Physiology, Pathophysiology, and Anthropology/Epidemiology of Human Earcanal Secretions

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Abstract

Two types of glands are found in the outer third of the human earcanal: sebaceous glands that produce sebum and modified apocrine glands that produce apocrine sweat. Together, these substances make up cerumen, which serves to clean, lubricate, and, to some extent, protect the earcanal from bacteria and fungus. Excessive/impacted cerumen can cause tinnitus, vertigo, itching, pain, external otitis, and hearing loss. Two populations are known to have a high incidence of excessive/impacted cerumen: individuals with mental retardation and the elderly. Anthropologists have used cerumen type to track human migratory patterns and epidemiologists have related cerumen type to breast cancer.

Key Words: Cerumen, earcanal, earwax, external ear

Two types of secretory glands are located in the outer third of the cartilaginous portion (outer two-thirds) of the human earcanal: sebaceous glands that produce sebum (a fatty substance) and modified apocrine (ceruminous) glands that produce apocrine sweat. Together, sebum and apocrine sweat, along with desquamated epithelial cells, dust and other small foreign bodies, and shed hairs, make up cerumen or earwax, which is a waxy-type substance found in normal earcanals (Perry, 1957). Cerumen can be dichotomized into the “dry” or “rice bran” type, which is found in 78 to 87 percent of the Mongolian populations (Matsunaga, 1962) and the “wet” or “sticky” type, which is prevalent among 95 to 98 percent of Caucasians and Negroid racial types (Petrakis, 1969). The distinction between the two types of cerumen is so clear that a diagnosis can be made by simple inspection of both earcanals, provided that no pathology is present (Matsunaga, 1962).

The chemical composition of cerumen has attracted attention from several investigators for two reasons: first, to relate the chemical make-up of cerumen to cerumen type (wet or dry); the majority of the findings suggest that cerumen contains lipids, protein-free amino acids, and several minerals, all of which relate to cerumen type; second, to understand whether similarities exist between the apocrine glands located in the earcanal and those in other parts of the body, mainly the mammary glands. Both of these topics are discussed in further detail later in this paper.

The dry type of cerumen is odorless, which explains why in some Oriental countries an axillary odor accompanying earwax is thought to be pathologic, often indicating the need for medical treatment (Matsunaga, 1962). Oriental populations also have a significant tendency for under-producing cerumen, resulting in dryness of the external earcanal (Perry, 1957; Meyers, 1977). This clinical observation suggests a sparsity of sebaceous and apocrine (ceruminous) glands for this population (Perry, 1957). The lack of odor for dry-type cerumen is consistent with a reduced density of apocrine (ceruminous) glands because the odor of cerumen results primarily from secretions of these structures (Matsunaga, 1962).

Chromatographic analysis of wet and dry earwax samples has shown that cerumen type is due to differences in quantity and composition of earwax lipids. Wet and dry cerumen contains squalene, triglycerides, free fatty acids, and...
cholesterol. However, the nonlipid substances, steryl esters and wax esters, were also found in dry cerumen (Inaba et al, 1987).

When produced, the dry/rice bran cerumen type is brittle, appears "ashlike and flaky," and ranges in color from light grey to brownish grey. Wet-type cerumen is sticky and light-to-golden brown in color. However, over time, as cerumen is exposed to the air, due to oxidation and dehydration combined with bacterial activity, the color of cerumen darkens to almost becoming black for the wet/sticky type (Matsunaga, 1962; Marshall and Attia, 1983). Clinicians must be aware of the normal color variations of cerumen types when examining ear canals and have familiarity with the association between the color and consistency of cerumen and race. The decision to remove cerumen from an ear canal must be based on the conclusion from otoscopic examination that the material in the canal is, in fact, cerumen and not some other substance, such as blood or purulent material.

Cerumen type is inherited as a simple Mendelian trait, with the dry-type allele (mutational gene group) being recessive to the wet type (Bass and Jackson, 1977). The genetically based polymorphic nature of cerumen has been used to study both genetics and anthropology (Matsunaga, 1962). The genetic/anthropological relationship of cerumen with other genetically determined traits is discussed in greater detail below.

