Nearly 3,000 salivary stones: some clinical and epidemiologic aspects

Paolo E. Sigismund, Johannes Zenk, Michael Koch, Mirco Schapher, Mihael Rudes, Heinrich Iro

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Nearly 3,000 Salivary Stones: Some Clinical and Epidemiologic Aspects

Paolo E. Sigismund, MD; Johannes Zenk, MD; Michael Koch, MD; Mirco Schapher, MD; Mihael Rudes, MD; Heinrich Iro, MD

Objectives/Hypothesis: To investigate epidemiological features and symptoms of sialolithiasis and their implications for diagnosis and management.

Study Design: Retrospective cohort study.

Methods: Retrospective analysis on 2,322 patients with sialolithiasis, between 1987 and 2009. The statistical significance between two sample distributions was computed using analysis of variance Student *t* test for two-tailed distribution.

Results: A total of 2,959 calculi were identified by means of ultrasound. Of those, 80.4% were located in the submandibular duct system (53% hilar/proximal, 37% distal, 10% intraparenchymal) and 19.6% were parotid stones (83% in Stensen's duct, 17% intraparenchymal). Sialoliths had been discovered beforehand in the submandibular gland ($P = 0.00024$; *t* test). Symptoms, measured from first visit, lasted on average 26 months (range: 1 day–30 years). The main group suffered from swelling (50.3%), followed by painful swelling (41.6%) and pain (3.1%). Multiple stones were found in 16.9% of patients (18.1% in the submandibular gland; 14.3% in the parotid). Average stone diameter in the submandibular gland was 8.3 mm (range 1–35 mm), and the stones were in Lustmann group II (46%). In the parotid gland, the average diameter was 6.4 mm (range 1–31 mm), and 51% were in Lustmann group I.

Conclusion: Nowadays, epidemiologic features and clinical manifestations of sialolithiasis play an important role, assisting not only in diagnosis but also in determining appropriate treatment. Due to their location and smaller diameter, parotid stones in some cases can only be treated using a mini-invasive endoscopic technique. Submandibular stones more often require a combined approach.

Key Words: Sialolithiasis, epidemiology, ultrasound, parotid gland, submandibular gland.

Level of Evidence: 4

INTRODUCTION

Sialolithiasis is said to be the most common disorder of the major salivary glands. Postmortem studies indicate that salivary stones are present in 1.2% of the population.[1] Furthermore, the recent literature estimates their annual symptomatic incidence at 1 per 10,000–30,000 individuals.[2,3]

The submandibular glands (SMG) are by far the most commonly affected glands (80%–90%), followed by the parotid glands (PG) (5%–20%); stones are discovered in the sublingual glands only rarely, and very rarely in the minor salivary glands.[4] The predominant prevalence of stones in the SMG is well known and explained by anatomic factors (the narrower opening of the main salivary duct, its ascendant course and predominant length) as well as by chemical factors (differing composition of saliva).[5]

Recurrent swelling and pain at mealtimes are typical symptoms. In many cases, a careful bimanual palpation is able to detect the stone in the floor of the mouth, to suggest a secretory stasis in the main duct as well as cases of acute secondary bacterial infection. Nowadays, high-frequency ultrasound examination (US) is an effective method of choice to confirm diagnosis[6]; oral application of ascorbic acid improves US visualization of the salivary gland duct in cases of obstruction.[7] Sialendoscopy generally enables a definitive diagnosis by allowing direct visualization of the duct.[7] Conventional radiography, standard and cone beam computed tomography, and magnetic resonance sialography complete the tools available for the detection of stones.[8,9]

The present retrospective study involved the collection of more than 22 years of epidemiologic data on patients treated for sialolithiasis. This is the most thorough investigation conducted by a single medical center to describe the main epidemiological features and typical symptoms of sialolithiasis leading to appropriate treatment.

