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Characterization of nasal paraffinoma following septorhinoplasty by attenuated total reflection – fourier transform infrared spectroscopy (ATR-FTIR)*

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SUMMARY

Vaseline and paraffin have been injected into various parts of the body. Vaselinoma and paraffinoma are well-described complications, despite which nasal packing with Vaseline gauze is still common in the management of epistaxis, after rhinoplasty, endonasal surgery, to control bleeding and prevent synechiae or restenosis. Our aim is to highlight this complication, propose a safe method for its diagnosis and establish guidelines for its prevention. We report two cases of paraffinoma occurring after rhinoplasty and discuss prevention of this rare but serious complication, and suggest an alternative dressing. Attenuated total reflection (ATR) FTIR spectra have proven to be a definitive characterising tool for surgical extracts, guaranteeing detection of mineral products that histology does not offer. For these lesions we propose the name "petroleum oilomas" which we feel to be more appropriate than the more commonly used paraffinomas. Relevance of the work: a description of an innovative and safe method of diagnosis, and proposal of a procedure for postrhinoplasty packing (without mineral oils) to avoid this complication.

Key words: characterization, paraffinoma, rhinoplasty, vaselinoma

INTRODUCTION

Prominences of the nasal pyramid occurring after rhinoplasty are nearly always residual deformities of the bony and cartilaginous skeleton. Actual tissue growth is rare but may derive from autogenous cartilage grafts [(1)]. In some cases, however, cystic lesionss may develop from displaced respiratory epithelium or skin. A foreign body reaction from penetration of Vaseline through rhinoplasty surgery is a rare complication but is one which should be considered.

In the otorhinolaryngological practice, Vaseline and paraffin are used for various purposes, some of which are generalized such as packing of a bleeding nasal cavity [(2)] whereas others, such as after endonasal ethmoidectomy [(3,4)], are more specific. They are also commonly used in orbit and eyelids [(5,6)], breast [(7,8)], penis [(9,10)] and cosmetic surgery. In some cases, tracking of these substances into surrounding tissues gives rise to an irregular appearance and the formation of masses called paraffinomas or vaselinomas. In other cases, their presence has been reported in the mesenteric ganglions or in the reticulum-endothelial system organs where they induce an unusual body reaction.

Paraffinomas may form due to mineral fat infiltration from packing through incisions into underlying tissue, although lymphatic transport of these products cannot be detected. A subsequent foreign body reaction is typical to any foreign substance entering the organism.

Post-nasal surgery paraffinoma is rare, and cannot be specified in percentage terms as only isolated cases have been reported in the literature [(1,3,11-17)].

Vaseline or petroleum jelly is a purified mixture of white, semi-solid, saturated hydrocarbons, mainly paraffin based, obtained from petroleum, which is chemically inert. Formerly regarded as a finite compound, paraffin is now known to be a complex mixture of several higher hydrocarbons of the Marsh-gas series. These are white waxy, tasteless and odorless substances, resembling spermaceti, obtained from coal tar, wood tar, petroleum, etc, by distillation. They are chemically inert, and are not acted upon by most of the strong chemical reagents. Nujol, trademark of Esso Standard Oil Co. for liquid paraffin, is a long chain alkane, which appears as a colorless liquid that may be harmful on inhalation, ingestion and

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through skin absorption. All of the above substances may be associated with small amounts of tensoactives such as sodium docusate (sodium dioctylsulfosuccinate), poloxalkol (polyoxyethylene-oxy-propylene, poloxamer 188), cetyltrimethylammonium bromide (CTAB) and a wide variety of antioxidants. The above reported mineral oils can also be percipients in formulations with antibiotics as oxytetracycline (for example, in Terramycin Pfizer®).

We feel these two cases of paraffinoma to be of interest to rhinologists, given the low incidence of this complication in rhinoplasty. We wish to draw attention to the characterization of nasal paraffinoma by ATR-FTIR, an approach that offers a safe diagnosis, which may resolve doubts arising when only histological diagnosis is available.

MATERIALS AND METHODS

We report two patients who underwent septorhinoplasty and developed tumors in the nasal pyramid several months after surgery.