**PHYSIOLOGY**

The physiologic factors that control the sebaceous glands in the ear canal are not fully known. However, the function of the modified apocrine (ceruminous) sweat glands has been well established. Perry (1957) studied cerumen production by direct visualization of the skin of the distal portion of the external auditory canal in 150 subjects. He found that smooth muscle stimulants (pitocin), adrenergic drugs (epinephrine and norepinephrine), and the emotional states of anxiety, fear, and pain resulted in an increased production of apocrine sweat. In addition, rubbing or cleaning the canal wall resulted in a mechanical "milking" of the ceruminous glands. In some cases, vigorous chewing caused distortions of the ear canal that caused the same milking effect.

The functions of cerumen are to clean and lubricate the ear canal. In addition, literature reports that cerumen protects the ear canal from bacteria, fungus, and insects (Adams et al, 1978; Caruso and Meyerhoff, 1980; Hawke, 1987). Cleaning occurs as a result of epithelial migration and the action of the jaw during chewing and talking. That is, cerumen is produced in the ear canal and as it migrates toward the entrance of the canal, foreign bodies such as dirt, dust, and other small particles adhere to it and are extruded as the cerumen is cast off from the canal. Alberti (1964) studied this "conveyor belt" process by quantifying the growth, migration, and desquamation of the skin covering the tympanic membrane and deep external auditory canal in 62 human subjects. Weekly estimates of rate and migration patterns were made from dye spots placed on the ear drumhead for each subject using hand-made sketches and serial photography. Migration was found to be centrifugal from the umbo spreading to all quadrants of the tympanic membrane. Near the umbo, the rate of migration was equivalent to the rate of growth to a human fingernail. Rate of migration accelerated as the markers moved away from the umbo, with the most rapid migration taking place on the anterior wall of the external ear canal.

Jaw motion helps by loosening debris from the epithelial layer. During speech and chewing, the jaw rotates vertically and horizontally about the terminal hinge axis of the temporomandibular joint, which makes up the inferior portion of the ear canal (Edwards and Harris, 1990). Debris attached to the canal wall is dislodged in this manner.

The second function of cerumen, lubrication, occurs because the sebum produced from the sebaceous glands has a high concentration of lipids, which accounts for its hydrophobic properties and acts as a natural emollient. Harvey (1989) used chromatography to analyze lipid concentrations in wet-type human cerumen and found the major constituents to be cholesterol, squalene, and several series of long-chain fatty acids and alcohols. Bortz et al (1990) made a similar observation.

While the cleaning and lubricating functions are well understood, the antibacterial properties are not and controversy exists in this area. Some histological and histochemical studies have failed to support the antibacterial function of cerumen. For example, Creed and Negus (1926) found that freshly secreted cerumen indeed contained no bacteria, but soon became contaminated with bacteria. They concluded that the only useful protective function cerumen can serve is to prevent the entrance of dust and insects into the ear canal, acting like a type of "fly
paper.” Perry and Nicholas (1956) supported this finding by culturing the virulent organisms of Pseudomonas aeruginosa from the earcanals of 45 healthy adult volunteers and examining the effect that cerumen had on their growth. Results demonstrated that cerumen provided no inhibition of the organism tested.

Other studies have found that cerumen is effective against certain bacteria. Chai and Chai (1980) showed cerumen to provide bactericidal activity against some strains of the bacteria they tested. The viability of Haemophilus influenzae, Escherichia coli K-12, and Serratia marcescens was reduced by more than 99 percent and the viability of two Pseudomonas aeruginosa isolates (E. coli K-1, Streptococcus) and two Staphylococcus aureus isolates was reduced by 30 to 80 percent. Stone and Fulghum (1984) also showed that a suspension of cerumen in a buffered medium inhibited the growth of certain bacteria (Staph. aureus, Staph. epidermidis, Strept. pyogenes, Streptococcus sp L22, Escherichia coli, Streptococcus marcescens, Propionibacterium acnes, Corynebacterium spp.

