FROM MARTINA HANSENS HOSPITAL, BÆRUM
CHIEF SURGEON: J. HALD, M.D.

EXAMINATION OF pH IN TUBERCULOUS PUS

By

HANS K. DAHL, M.D.

It has been stated in a number of textbooks that tuberculous pus is acid. In a survey of the accessible literature of the last 20-30 years, one finds that few investigations of the degree of the acidity in tuberculous pus have been made. Schade and Claussen (1) found, during an examination in 1925, that pH in tuberculous abscesses lay between 7.02 and 7.21. The method used is not mentioned.

Koldajew and Kutzenok (2) found by means of colorimeter measurement in 1948 that pH in tuberculous pus from patients with bone and joint tuberculosis lay between 6.8 and 7.2; and found too, in agreement with Schade and Claussen, that pH decreases, when there is mixed infection at the same time.

By potentiometer measurement with glass electrodes, Streeten has more recently determined the pH-value in a number of inflammatory exudates from tuberculous processes; and he states that the pH-value is dependent upon the degree of acuteness of the inflammation. In tuberculous empyema, pericardial exudates, and arthritis, he found that the pH was below 7.0 but in isolated cases, of the more chronic type, found values of 7.9-8.1 (personal report).

By means of colorimeter measurements of pH in a number of abscesses and joint punctates from tuberculous lesions Thrap-Meyer has found pH from 7.0 to 7.3, and he also states that the pH falls to a lower degree when mixed infection is present, (personal report).

Waksman (3) states that streptomycin activity is dependent on the pH in the area where the streptomycin is to be effective, and that the optimal activity lies at pH 7.8, and that the activity rapidly decreases when the pH falls below 7.0.

As a result of his investigations, Streeten, (4) now injects an alkaline along with streptomycin in local treatment of tuberculous athritis, in order to get the optimal pH-area.

PERSONAL EXAMINATIONS

pH was calculated by means of abscess punctates from 25 patients with bone and joint tuberculosis.

Of these 25 patients, 11 were women and 14 were men. Their ages were as follows:

10-19 years: 4 patients, 20-29 years: 9 patients, 30-39 years: 9 patients, more than 40 years: 3 patients.

Diagnosis of the 25 patients was as follows:

Tbc. vertebrae	18	patients
Tbc. artic. coxae	2	„
Tbc. artic. iliosacr.	2	„
Tbc. artic. humero-scap.	1	„
Tbc. artic. talocrural	1	„
Tbc. abscessus reg. glutealis	1	„

In 22 of these patients the diagnosis was verified with the proof of mycobacterium tuberculosis, and in all of them this was found to be of typus humanus. In the 3 other patients, the course of their illness, the appearance of other metastasis, and the clinical and roentgenological signs were so typical, that one can almost with certainty count their disease as having a tuberculous etiology.

None of the patients has shown clinical symptoms of mixed infection, and none of the patients has had sinuses.

METHOD

In determining pH, the glass electrode method was used, as it is far superior to other methods in measuring liquids of so turbid a character as tuberculous pus. Besides, the measurements are independent of the subjective estimate, which is an uncertain element with the colorimeter method in determining pH.

An ordinary glass electrode was used as a measuring electrode, and as reference electrode, a saturated KCl-electrode. The apparatus was kindly lent by the Physiological Institute of the University in Oslo.

In the investigation, the abscesses were punctured under local anesthesia, according to the usual methods for the puncture of tuberculous abscesses. As soon as the pus was aspirated, it was transferred to a sterile measuring glass and the pH measurement was made. The temperature was taken at the same time as the measurement, and the values found were corrected to 20° C, according to the table given by Dole (5).

RESULTS

A series of measurements was made, to determine if any change in the pus occurred if it was left standing, but when the pus was put in a closed glass syringe no distinct difference was found in the measurements taken after 6 and 24 hours. By standing the pus became viscous and less delicate to work with when therefore the measurements were made immediately after the aspiration. The results are shown in the table below:

pH 20° C:	7,05	7,10	7,15	7,20	7,25	7,30	7,35	7,45	7,50	7,65	7,80
No. of tests:	1	1	4	12	11	5	2	2	1	1	1

It is apparent from the table above that pH in tuberculous abscesses for 33 of the 41 tests has about the same values as one finds in the blood; the values ordinarily given in textbooks are pH 7.2 to 7.5.

In the same patient the changes in the pH in the same abscess were rather small from one time to the other.