MATERIALS AND METHODS

Data was systematically collected from all patients interviewed for sialolithiasis of the major salivary glands at the Department of Otorhinolaryngology–Head and Neck Surgery,

From the Department of Otorhinolaryngology–Head and Neck Surgery, Friedrich-Alexander University of Erlangen-Nuremberg (P.E.S., M.K., M.S., M.R., H.I.), Erlangen; and the Department of Otorhinolaryngology–Head and Neck Surgery, Klinikum Augsburg (J.Z.), Augsburg, Germany.

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Send correspondence to Paolo Enrico Sigismund, MD, Waldstrasse 1, 91054 Erlangen, Germany. E-mail: paolosigismund@gmail.com

TABLE I.
Demographic Details, Including Number of Stones, Number of Patients, Gender, Location, Age at First ENT Evaluation and Size of Stones.

	Total	Submandibular Gland	Parotid Gland
Number of Calculi	2,959	2,378 (80.4%)	581 (19.6%)
Number of Patients	2,322	1,838 (79.2%)	484 (20.8%)
Children	50 (2.2%)	46 (2.5%)	4 (0.8%)
Male	1,232 (53.1%)	977 (53.3%)	255 (52.7%)
Average Age	46.1 years (3–91)	42.5 years (6–91)	51 years (3–89)
Size	6.9 mm (0.1–35)	8.3 mm (0.1–35)	6.4 mm (0.1–31)

Friedrich-Alexander University of Erlangen-Nuremberg, Erlangen, Germany, between January 1987 and June 2009. A retrospective analysis was performed on 2,322 patients in order to investigate the main epidemiological features (gender, age of presentation, duration of symptoms, location, number and size of stones) and the typical symptoms of sialolithiasis. Diagnosis was based on clinical presentation, bimanual palpation, and ultrasound. In some cases, small sialoliths (less than 3 mm) were confirmed by sialendocopy. No further diagnostic tools were utilized. The patients were classified into four different groups depending on their symptoms (group 1: painful swelling; group 2: swelling; group 3: pain; group 4: no symptoms; stone discovered incidentally). All images were obtained using a state-of-the-art ultrasound system from Siemens (Siemens Medical Solutions Malvern, USA, Inc.). The different systems used over the years were regularly supplied with a VF10-5 linear scanner (Siemens Medical Solutions USA, Inc.). Based on the US results, the stones were classified by their location in the SMG ductal system as intraparenchymal, hilar/proximal, and distal (2/3 distal duct); and in the PG as ductal and intraparenchymal. The stones were further classified by maximum diameter as per Lustmann et al.[4] (group I: 1–5 mm; group II: 6–10 mm; group III: 11–15 mm; group IV: mm: > 15 mm).

The statistical significance between two sample distributions was computed using analysis of variance Student *t* test for two-tailed distribution, which determines whether two samples are likely to have come from the same two underlying populations that have the same mean.

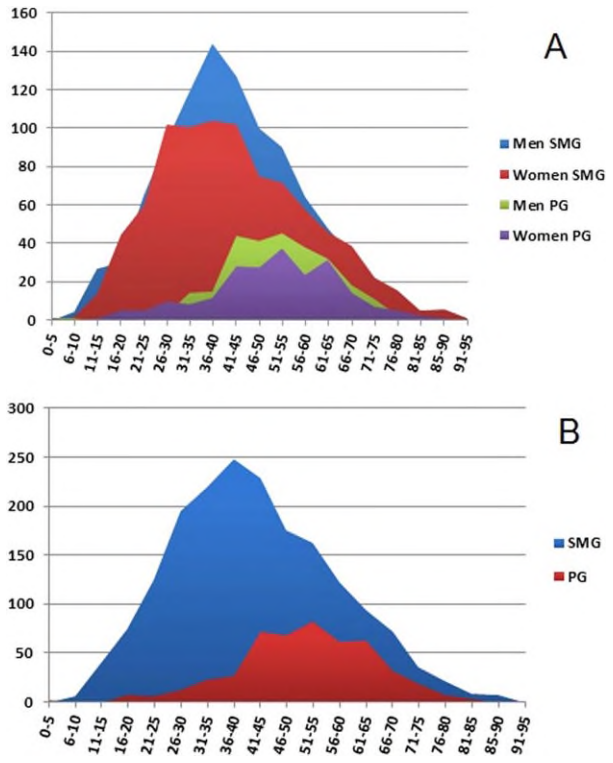

Fig. 1. A. Number of cases of sialolithiasis by age at first evaluation by gender and gland. B. Number of cases of sialolithiasis by age at first evaluation by gland.
PG = parotid gland; SMG = submandibular gland.

