

Pathology of the Holocaust

Prof. Ludwik Fleck

Investigation of epidemic typhus in the Ghetto of Lwów in 1941-1942.

(Translated in 1959 from Polish to Hebrew by Prof. Marcus Klingberg)

The first cases of epidemic typhus appeared in the Jewish quarter of Lemberg (Lwów, Lviv) at the beginning of winter 1941-1942, with the returnees from work camps. The sanitary conditions in the quarter were horrendous. The living spaces were filled beyond imaginable capacity and in each room lived more than ten persons. The possibilities for simple washing, a bath or underwear cleaning were very restricted. In addition there was hunger and more and more we saw cases with hunger edema. Therefore it is no wonder that under those conditions the spread of typhus was very quick.

At this time I worked in the Jewish hospital on Kuszewicz Street as head of the chemo-bacteriological laboratory of the hospital that was situated in the building that formerly served as a high school and was modified provisionally for its new role. Its organizer and director was Dr. Izidor Kurtzrock. The medical staff included among others, Prof. Dr. Beck—gynecologist, Dr. Zaghauser—internal medicine (now Professor in Lublin), Dr. Landsberg—internal medicine (later Professor in Lodz), Dr. Ungar (now in England). Dr. Drucker—surgery, Dr. Kessler—surgery, both murdered by the Germans, Dr. Begleiter—neurologist, and Dr. Zion—ophthalmologist, the last two died in the quarter. At the hospital were two wards for infectious diseases, each in another building. One was at Kuszewicz street and the other at Zamarstinowska street. The director of the other one was Dr. Edward Elster, who was murdered later at the Belzec camp.

In order to isolate the epidemic typhus patients effectively, an early diagnosis was imperative. The Weil-Felix-reaction usually gives positive results only on the sixth or the seventh day of the illness, sometimes even later, and only in very rare cases earlier. Antibodies against *Rickettsia* and complement fixation with a *Rickettsia*-antigen appear earlier, but we could not get the specific antigen. Under these circumstances, in the first months of 1942, I started to analyze the urine of patients with epidemic typhus with the aim to find out if in their urine we can find, as in the

case of patients with pneumonia, specific antigens. It was likely that release of this material, if it appears at all, will be found before the antibodies appear. Therefore, a diagnostic test grounded on such a basis must offer earlier results than the Weil-Felix reaction or the fixation of complement with *Rickettsia*.

In the hospital laboratory except of me worked: Dr. Bernard Umszewicz, a biochemist, the assistant of Prof. Jakob Parnas from Lwów, Dr. Olga Elster of Lwów, and Dr. Anhalt from Warsaw. Later Dr. Landsmann from Łódź worked with us also. Afterwards he succeeded to move to Warsaw, where he joined Prof. Hirschfeld. In the last stage Dr. Zeimann a chemist and her husband, J. Zeimann, joined us.

Already the first trials done on the urine of the patients and a serum with high titer of antibodies with the Weil-Felix reaction have shown a distinctive ring of sediment. In order to be sure that we are dealing with a specific antigen, I injected rabbits intravenously with sterilized urine from patients in a volume of 10 ml. The serum of rabbits that before the injection did not agglutinate *Proteus* OX-19 in a solution of 1:10, produced after seven days a titer of 1:320. I also established that there exists an agglutination that I prepared from Weigl's vaccine. On the bases of these results, I decided to investigate the problem systematically. I aimed, in addition to the diagnostic test also to use the urine as a source for a specific antigen for production of an epidemic typhus vaccine that we lacked so much.

In May 1942 the investigations reached a stage that I announced the results at a staff meeting of the hospital and in the daily press, (the Jewish newspaper of 27.5.1942), and I sent also information of my results to Prof. Groer in Lwów and to Prof. Hirschfeld in Warsaw.

The initial technique based on direct precipitation gave caprice results: sometimes urine obtained from positive cases did not agglutinate and even sometimes we got unspecific sediments with urine of healthy persons. Because of that we have developed a system of concentrating antigen in urine and purifying it from contaminants. This method was based on concentrating the sample to a tenth of the volume in a vacuum and at a temperature of 40 degrees Celsius, followed by dialysis of the concentrate. In laboratories equipped with standard equipment this technique is very simple – but under the improvised conditions in the ghetto laboratory it was not simple at all. An oil pump we got almost in a miraculous way in the „town“, a dialysis machine was produced purely by improvisation and was operated by turning a

waterwheel made by hand jigsaw that ran by the force of an open water faucet. Still, it functioned without a hitch.