The earcanal is a perfect milieu for growing fungus. It is warm, dark, humid, and moist. For this reason, it has been called the “greenhouse of the human body” (Hawke, 1994). One study has documented the antifungal properties of cerumen. Megarry et al (1988) showed that the growth of two species of fungi commonly encountered in otomycosis (Candida and Aspergillus) were significantly inhibited by the presence of human cerumen. The growth of fungus requires an environment with low acidity and the presence of fatty acids in cerumen may inhibit fungal growth (Osborne and Baty, 1988).

The amount of cerumen found in earcanals varies widely. Clinicians who regularly examine

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>Prevalence (%)</th>
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<tr>
<td>Children</td>
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</tr>
<tr>
<td>Roche et al (1978)</td>
<td>224</td>
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<tr>
<td>Bricco (1985)</td>
<td>349</td>
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<tr>
<td>Adults</td>
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<td>Lebensohn (1943)</td>
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<td>Perry (1957)</td>
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<td>Foltner (1984)</td>
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<td>Cooper (1985)</td>
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<td>Nudo (1965)</td>
<td>494</td>
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<td>Fulton and Griffin (1967)</td>
<td>191</td>
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<td>Brister et al (1986)</td>
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<td>Dahle and McCollister (1986)</td>
<td>18</td>
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<td>Crandell and Roesser (1993)</td>
<td>121</td>
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<td>Geriatric Population</td>
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<td>Mahoney (1987)</td>
<td>133</td>
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<tr>
<td>Lewis-Cullinan and Janken (1990)</td>
<td>226</td>
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<tr>
<td>Mahoney (1993)</td>
<td>104</td>
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\(^*\)Adapted from Roesser and Roland (1992).
\(^1\)The prevalence was age dependent, with the older subjects having a higher prevalence.
\(^2\)Thirty-four percent of the subjects were found to have impacted cerumen and an additional 23 percent had moderate-to-large amounts of cerumen for a total of 57 percent with excessive/impacted cerumen.
\(^3\)Twenty-five percent of the subjects were found to have impacted cerumen and an additional 17 percent had moderate-to-large amounts of cerumen for a total of 42 percent with excessive/impacted cerumen.
earcanals can testify that individual variation in cerumen production is evident; however, more striking are the differences observed across certain populations. Table 1 provides data from children and adults and from two special populations: individuals with mental retardation and the geriatric population. In children, two studies found the prevalence of excessive cerumen to be 10 percent (Roche et al, 1978; Bricco, 1985). Based on clinical experience, the 10 percent prevalence found in these studies appears to be high and may be due to the low number of subjects in the samples. Clinical experience would suggest that the prevalence of excessive cerumen in normal children is similar to adults and ranges from about 3 to 5 percent.

As shown in Table 1, data from seven studies found the prevalence of excessive cerumen in adults to be from 4 percent to 34 percent. Lebensohn (1943) studied the largest sample of adults. His populations were two groups of male naval personnel aged 20 to 50 years. Results showed occluding cerumen in 2.5 percent of 794 reserve midshipmen and in 7.7 percent of 3258 officers; no explanation was given for the sizable difference in the results. Methodological differences and sample size may account for some of the variability in prevalence, the rates shown in Table 1. There is a general tendency for the studies with the larger sample size to have lower prevalence rates. However, these data also suggest that there may be complex interactions accounting for excessive/impacted cerumen.

Whether excessive cerumen accumulation results from a lack of separation from the apical parts of the lining cells, indicating increased secretory activity. The results from Mandour et al suggest that excessive cerumen is due primarily to an increase in the activity of the ceruminous glands.

Robinson et al (1990) accept the finding that increased cerumen production by the ceruminous glands may account for excessive cerumen in some patients, but argue that cerumen type and variety (dry or wet and hard or soft) significantly affect the process. Robinson et al analyzed hydrated cerumen plugs taken from cerumen samples of 28 individuals having recurrent cerumen impaction in two studies. Those with wet cerumen type of the hard variety were more commonly found to have chronic and recurrent cerumen impaction. Moreover, hard cerumen plugs contained more sheets of keratin than soft cerumen plugs. From their results, they conclude that patients with chronic and recurrent cerumen impaction have a disorder of keratinocytoc separation, resulting in a failure in the breakup or separation of the individual keratinocytes that normally occurs in the superficial external auditory canal. This condition reduces the integrity of the outwardly migrating sheets of epithelium. Taken together, results from the above two studies suggest that excessive cerumen results from a complex interaction of multiple factors.

