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ORIGINAL ARTICLE

Evaluation of crystallization processes in the calculi of the submandibular salivary glands

Elzbieta Reroñ,[1] Jacek Skladzień,[1] Marek Pawlikowski [2] & Janusz Stepiński[3]

1. Department Otolaryngology Faculty of Medicine Jagiellonian University, Cracow
2. Biomineralogy Laboratory, Department of Petrography and Geochemistry, Academy of Mining and Metallurgy, Cracow
3. Department of Structural Metallurgy and Powder Metallurgy, Academy of Mining and Metallurgy, Cracow

Correspondence to: Elzbieta Reroñ, M.D. Sniadeckich str 2, 31-501 Cracow, Poland.
TEL/FAX: +48 12 421 0038

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Abstract

Four patients were subjected to sialolithotomy of the submandibular gland in the Department of Otolaryngology, Collegium Medicum, Jagiellonian University in Cracow. The resected calculi were examined under a scanning electron microscope and chemical analysis of their structure was carried out. Results of these studies were compared with clinical observations.

It has been found that sialoliths are built up by inorganic salts, mainly calcium compounds. Crystallization processes proceed at variable rates and are related to duration of the disease and intensity of inflammatory reaction.

Introduction

The progress in technique and modern methods of treatment enable, for instance, treatment of ureterolithiasis without surgical intervention. Unfortunately, until now, avoiding surgery has not been possible in case of sialolithiasis. Acording to observation of the process by Diamant et al. (1973), Chilla and Arold (1975) and Goldstein (1984), crystallization can be the basis of the complex analysis of pathomechanisms of formation of submandibular salivary calculi and suggest, in some stages of the disease, non-surgical methods of treatment.

Aim of Study

Evaluation of crystallization processes of submandibular salivary calculi taking into consideration clinical findings in order to facilitate understanding of pathogenesis and growth of these calculi.

Material and Methods

Four patients (3 males, 1 female) referred to the Department of Otolaryngology of University Hospital in Kraków underwent sialolithotomy and their calculi were collected for further examination. The age of the patients ranged between 38 to 58 years; the mean age was 48 years. The calculi were localized in 3 patients both in the submandibular gland and the salivary duct and in 1 patient in the salivary duct exclusively.

After their excision, the calculi were washed in physiological saline, dried in liophilising cabinet and sprinkled with gold powder. The observation of the surface of sections was carried out using scanning electron microscopy (SEM) at magnification of 500 to 15,000 times. Photographic documentation of typical sites was taken. The observation was performed under a Stereoskan S4 microscope. For selected objectives qualitative chemical assessment was carried out using fluorescent analysis.

Fig.1 Crystals of calcium oxalate in calculus 1. SEM photography, magnification 400x.

Results

Calculus 1

It was of irregular shape, 3 cm in diameter, yellow in color but not uniform. After breaking, it showed homogenous, fine-crystalline structure. In SEM its crystalline structure was well seen, the size of crystals amounted to a few dozen of microns. Crystals in the central part of the calculus were more coarse-crystalline than in its outer part. Fluorescent analysis revealed the presence of calcium (Figure 1). The calculus was resected from the patient suffering from sialolithiasis with no periods of remission for 8 months. He was on non-steroid anti-inflammatory drugs, antibiotics, steroids and other medications, which were withdrawn 7 days prior to the surgery.

Calculus 2

It had irregular shape, about 8 cm in diameter. After breaking, it showed laminar structure indicating several stages of growth separated by stages lacking growth. SEM revealed its fine-grained structure. Granular areas were separated by areas of mineral substance having non-crystalline structure. Qualitative analysis revealed calcium phosphate as a building material (Figure 2). The sample was excised from the patient suffering from sialolithiasis manifested by pain and swelling of the salivary gland only after ingestion of sour foods for 6 months.

Calculus 3

It was hard with sharp edges, about 4 cm in diameter, and grey-yellowish in color. SEM showed its non-crystalline areas whose structure was similar to that of calculus 2. It had a laminar structure but was almost exclusively built of non-crystalline substance. Irregular cracks and fine holes were also observed. Fluorescent analysis revealed calcium and phosphorus, most probably in the form of non-crystalline calcium phosphate (Figure 3). This calculus was resected from the patient complaining of recurrent pain of the submandibular gland accompanied by its swelling. These symptoms lasted for 6 months.

Calculus 4

It was the smallest in size, up to 3 mm in diameter, yellow in color and with a rough surface. Its interior structure was heterogenous. SEM revealed its non-crystalline structure. Fragments of organic substance were also observed (Figure 4). Fluorescent analysis found calcium phosphate. The calculus was excised from the patient suffering continuously from the submandibular gland disease for 25 months with no evident periods of remission or aggravation.