RESULTS

From the 1st January 1987 to the 30th June 2009, 2,322 patients were interviewed in our department for sialolithiasis of the major salivary glands; 2,959 stones were identified; and 2,205 patients were treated. Demographic details relating to the SMG and the PG separately and together are shown in Table I. Data giving the side of the body affected was available in 71% of the stones; 54.8% were located on the left. No significant difference in age at onset of symptoms was observed between male and female patients (46 years; 46 years and 4 months). However, diagnosis of sialolithiasis was made significantly earlier in patients with SMG stones if related to the ones with PG stones: 42 years and 6 months and 51 years, respectively ($P = 0.00024$; *t* test) (Fig. 1). Fifty patients (2.2%) were children (age < 15), of whom 32 were male (64%). The youngest patient was a

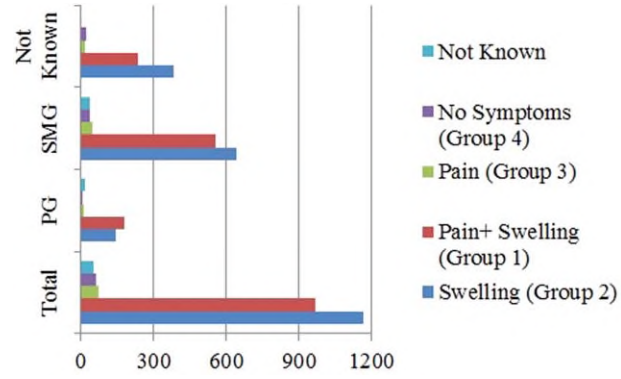

Fig. 2. Clinical presentation of sialolithiasis in this study.
Total = PG + SMG.
PG = parotid gland; SMG = submandibular gland.

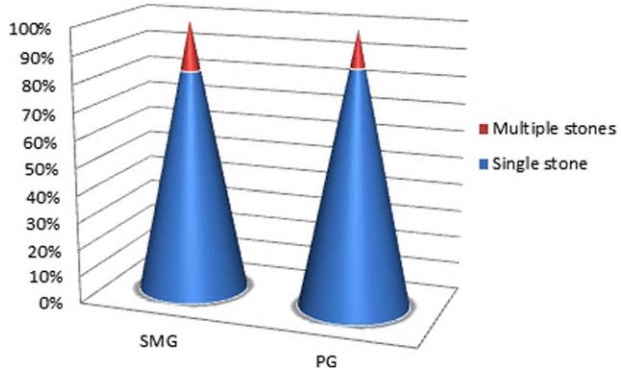

Fig. 3. Percentage of patients with single and multiple stones by location (SMG; PG).
PG = parotid gland; SMG = submandibular gland.

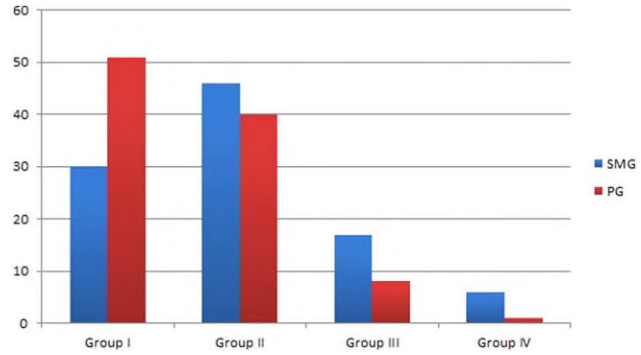

Fig. 5. Classification of stones by maximum diameter, as per Lustmann et al.[4].
Group I = 1–5 mm; Group II = 6–10 mm; Group III = 11–15 mm; Group IV = mm > 15 mm.
PG = parotid gland; SMG = submandibular gland.

