

AN EXPLANATION FOR CHLORACNE—AN INDUSTRIAL HAZARD

W. J. Cunliffe, M. Williams, J. C. Edwards, S. Williams, K. T. Holland, C. D. Roberts, R. L. Holmes, D. Williamson and W. C. Palmer

From the Departments of Dermatology, The General Infirmary, Leeds, Leeds (St. James's) University Hospital, Pontefract General Infirmary, and the Departments of Microbiology and Anatomy School of Medicine, University of Leeds, England

Abstract. Patients with chloracne were investigated and the results compared with data matched for age and site from patients with acne vulgaris. The ultrastructural appearances of pilo-sebaceous ducts in both groups were similar. The industrial group had significantly fewer *C. acnes* than the patients with ordinary acne. They also showed a significant increase in the surface lipid percentage composition of squalene, wax ester and cholesterol and this was associated with a significant decrease in the triglyceride free fatty acids and total triglyceride pool. We suggest that the acnegenic agent has produced its effect by modifying the metabolism of the pilo-sebaceous gland.

Key words: Chloracne; Comedogenic; Squalene; Metabolism; *Corynebacterium acnes*; Keratin

Chloracne is a well recognised (2) but little understood clinical entity. Recently, there was an outbreak in Yorkshire and the opportunity was taken of investigating these patients in the hope that some light would be shed on its pathogenesis, and that this in turn might help in the understanding of acne vulgaris.

MATERIALS AND METHODS

Twelve male patients were investigated (mean age 28.2 ± 2.2 yrs). All worked in a large chemical factory in the West Riding of Yorkshire; their precise clinical details will be reported elsewhere (11). The patients were exposed to a chlorinated hydrocarbon for a period of about 12 months; we investigated them some 11 months after they had theoretically been withdrawn from the polluted environment. Nevertheless, the patients were continuing to develop fresh crops of lesions consisting almost exclusively of facial blackheads (Fig. 1).

The investigations performed were:

1. *Electron microscopic examination.* Samples of pilo-sebaceous keratin were obtained by the surface biopsy technique of Marks & Dawber (9) using cyanoacrylate gel and were fixed by immersion in buffered glutaraldehyde. Individual hairs and pilo-sebaceous keratin were then picked off, post-fixed with osmium tetroxide, embedded in Araldite

and aligned longitudinally, several to a block. Thin transverse sections were examined with the electron microscope.

2. *Microbiological examination.* Surface micro-organisms were collected from a standard 1 cm² site using a sterile moistened swab which was then transferred to 5 ml nutrient broth. The organisms were dispersed using a rotamixer. This method samples no more than 20% of the bacteria and a correction factor was applied to allow for this in calculating the results (5). The pilo-sebaceous ducts were sampled using a method which collects material specifically from that site (4). The organisms were cultured using standard media.

3. *Surface lipid composition.* The lipids were collected with an ether-soaked sponge and analysed by thin-layer chromatography (1).

We compared our data with results obtained from a group of acne vulgaris patients matched for age, sex and site of sampling.

RESULTS

The ultrastructure of the pilo-sebaceous keratin was similar in patients with industrial and ordinary acne. The samples consisted of lamellae of keratin surrounding the central hair or hairs, a variable amount of amorphous material intervening between the two. A striking feature was the presence of irregularly-shaped vacuoles, of variable size up to about 10 μ m in diameter, within the keratin lamellae (Fig. 2). The vacuoles appeared to increase in size from the periphery towards the centre and may have contained a lipid substance which had dissolved out during the processing.

There were significantly more *Corynebacterium acnes* (*C. acnes*) than *Micrococcaceae* in both types of acne as compared with normal subjects, but significantly fewer *C. acnes* were isolated from patients with industrial acne than from those with ordinary acne (Fig. 3).



Fig. 1. The predominance of many blackheads.