Special difficulty was caused by continuous „actions“ by the Germans that were abducting people on the town's streets, emptying houses and also bothering hospitals. As a result of those „actions“ the sick were hijacked, taken outside the town and eliminated. My colleagues in my workplace were very often missing for several days and sometimes for ever, and the work was being suspended.

But the new method gave good results: the controls, prepared from the urine of the healthy, stopped giving positive results, while the urine tests of the sick reproducibly gave positive results. We were able to confirm that the antigen is being released in the first days of the illness and its amount is in direct relation to the seriousness of the illness. In the second week, there was a lower amount of antigen detected, and afterwards it disappeared completely from the urine.

This gave rise to another question: is this specific antigen released also in the incubation period of the disease? We distributed sterilized bottles among persons living in the vicinity of proven sick people with epidemic typhus, and we kept their samples in a refrigerator. If somebody of those people suddenly got sick we had a whole series of their urine samples from the days before the infection. Those were checked for presence of the specific antigen. It was proven that in many cases we could in the last days of the incubation period find the presence of the *Rickettsia* antigen in the urine of persons seemingly entirely healthy. In the two last days of the incubation period this was a usual phenomenon, but sometimes, it was already present four days before the onset of fever. Because such results seemed paradoxical to us, in addition to the sediment test, we also performed several control tests on rabbits. It was clearly shown that the rabbits, which were injected intravenously with concentrated dialysate of sterilized urine from the last days of incubation, produced antibodies against *Proteus* OX-19 as well as against *Rickettsia prowazekii*. Therefore, we could assume that an infected body, at least in some cases, excretes already in the incubation period substances that originate from the *Rickettsia*.

At this stage of our study, we checked if it is possible to immunize, with the help of the excreted antibodies from the urine of guinea pigs, those infected. These trials gave positive results: guinea pigs which were immunized did not react to injections of blood from infected patients. On the other hand, control rabbits who were not immunized, responded with the typical temperature graph. On the basis of these

results, we decided to start to produce a vaccine from the urine. Of course, we had to overcome many organizational and technical problems.

First of all we had to decide, where to manufacture the vaccine in the amount of about 50-100 liter of urine processed per day. This was the daily amount that at that time we could collect in our hospitals. Obviously, this could not be done at the small hospital laboratory, in which the experimental equipment could hold 1 liter.

Not far from the Jewish quarter of Lwów the pharmaceutical factory „Laokoon“ was situated that until the war was owned by Jews and at that time was in the hands of the German Dr. Schwanenberg. We contacted this German by promising him to hand over the patent of producing the vaccine without any financial compensation on the condition that he will allow us to produce it in ‚his‘ factory. The German consented. We sent a request to the patent office without mentioning at all our names, and Dr. Schwanenberg appeared as the patent applicant. He contacted the Gestapo that was responsible for Jews and their work, and as a result, I was ordered to appear together with Dr. Kurtzrock in the Gestapo building in Placzinska Street. This route was much more dangerous than the typhus: only seldom returned a Jew from it alive. We went there with the protocols and graphs and examples of our experiments. We were investigated by professionals in uniform in the presence of the Gestapo. They asked, compared our answers, checked repeatedly, and as a matter of fact, shouted at us and threatened us. Some questions were exemplary for their intelligence. For example, we were asked whether such a vaccine made from urine could be efficient also for Aryans. „Of course, but it must be produced from the urine of Aryans and not from Jews“. Finally, they decided to send the samples to Prof. Otto in Frankfurt a/M. When we left the room, we were not sure that we would be able to leave the building. The mode of preparation and the samples were already in their hands; hence, we were no longer needed, even if the vaccine was of importance to them. At the end, they let us out, and outside the gate there was only the daily usual danger.

Afterwards, a delegation of several persons headed by Prof. Kudicke arrived in the Jewish hospital. They looked how we are producing the vaccine, and they ordered to show them the reactions and left. After the Gestapo put us under the guard of a sergeant, Dr. Kurtzrock immediately came with him to a mutual understanding. The patients that were our urine donors got the title of „urine-donors“ and because of that were exempted from the immediate danger of extermination. Our workers got special

documents: „Employed for preparation of a vaccine against typhus“, and that at least gave an atmosphere of security.

The urine was collected in the two hospitals for infectious diseases that were situated in the Jewish quarter. We arranged suitable tin containers that were easy to sterilize. Into those the patients donated their urine, also into sterilized bottles that were exchanged twice daily. The urine we transferred into large bottles of 50 lt. They were preserved with chloroform and kept in a refrigerator. Each day we handed over 2-3 such bottles to „Laokoon“. There was excellent equipment for concentration and dialysis, and besides that, also well equipped laboratories, where we could check various ways for adsorbing the antigen, for example with benzoic acid, aluminum hydroxide, uric acid etc. And also different ways for aluzia of Adsorbethine (?). There were also experimental animals available that we used to check the efficiency of our vaccine.