3-year-old boy with a PG stone. The oldest patient was a 91-year-old woman with a SMG stone.

Symptoms, measured from the first visit, generally lasted 26 months (range 1 day–30 years). The main group of patients (group 2) suffered from salivary gland swelling (50.3%); patients with painful swelling (group 1) were 41.6%, and local pain as an isolated symptom was present in only 3.1% of the patients (group 3). A stone was incidentally discovered in 61 cases (2.6%) following ultrasound evaluation for other reasons (group 4). In 54 cases (2.3%), it was not possible to determine from the files to which group the patients should be assigned (group 5) (Fig. 2).

A total of 2,959 stones (80.4% in the SMG) were identified by means of US. A total of 83.1% of the patients revealed a single stone; 81.9% of SMG cases and 86.6% of PG cases involved a single stone. Multiple stones were discovered in the remaining 16.9% of cases (Fig. 3).

The majority of SMG stones were located at the hilum or in the proximal duct system (53%); 37% of stones were located within the 2/3 distal duct system; whereas only 10% were located in the intraparenchymal duct system. The distal Stensen's duct was the primary location for PG stones (83%), only 17% being located in the intraparenchymal duct system (Fig. 4). Mean stone size, evaluated as the predominant mean size measured by means of US, was 7.9 mm (range 1–35 mm). The diameter in the SMG was 8.3 mm (range 1–35 mm) and in the PG was 6.4 mm (range 1–31 mm). A total of 1,367 calculi in the SMG and 363 in the PG were classified, as per Lustmann et al.[4] With regard to the SMG, 46% of stones were in group II, 30% were in group I, 17% were in group III, and 6% were in group IV. In the PG, 51% were in group I, 40% were in group II, 8% were in group III, and 1% were in group IV (Fig. 5).

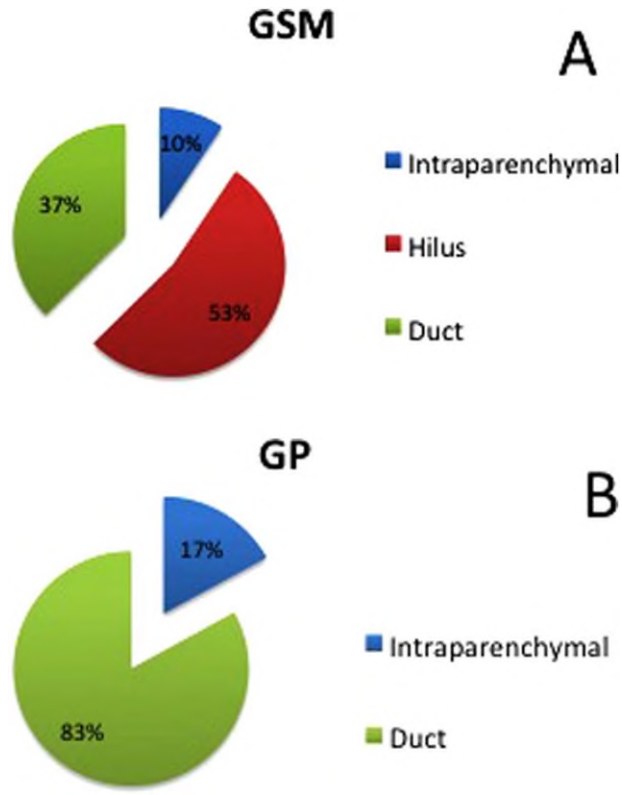

Fig. 4. A. Location of stones in the submandibular duct system. B. Location of stones in the parotid duct system.
SMG = submandibular gland. PG = parotid gland.