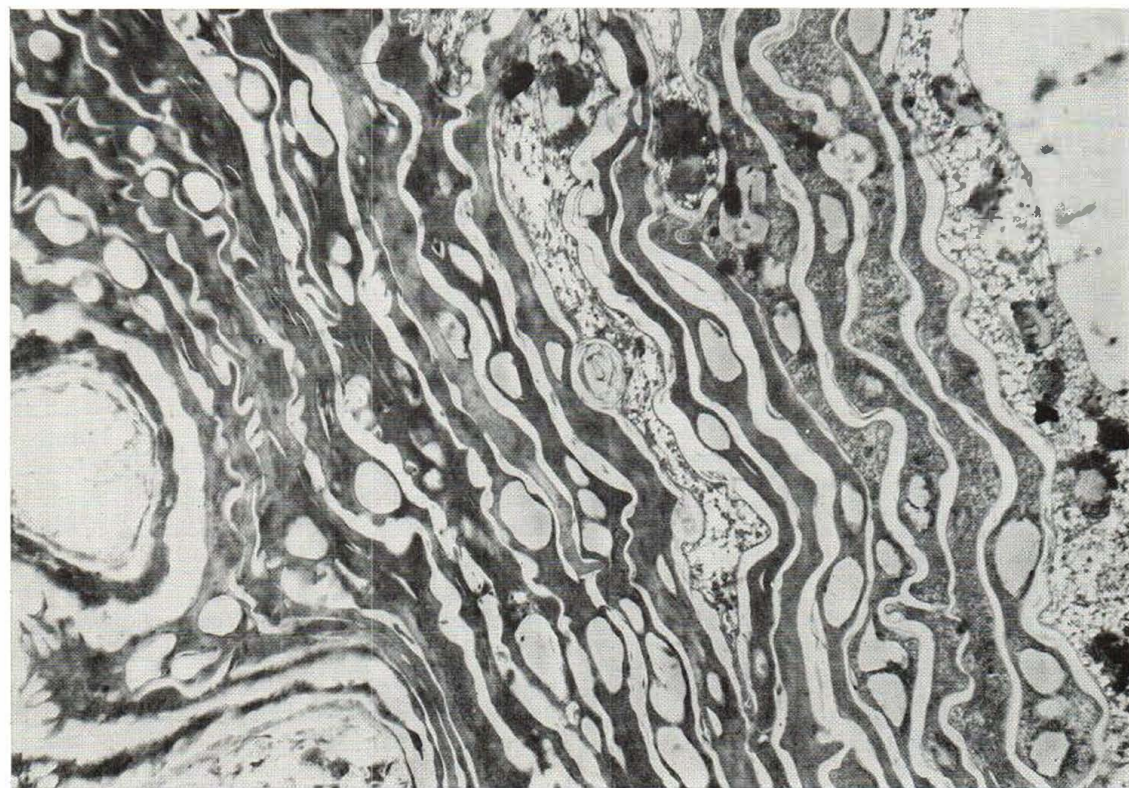
Thin-layer analysis of the surface lipid demonstrated some striking differences. There was a significant increase in the percentage of squalene, wax ester and cholesterol in patients with industrial acne (Fig. 4) compared with those with acne vulgaris and a significant decrease in the free fatty acids, triglycerides and total triglyceride pool (Fig. 4).

DISCUSSION

Jenson et al. (6) found a decrease in sebum excretion rate in patients with chloracne, yet there has been comparatively little laboratory investigation in these patients.

In our investigations the ultrastructural appearance of keratin from patients with industrial acne was the same as that seen in acne vulgaris and in agreement with the findings of Knudson (8) suggesting that the function of the keratin is similar in both clinical situations.

Fig. 2. Electron micrograph of keratin lamellae from the pilo-sebaceous duct ($\times 9\,560$). Note the apparently empty (? lipid) vacuoles within the lamellae.



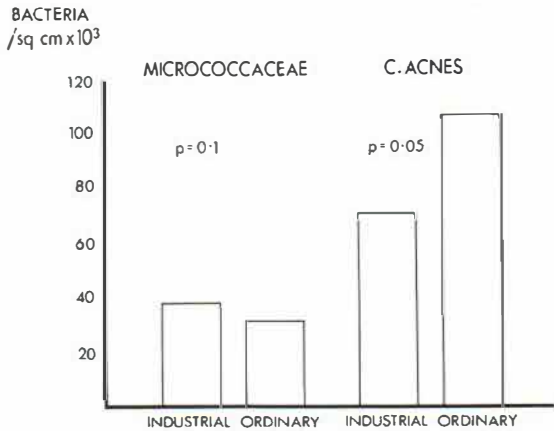


Fig. 3. The total number of *Micrococcaceae* and *C. acnes*.