There does not appear to be a gender difference in the chemical make-up or amount of cerumen in the ear canal (Yassin et al, 1966; Mandour et al, 1974; Roche et al, 1978; Cipriani et al, 1990). However, seasonal changes and marked racial tendencies in the chemical composition and appearance of cerumen have been reported. Cipriani et al (1990) studied cerumen over a 9-month period (November–July) and found a significant decrease in triglyceride production as the seasons progressed from the winter to the summer months. These investigators suggest a relationship between seasonal diet and triglyceride levels in the ear canal and postulate a correlation between ear canal infectious pathology and triglyceride levels.

As shown in Table 1, two populations clearly have a significantly high prevalence of excessive cerumen: those with mental retardation and the geriatric population. Nudo (1965) was among the first to document that individuals with mental retardation have a propensity for excessive cerumen. In 194 individuals in a residential center for mental retardation, 178 (34%) were found to have abnormal amounts of cerumen or foreign bodies in their ear canals; of significance is that 23 percent also exhibited hearing loss. Fulton and Griffin (1967) reported that 55 of 191 subjects (28%) had impacted cerumen, with 29 of those (54%) manifesting bilateral impaction and 26 (46%) unilateral impaction. Similar observations were reported by Brister et al (1986). Comparing otoscopic results from 44 mentally retarded adolescents to a nonretarded control group matched for age and sex, Brister et al (1986) found a prevalence of 34 percent (15/44) in the subjects with retardation, with 73 percent
of those (11/15) exhibiting unilateral occlusion and 27 percent (4/15) bilateral occlusion. None of the nonretarded control subjects were found to have excessive cerumen.

The prevalence of audiologic and otologic disorders in 30 subjects with Down syndrome and an equal number of non-Down syndrome retarded children matched for chronological age and IQ was studied by Dahle and McCollister (1986). Eighty-three percent of the Down syndrome children had some observable external or middle ear abnormality compared to 59 percent for the control subjects. Impacted cerumen was found in 31 percent of the Down syndrome children and only 14 percent of the control group.

Crandell and Roesser (1993) studied longitudinal data from 117 mentally retarded adults (20–67 years of age) living in a privately owned residential center to document prevalence rates of excessive and impacted cerumen in this population. Retrospective data analysis was performed by examining annual audiologic and otoscopic records from a 12-year period. Over the 12 years, subjects were evaluated from 4 to 7 consecutive years. Results from otoscopy were categorized into (a) nonoccluded (less than 50%), (b) excessive cerumen (50–80% occlusion), and (c) impacted cerumen (greater than 80% occlusion). Of the 586 otoscopic examinations performed, 165 (28%) revealed excessive/impacted cerumen, with 56 percent of the subjects showing bilateral excessive/impacted cerumen. An important finding is that recurrence of excessive/impacted cerumen occurred in 54 percent of those with excessive cerumen on the first examination and 66 percent of those with impacted cerumen on the first examination. These findings clearly show an individual propensity for excessive cerumen production that may be anatomical or physiologic. However, the specific reasons for abnormal amounts of cerumen in the mentally retarded population are unknown. Nevertheless, it is clear that those working with mentally retarded individuals will have to make provisions for the extremely high prevalence when providing audiologic or otologic health services, and regular otoscopy and ear canal management are needed for this population.

The aging process decreases the number and activity of ceruminous glands, which results in a drier type of cerumen. Coupled with an increase in the coarseness of the hair cells in the external auditory canal, especially in males, the prevalence of excessive and impacted cerumen is high in the geriatric population (Ruby, 1986). The relationship between age and an increase in excessive/impacted cerumen was clearly demonstrated by Gleitman et al (1992). When comparing the percentage of impacted cerumen to the chronological age of 892 subjects categorized between 26 to 74 years, a linear relationship was seen. For the youngest group (26–44 years), the prevalence was 5 percent; for the 65- to 74-year-old group, the incidence was 34 percent.