Really acid pus was only found in one patient. This was a 35 year old man. He had had different tuberculous metastases since 1936, and in the last 12 years he had shown symptoms of thoracispinal spondylitis, determined by roentgenography in 1944. In January 1949, spondylitis of the lumbar spine was observed. In February 1950, there was acute intensification of the disease, with increasing SR, increased temperature, which has since remained as a febris continua around 39° C. At the same time there was greatly increased pus production in the abscesses. Upon puncture great quantities of pus with a characteristic feculent odour were aspirated at short intervals. In numerous investigations of mixed infection no growth was found either on aerobe or anaerobe media. In the several measurements made with this patient, pH 6.50-6.60 was found in pus from his abscesses.

These findings may prove Streeten's statement that the pH is dependent upon the degree of acuteness of the inflammation.

CONCLUSION

This examination shows that pH in closed tuberculous abscesses has about the same value as that found in the blood, and that tuberculous pus can hardly be said to be acid. Streeten's use of an alkaline along with streptomycin in the local treatment of tuberculous disease, seems theoretically to be quite rational, as the pH lies somewhat

below the values in which streptomycin has its greatest effect, but his statements need more clinical observations.

The values which have been found in this examination are somewhat higher than those found by others earlier. The difference may be due to the method, since one may count upon surer results with the method used in this examination. The difference may also be laid to the possibility that the earlier investigators have included a greater number of tuberculous bone and joint cases, running a more acute course. There is also the possibility that the tuberculous disease occasioned by the human type and the bovine type, may appear somewhat different from a biochemical point of view. Thus, Thjötta (6) states that the bovine type of tubercle bacilli grows best in media with pH from 5.8-6.9, while the human type grows best with pH from 7.4-7.8. Neither Schade and Claussen, nor Kutzenok and Koldajew, nor Streeten report which type of tubercle bacilli they have found in their patients.

SUMMARY

Very few examinations of pH in tuberculous pus are to be found in medical literature, but it has been affirmed in many textbooks that tuberculous pus is acid. The most important investigations are reviewed.

pH in the abscess punctates of 25 patients with bone and joint tuberculosis was examined. pH was determined by the potentiometer with glass electrodes.

pH in tuberculous abscesses was found to show about the same values as are found in the blood—from 7.2 to 7.5. Only in one patient with acute detoriating spondylitis, was acid pus actually found, pH 6.5 to 6.6.

The conclusion is that tuberculous pus cannot be said to be acid. The values found are somewhat higher than those given by earlier investigators. The causes of the difference between earlier results and those found by the author are discussed.

RESUME

La littérature ne donne que très peu de compte rendu de recherches sur le pH du pus tuberculeux, mais on prétend dans une série de manuels que le pus tuberculeux est acide.

On a examiné le pH de ponctions d'abcès chez 25 malades atteints

de tuberculose osseuse ou articulaire. Le pH est détermine potensiométriquement au moyen d'un électrode en verre.

Dans l'ensemble, on trouve dans le pH du pus tuberculeux les mêmes valeurs que dans le sang, pH 7,2 à 7,5; chez un malade seulement avec aggravation aiguë d'une spondylite tuberculeuse, on a trouvé du pus véritablement acide, pH 6,5—6,6.

Il faut en tirer la conclusion qu'on ne peut pas considérer le pus tuberculeux comme étant acide. Les valeurs obtenues sont un peu plus élevées que celles indiquées dans les recherches antérieures. Les raisons de la divergence entre les résultats antérieurs et ceux auxquels est arrivé l'auteur sont discutés.

ZUSAMMENFASSUNG

In der Litteratur findet man nur wenige Untersuchungen über pH im tuberkulösen Eiter, aber in einer Reihe von Lehrbüchern wird behauptet das der tuberkulöse Eiter sauer reagiert.

Die wichtigsten Untersuchungen werden besprochen.

Man untersuchte pH in Abszesspunktaten von 25 Patienten mit Knochen und Gelenktuberculose. pH wurde potentiometrisch mit der Glasselektrode bestimmt.

Man findet, dass pH im tuberkulösen Eiter im allgemeinen die gleichen Werte wie im Blute zeigt, von pH 7,2—7,5. Nur bei einem Patienten mit einer akuten Verschlechterung einer tuberkulösen Spondylitis fandt man wirklich saure Reaktion im Eiter, nähmlich pH 6,5—6,6.

Die Schlussfolgerung ist daher, dass man den tuberkulösen Eiter nicht als sauer reagierend bezeichnen kann. Die gefundenen Werte sind etwas höher als die von früheren Untersuchungen angegebenen.

Die Ursachen der Verschiedenheit zwischen den früheren Resultaten und den Resultaten des Verfassers werden diskutiert.

LITERATURE

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