounds are usually near the top of the earthen works and are the skeletons of Indians buried many thousands of years later.

Eskimos of today, however, represent roughly the same cultural level, and in a personal communication Dr. D. Jenness, of the National Geological Survey, who conducted an extensive survey of the life and customs of the Eskimos, suggests that they had no knowledge of medicine at all and very little of surgery. They know only one cause for all illness or accident and that is the machinations of active evil spirits. But they at least introduce some element of spiritual and religious feeling into their care of the sick. Broken limbs are splinted. Aksiatak suffered a dislocation at the ankle. He pulled it back into position and put on a long deerskin sock with a splint at the sides and one at the back. These

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From the Department of Surgery, University of Toronto.