Two investigators have studied the prevalence of cerumen in the elderly population. Mahoney (1987) screened 133 elderly subjects and found that 82 (34%) had impacted cerumen and an additional 56 (23%) had “moderate to large” amounts of cerumen. In a follow-up investigation of 104 nursing home residents 62 to 100 years of age, 25 to 42 percent were found to have ears with moderate-to-large amounts of impacted cerumen (Mahoney, 1993). An observation made by Mahoney that should cause concern is that 6 months after the initial identification, most of the residents identified with excessive cerumen remained unchanged because medical treatment or nursing orders to administer ceruminolytic eardrops could not be obtained. Moreover, the majority of the ear canals of those reported to have received treatment were found to be unchanged. Physicians were reluctant to perform ear irrigations personally and nurses reported that they were unable to administer ceruminolytic eardrops independently, use an otoscope, or perform ear irrigations.

Lewis-Cullinan and Janken (1990) performed otoscopic examinations on a random sample of 226 individuals 65 years or older. In addition, a four-frequency screening was administered at 40 dB HL to all subjects; when excessive cerumen was found, the screening was repeated following cerumen removal. Results showed that 35 percent of the subjects had occluding cerumen, with more having bilateral (19%) than unilateral (15%) impaction. Of the 124 ears irrigated, improved hearing sensitivity on the 40 dB screening test was found in 93 (75%) subjects. As with the mentally retarded population, the elderly will need regular ear care to prevent excessive cerumen and associated hearing loss.

**PATHOPHYSIOLOGY**

Tinnitus, vertigo, itching, pain, external otitis, and hearing loss are complications of excessive cerumen in the ear canal (DeWeese and Saunders, 1973; Adams et al, 1978; Bricco,
1985). Chronic cough has also been reported (Raman, 1986). The larynx is innervated by the vagus nerve and the auricular branch of the vagus nerve serves the posterior and inferior wall of the earcanal and concha area of the pinna. This neural connection between the earcanal and larynx also explains why reflex coughing and sometimes sneezing occur when the earcanal is manipulated during procedures such as cerumen removal.

Vagus nerve connections between the earcanal and tympanic membrane and the cardiac muscle also explain why cardiac depression has been seen during earcanal irrigation (Prasad, 1984). Although cardiac depression is rare, clinicians should take note of the possibility that during earcanal manipulation (cerumen management, taking earmold impressions, ENG testing, etc.), loss of consciousness may result when it occurs. Patients must be positioned with proper support during earcanal manipulation so that loss of consciousness will not result in head trauma and possible concussion.

Myers et al (1987) report one case of pseudodementia, a deterioration in mental and behavioral functions that simulate dementia, associated with impacted cerumen. Although this is an isolated report, indicating that pseudodementia must be a rare consequence of excessive cerumen, it reinforces the annoyance that occlusion of the earcanal can cause and possible behavioral manifestations.

Excessive cerumen affects auditory threshold sensitivity by gradually decreasing high-frequency threshold sensitivity as the amount of cerumen increases. Figure 1 presents data from Chandler (1964), who systematically occluded the earcanals of two subjects from 80 to 95 percent. As shown, when the earcanal is occluded between 80 to 95 percent, hearing loss is restricted to the high frequencies and thresholds decrease only by 15 to 20 dB. As occlusion increases to 90 to 95 percent, high-frequency threshold sensitivity decreases by 25 to 35 dB. Only when the earcanal is totally occluded (100%) does threshold sensitivity decrease in the low frequencies, with a pure-tone average shift of 40 dB. The loss of low-frequency pure-tone threshold sensitivity shown by Chandler’s data explains why patients complain of sudden onset hearing loss when complete occlusion occurs; in reality, these patients had high-frequency hearing loss, but it became apparent when threshold sensitivity was affected in the speech frequencies.