The most successful were the preparations K14 and K20, which I had described in 1946 in the Polish Weekly Medical Journal No. 21. On prescription, we prepared a large quantity of vaccine from K14 for immunization of people. With this vaccine, I experimented by immunizing myself and my family. After that Dr. Elster immunized 32 volunteers. The immunization consisted of three subcutaneous injections of 0.5, 1.0 and 2.0 ml in intervals of three days between each injection. The local reaction was a bit painful; however, a general reaction did not appear. After the immunization appeared antibodies against *Rickettsia* and against *Proteus* OX-19.

After that we immunized every inhabitant of the quarter that contacted us.* The Germans allowed immunizing the miserable inhabitants of the camp on Janowska Street. Dr. Kurtzrock succeeded to organize a small hospital in this camp, where it was possible to cure patients. In this hospital Dr. Kurtzrock was later killed, already after I and my assistants were sent to Oswiecim (Auschwitz).

We could not follow the results of the immunizations. The population of the camp and of the quarter was constantly forced to relocate, some were exterminated and some succeeded to flee. The list of the immunized people was lost. I only know that a large number of those who were immunized did not get ill in the camp, in spite of the fact that for months they lived in an epidemic environment and under very bad conditions: People who were not vaccinated usually became sick already in the first month after their arrival. I witnessed several latent cases of illness among the immunized. I and my son were infected at the Oswiecim Concentration Camp in March 1943, i.e. seven

months after immunization. Both of us were sick for seven days, and the rash was visible. In spite of it, I could do physical work during this time, and my son was sick for only a few days. Therefore, we can say that the course of the illness was very mild.

We may assume that our vaccine, similar to other vaccines against epidemic typhus, is only of relative efficiency. Theoretically, our vaccine is better than the others, for it was prepared from the antigen directly from sick people during an epidemic.

The results of our investigation on epidemic typhus were later confirmed several times by others. L. Hirschfeld and T. Epstein realized the connection with the urine almost simultaneously with us. Although they have thought that it originates with the excretion of anti-*Proteus* antibodies, in agreement with the established idea of a transformation of *Rickettsia* to *Proteus*. In September 1942, Alberto P. Leon in Mexico published his observations on the appearance of antigen in the urine of typhus patients. His technique was based on adsorption of the antigen from urine to colloidal cells and agglutination of those in the serum of recovering patients. Finally in 1950 two Australian scientists I. L. O'Connor and J. M. MacDonald published their findings: they were using the technique of hemo-agglutination. They are quoting my work and confirming the findings concerning the excretion of specific antigen in the urine of infected patients by Eastern Asia typhus (*Rickettsia tsutsugamushi*). Those are the principal points. They also assume that it is possible to make the diagnosis within the incubation period, because the quantity of the excreted antigen is so high that its presence in the first days of the illness seems to be almost sure, and thus, also in the last days of the incubation period the antigen is possibly present. The future will show if the possibility of making a specific diagnosis from urine can be utilized also in other infectious diseases.

Literature:

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* Stefan Szende describes the event as following (Stefan Szende, *Der letzte Jude aus Polen*, Europa Press, Zurich and New York 1945, p. 215): «A Jewish doctor whose name was Fleck succeeded then to produce a new vaccine against epidemic typhus. German doctors too were experimenting with the production of new vaccines. Although it was forbidden for Jews to obtain vaccines, the Gestapo was offering Jews from the Labor camps with the purpose to be used in experiments by German doctors. Meanwhile, Dr. Fleck prepared the vaccine under deadly peril and immunized so many Jews as he could. When this became known to the German authorities, they arrested Dr. Fleck and his assistants. They forced the inmates to teach a number of German doctors how to produce the vaccine, and afterwards the inventors of the new vaccine disappeared from the town. There is no doubt that they were murdered. The Germans used now the Jewish invention and it was forbidden under the pain of death to prepare the vaccine in the Ghetto.»

As you can see, there is an exaggeration in this story. The truth is that Dr. Schwanenberg insisted that I include in the production of the vaccine Dr. Miller from Berlin. But the German was a so bad student, or I was a bad teacher. In any case, after a short time, I, my family, Dr. Umszewicz with his family, Dr. Zeimann with his family and the technician A. Abramowicz were arrested and sent to Oswiecim.