Cholesterol is predominantly, if not entirely, keratinous in origin (3) and therefore the finding of many more comedones (which are predominantly keratinised structures) in the chloracne group could

explain the raised cholesterol. We are not certain why there are fewer *C. acnes* in patients with industrial acne; though this possibly could be explained by the age of the comedones. There is no information in the literature on the rate of epidermal turnover of comedones in patients with industrial acne but there is evidence that the number of bacteria isolated decreases with increasing age of the comedone (10). Since bacteria are the chief source of lipases within the pilo-sebaceous duct, the finding of fewer *C. acnes* in the industrial group explains the smaller proportion of free fatty acids. We were surprised, however, to find a significant reduction in the proportion of triglyceride; triglycerides are the substrate from which free fatty acids are formed and we might have expected a significantly increased triglyceride such as is found following treatment of acne with oral tetracycline (4). This decrease in the total triglyceride pool together with the significant increase in squalene and wax ester content may

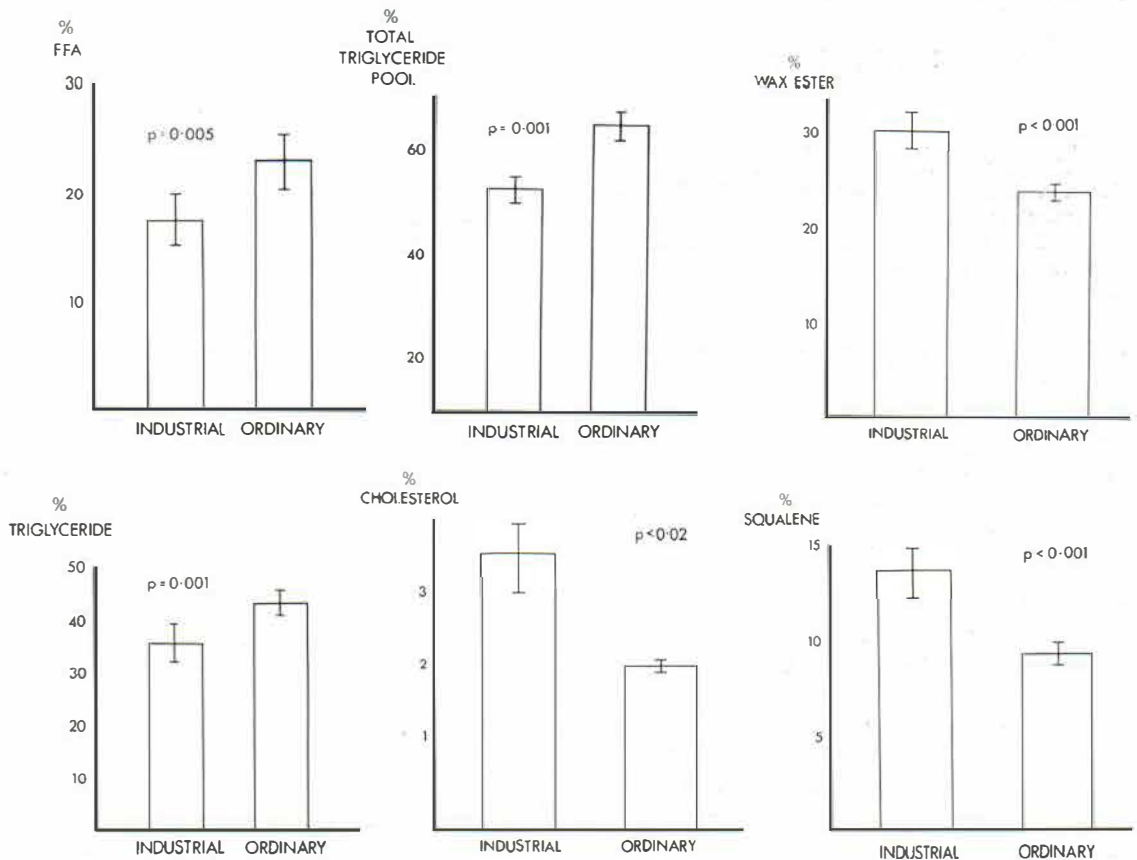


Fig. 4. The surface lipid percentage composition.

indicate a direct effect of the industrial agent on the metabolism of the pilo-sebaceous unit.

The predominance of comedones, together with the increased squalene and wax ester content found in these patients, supports the observations of Kligman et al. (7) that in high concentrations squalene and wax ester are comedogenic.

Although the acnegenic agent had been removed from the environment, it is possible that traces still persisted, although no new cases have been seen since this action was taken. We therefore suggest that the acnegenic agent has probably modified the metabolism of the pilo-sebaceous unit and this in turn explains the clinical appearance of blackheads in these patients with chloracne.

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W. J. Cunliffe, M.D.
Department of Dermatology
The General Infirmary
Great George Street
Leeds 1
England