Of course, the threshold shifts found by Chandler would be added to any pre-existing sensorineural hearing loss. Figure 2 illustrates the effect of total earcanal obstruction on pure-tone thresholds for a patient who had a pre-existing sensorineural hearing loss. The patient, a 66-year-old female, was found to have impacted cerumen.
Pure-tone air- and bone-conduction findings revealed a severe-to-profound mixed hearing loss. Figure 2 shows pure-tone thresholds before (occluded) and after (unoccluded) cerumen removal. As indicated, the pure-tone average improved from 65 dB to 28 dB, or by 37 dB. Threshold shifts from the occluded and unoccluded conditions for this clinical case study are in surprisingly good agreement with the limited data reported by Chandler (1964) above.

In contrast to excessive cerumen, astreosis is a condition where cerumen is underproduced or absent in the ear canal. Due to the dryness of the ear canal from proper lubrication, patients with astreosis will complain of ear canal itching. Prescriptive and over-the-counter topical ointments are helpful for these patients.

ANTHROPOLOGY/EPIDEMIOLOGY

The secretory functions of the ear canal glands are affected by age, but the two types of cerumen (wet and dry) are markedly manifested soon after birth and do not appear to be subject to remarkable change throughout the normal lifespan. Familial studies have documented a genetic link in cerumen type: results are consistent with the hypothesis that ear wax types are controlled by a pair of autosomal alleles with complete dominance, W and w, the genotype of wet cerumen being WW or Ww and the genotype of dry cerumen ww (Matsunaga, 1962).

Because cerumen type is genetically based, a number of investigators have attempted to correlate cerumen type to other genetically controlled traits. There is no relationship between ear canal secretions and gender (Yassin et al, 1966; Cipriani et al, 1990), and no relationship appears to exist between cerumen type and ABO blood groups, MN blood groups, P blood groups, and taste ability for P.T.C. (Matsunaga, 1962). However, as described below, cerumen type and other genetically controlled traits have been established.

The genetic influence of ear canal secretions has also been used by anthropologists to study human migratory patterns. Since the wet-type cerumen allele is dominant over the dry-type cerumen allele, and a very high frequency of dry-type cerumen allele is present in Mongolian Asians, migratory trends away from Mongolian Asia can be documented by establishing the prevalence of regional cerumen type. As an example, Bass and Jackson (1977) supported the Mongolian migration eastward across the Bering Strait to North America by documenting the high prevalence of the dry cerumen type in Eskimos. A finding from this study of particular importance is that the frequency of the dry type of cerumen decreased as the distance from the Bering Strait increased.

An eastward migration from Mongolian Asia across North, Central, and South America has been postulated (Petrakis et al, 1967). Analysis of cerumen type for 17 American Indian tribes documented a significantly high average prevalence rate of dry cerumen (36.2%), with some tribes in North and South America well above 50 percent, which lends credence to the eastward migration theory (Petrakis, 1969).

Westward migration from Mongolian Asia into the Middle East, Southeast Asia, and Europe through analysis of cerumen type was supported by data from Petrakis et al (1971). Frequencies for the dry allele in the Middle East and Southeast Asia were intermediate between the high values for Mongolian Asians and low values for Caucasians and Negroes. This observation is conclusively documented by the finding in a later study that the incidence of wet-type cerumen is 92.4 percent of white women, 96.9 percent of black women, 40.6 percent of Chinese women, and 17.5 percent of Japanese women (Petrakis et al, 1981). Petrakis et al speculate that the high frequencies of dry-type cerumen in the Middle East and Southeast Asia probably reflect the introduction of the dry allele into the indigenous populations during prehistoric and historic migrations, as well as from invasions from central and eastern Asia.

Based on the observation that mortality breast cancer rates are exceptionally low in Oriental populations and intermediate in those of Eastern Europe and the Middle East populations, when compared to women in Western Europe and the United States, a possible genetic link between the polymorphism of cerumen and breast cancer was postulated by Petrakis (1971). An association between cerumen type and breast cancer is plausible because the ceruminous, mammary, and certain axillary sweat glands are histologically of the apocrine type, and their secretions are biochemically similar. Disparate breast cancer rates for populations having dry-type cerumen (Mongolian) and wet-type cerumen (Caucasians and Negroes) might reflect genetic differences expressed through the apocrine gland system. Petrakis (1971) studied the relationship between cerumen type and breast cancer through retrospective correlations of the frequency of the allele for wet cerumen with breast cancer mortality rates and breast cancer case.