DISCUSSION

In the past, sialolithiasis was thought to affect mostly males[1]; more recently, distribution has been described as equal.[4] In this study, there was no statistical difference with respect to gender. Equal distribution between the side of the body affected was also observed and previously reported.[10] This finding is partly explained by the high level of right–left symmetry described in linear morphometric parameters in the SMG.[11]

Stone distribution within the salivary gland system differs between the PG and the SMG. With regard to our data, the majority of SMG stones were located in the hilum or in the proximal duct system (53%); 37% were located within the 2/3 distal duct system; and only 10%

were located in the intraparenchymal duct system. In the PG, however, the main duct was the primary location (83%). Previous studies also described predominant stone distribution in the glands in these two areas, 57% being in the hilum of the SMG and 63% in the distal duct system of the PG; 13% of stones are then considered to be located in the hilum of the parotid gland.[12]

In total, multiple stones were discovered in 16.9% of patients. A total of 18.1% were in the SMG and 13.4% in the PG. A slight prevalence of multiple stones in the SMG has already been reported, although our data slightly exceeds that given in the literature.[1,12]

Fifty patients were children under 15 years of age (2,2%). According to the literature, about 3% of all sialolithiasis cases are reported in children.[13]

Escudier et al.[3] described a peak incidence of symptomatic salivary stone between 25 and 50 years of age. Lustmann et al.[4] reported a high incidence in the third to sixth decades. Age of onset in middle age is confirmed here, and no difference was observed between males and females. Interestingly, PG stones were discovered on average later compared to SMG stones ($P < 0{,}0024$); incidence of SMG stones peaked between 25 and 55 years of age, and that of PG stones between 40 and 65 years of age. In contrast, McGurk et al.[14] described, in a series of 455 patients, an average of 45 years for SMG calculi and 48 years for PG calculi.

The symptoms, measured from first visit, lasted approximately 26 months (range 1 day–30 years). McGurk et al.,[14] however, reported symptom duration lasting as long as 64 months for SMG stones, and 58 months for PG stones, before patients decided to contact their doctor.

In previous studies, swelling is given as the most common symptom, followed by pain. The results of this study are consistent with these clinical findings. Furthermore, because ductal obstruction causes the symptoms, and considering the slow rate of stone growth, as postulated by McGurk et al.[15] (1 mm/year), it is not surprising that some stones were only discovered incidentally.

Stone size in the SMG was generally greater. Most SMG stones (46%) were in group II, as per Lustmann et al. (5–10 mm). Most PG stones (51%), on the other hand, were in group I, as per Lustmann et al. (1–5 mm).[4] The relatively greater size of the SMG duct, as apparent from prior histological examination, might partially explain this difference.[16]

The differing size of the calculi, as well as their location in the SMG and in the PG duct systems, is surgically significant. This emerged from data already published by Zenk et al.[17] for a period between 2003 and 2008, and the use of sialoendoscopy as a diagnostic and therapeutic tool in the management of sialolithiasis. As was published, some of the parotid stones (22%) could only be removed using an endoscopic procedure. In this regard, the relatively small size and distal location of some of the stones in the duct were important factors. On the other hand, only 5% of SMG stones were treated by means of endoscopy alone. In fact, in most cases a combined transoral approach was required (92%). This is more easily understood when it is considered that most of the submandibular stones in our study were classified as being in group II, as per Lustmann et al., and located mainly in the hilum region.[4]

CONCLUSION

Nowadays, epidemiologic features and clinical manifestations of sialolithiasis play an important role, assisting not only in diagnosis but also in determining appropriate treatment. In fact, the modern concept of therapy based on minimally invasive surgery proposes a wide number of conservative solutions that, based on data in recent literature, have to be fully considered in determining appropriate treatment of sialolithiasis. Due to their location and smaller diameter, some cases of parotid stones can only be treated using a surgical endoscopic technique. Submandibular stones more often require a combined approach.

Acknowledgments

Paolo E. Sigismund, MD, and Johannes Zenk, MD, contributed equally to the drawing up of this article.

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