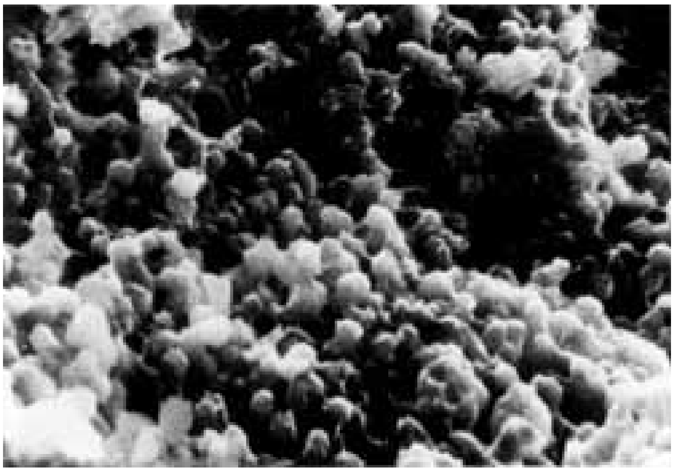

Fig. 2. Finely grained structure of bacteria mineralized with phosphates in calculus 2. SEM photography, magnification 1800x.

The patients who had calculi 2, 3 and 4 were administered anibiotics and anti-inflammatory non-steroid drugs but not so regularly and not in such doses as the patient with calculus 1.

Fig. 3. Massive shapeless phosphates with single cracks in calculus 3. SEM photography, magnification 600x.

Discussion

The study indicates that the primary substance building up submandibulary gland calculi are calcium compounds. In three cases out of four they were calcium phosphates (Diamant et al. 1973 and Pawlikowski 1993, 1995). SEM revealed that the formation of the calculi took a certain period of time, growing gradually without intervals; however, it is possible that the intervals occurred but their duration was difficult to assess retrospectively Pawlikowski (1993, 1995).

In the specimens examined, a variable crystallization of their components was noted, since there were areas well-, moderately- and non-crystallized.

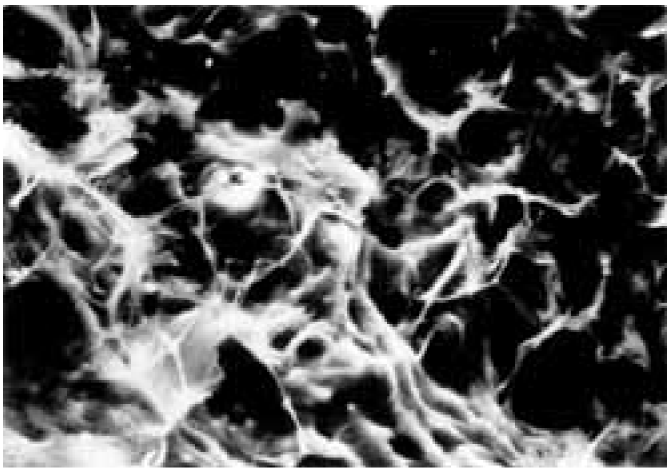

Fig. 4. In the interior structure of phosphates. SEM 700x

The probable cause of it were conditions of crystallization. As a rule, in inorganic matter, rapidly formed mineral substances are poorly crystallized or not crystallised at all (Goldstein et al. 1984 and Pawlikowski 1987, 1993, 1995). On the contrary, grains which are formed for a long period of time are usually better crystallized.

In all specimens some forms resembling by appearance bacteria were observed. They were most numerous in calculus 2. In all preparations they were saturated with mineral compounds (Chilla and Arold R 1975; Goldstein 1984; Pawlikowski 1993, 1995). It indicates that formation of salivary calculi is related to infections which the patient underwent. Bacterial infections, especially toxins secreted by bacteria, may cause local decrease in pH to 5.5. Acidification of the environment causes damage to the tissues (Fabricont 1964). Healing, which apart from other processes, restores pH to 7.2 facilitates crystallization of mineral substances in tissues, mainly calcium phosphates (Pawlikowski 1987, 1993, 1995; Diamant et al. 1973; Chilla and Arold 1975; Pimonle et al. 1980).

Conclusions

1. Calcium compounds, mainly inorganic phosphates, are the basic components of submandibular calculi.
2. Crystallization processes undergo at variable rates and are related to duration of the disease and intensity of inflammatory processes in the submandibulary gland.

REFERENCES

Chilla R, Arold R (1975) Uber Sekretionsmechanismen der Ohspeicheldruse und deren Medicamentose Beeinflussung. HNO 23: 229–232

Diamant H, Ericson S, Wiberg A (1973) Diagnostic aspects of salivary gland disorders. Annals of Clinical Research 5: 357–364

Fabricant ND (1964) The pH of the acutely inflamed throat. Arch of Otolaryngology 79: 91–93

Goldstein JI (ed) (1984) Electron microscopy and X-ray microanalysis. Plenum Press, New York and London

Pawlikowski M (1987) Mineralisation in the living human body. Zaklad Narodowy im. Ossolinskich. Wydawnictwo Wroclaw. Prace mineralogiczne 79

Pawlikowski M (1993) Crystals in the human body. Atlas. Secesja, Kraków

Pawlikowski M (1995) Secrets of mineralisation of tissues. Centrum PGSM i E - PAN, Kraków

Pimonle C, Briley M, Arbilla S, Langer SZ (1980) Chronic sympathetic denervation increases muscarinic cholinoceptor binding in the rat submandibulary gland Naunyn-Schmiedebergs. Arch Pharmacol 312: 15–18