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frequency ratios for 24 selected countries or regions. Correlation coefficients of 0.95 and 0.64 were found for mortality rate and case frequency ratios, respectively. In the same study, Petrakis examined cerumen type from a group of 31 California Japanese women with surgically confirmed breast cancer, and found the prevalence of wet-type cerumen to be almost double the expected rate. These initial positive findings provided evidence that breast cancer and wet-type cerumen are associated due to the action of a pleiotropic allele, affecting the apocrine system, the fat depots, and possibly other systems.

It is known that cytologic diagnosis of breast cancer and biochemical and virologic study of breast cancer etiology and epidemiology can be made from aspirated nipple secretions. Based on this known relationship, Petrakis et al (1975) used a breast fluid aspirate technique with 606 normal, nonlactating women of disparate racial background. Results from this study indicated that the availability of aspirated breast fluid in nonlactating women is significantly related to race, age, and menopause and to genetic factors associated with apocrine gland function, with cerumen type being a contributing factor. Fluid aspirates were obtained from 290 subjects (48.0%) and were most often available from Caucasian women (70.2%) and least often available from Chinese women (24.1%). Moreover, Chinese and Japanese women with dry-type cerumen had a lower percentage of successful aspirations than those with wet-type cerumen.

Petrakis et al (1981) extended findings from earlier work by examining available aspirates of breast fluid from an additional 3929 nonlactating women of diverse racial groups. As with earlier findings, variations in the proportions of secretors was related to most breast cancer risk factors, including age, race, age at menarche, age at first pregnancy, age at menopause, clinically diagnosed fibrocystic disease, menopausal estrogen use, and cerumen phenotype. Interestingly, the quantity of aspirated breast secretions was associated with cerumen type, with the proportion of women secreting more than 28 ml of fluid and having wet-type cerumen being greater than 2½ times those having dry-type cerumen. Results lend additional support for the hypothesis that genes determining cerumen type and axillary apocrine secretion also influence breast secretory activity.

In a final study, Petrakis et al (1990) evaluated the relationship between a possible genetic-environmental interaction for breast cancer by examining nipple aspirates for proliferative disease in 172 American-born and immigrant Chinese and Japanese women. Data from this study established three statistically significant relationships: (1) a significantly higher incidence of nipple-aspirated fluid contained proliferative disease for American-born Asian women than immigrant Asian women (28.6% vs 16.5%); (2) a significantly higher proportion of American-born Asian women with wet-type cerumen had proliferative epithelial cells in nipple-aspirated fluid (39.3%) than women with dry-type cerumen (20.0%); and (3) a statistically significant relationship was present for proliferative epithelial cells and cerumen phenotype in American-born women with wet-type cerumen (47.6%) than dry-type cerumen (16.0%). These findings provide clear evidence for a possible differential influence between proliferative breast disease in Asian women born in environments presumed to be at high risk for breast cancer compared to women from low-risk environments and an apocrine genetic polymorphic trait. Together, the work of Petrakis et al point out an intriguing genetic relationship between earcanal secretions and breast cancer.

**SUMMARY**

This paper has reviewed the physiology, pathophysiology, and anthropological/epidemiological aspects of earcanal secretions. Cerumen is the product of two types of glands in the earcanal: sebaceous glands and modified apocrine glands. Two types of cerumen can be found in the earcanal (dry type and wet type), which is genetically determined. Its function is to cleanse and lubricate the earcanal and it has some protective properties. Although cerumen normally builds up and falls from the earcanal, in some individuals, it does not and becomes excessive or impacted, a finding that is more common for individuals with mental retardation and the elderly. Anthropologists have used cerumen type to study human migratory patterns. Epidemiologists have shown cerumen type to be correlated with breast cancer.

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