Case 1

A twenty-two year-old female suffering from a nasal deformity underwent closed septorhinoplasty in February 2001. The operation, which involved removal of a hump and lateral and medial osteotomies, proved incident free and packing with a gauze soaked in Terramycin Pfizer® ointment was inserted for 48 hours. An external plaster splint was applied for ten days. The postoperative period was normal and cosmetic outcome of the operation was satisfactory. In April of the same year, a swelling began to appear on the right alar cartilage, exhibiting slow growth, reaching a mass of 20 x 10 mm and a projection of 8 mm in January 2002. A CT scan revealed no bone changes pointing to the origin of the mass. Surgical treatment was proposed and performed in May 2002, the patient underwent an open approach rhinoplasty and resection of the mass with a wide margin. Histological analysis showed lipogranulomatous neoplasia, the contents of which ATR-FTIR identified as a mineral oil.

Case 2

In November 2002, a closed septorhinoplasty was performed on a forty-one year-old female due to nasal deformity, involving resection of a hump and narrowing of the nasal pyramid by lateral osteotomies. Secondary open approach rhinoplasty was performed to enhance the result on the nasal tip in May 2003. In both operations packing with Terramycin Pfizer® ointment gauze impregnated was used for 48 hours. Three months after the second operation a mass began to appear in the mid-line of the nose, occupying the bony and cartilaginous dorsum, reaching a size of 25 x 15 mm and a projection of 9 mm in just a few weeks. A CT scan revealed no bone alteration. The pseudotumoral mass clearly adhered to the skin and surrounding soft area, as a consequence of which an external removal was performed. Surgical treatment involved accessing the lesion with an outer longitudinal incision on the mid line of the nasal dorsum, enabling extraction of a mass from which a substance similar to the oily ointment used in packing appeared (Figure 1). Part of the sample was sent for histological analysis and another for chemical analysis. Histological examination revealed a granulomatous lesion, the contents of which ATR-FTIR identified as a mineral oil.

Figure 1

In both cases histological analysis led us to suppose that the lesion was due to a foreign body reaction caused by a mineral oil, although chemical analysis of the product taken from the mass would offer conclusive proof.

Attenuated Total Reflection – Fourier Transform Infrared Spectroscopy (ATR-FTIR) is a fairly recent development for identifying chemicals. It is based on the generation of an interferogram (using a moveable mirror and beam splitting) and its subsequent conversion to a spectrum (through a mathematical operation, the Fourier transform). FTIR instruments, such as those used in this work, are computerized, making them faster and more sensitive than former dispersive infrared instruments.

To discard any mucilaginous origin for the surgically removed samples under study and to confirm suspicion of their hydrocarbon nature, attenuated total reflection (ATR) FTIR spectra were recorded both for the sample and comparison with suspected chemicals was made. Scans were conducted using a Golden Gate ATR MkII system (KRS 5 lens, upper plate and basis plate for the range 300 – 5000 cm^{-1}). Sixty-four scans were averaged for each spectrum. Spectra were recorded at a nominal resolution of 4 cm-1 unless otherwise stated. All chemicals used were reagent grade.

RESULTS

Chemical findings

The spectrum of the surgical extract exhibits high intensity bands at 2918 and 2851 cm^{-1}, medium intensity bands between 1500 cm^{-1} and 1300 cm^{-1} (at 1462 and 1377 cm^{-1}), and low intensity bands and 719 cm^{-1}, like those of Vaseline. In addition, it revealed low intensity bands at 2361 and 2341 cm^{-1} produced by CO_2 evolved from carbonate in carbonated hydroxyapatite remnants from the surgical procedure (Figure 1). Therefore, no possible confusion with products analogous to Vaseline was possible. The Nujol spectrum exhibits bands at 2900, 2850, 1460, 1370 and 723 cm^{-1} whereas paraffin oil shows main absorptions around 2953, 2924 and 2854 and low intensity bands around 2727 and 2671 cm^{-1}. Cyclododecane absorbs at 2925 and 2845, 1472, 1438, 1342, 1243 and 717 cm^{-1}. CTAB absorbs at 2916, 2848, 1462, 1395, 961 and 720-728 cm^{-1}.

ATR-FTIR analysis enabled us to confirm with total certainty that the mass, which histologically was a granulomatous reaction to a foreign body, was caused by the Vaseline in the packing ointment applied after surgery. Use of this technique avoids the possibility of inaccurate clinical and histopathological diagnosis.

Clinical follow-up

Patient follow-up in Case 1 was 26 months and in Case 2 13 months. In neither patient was a recurrent paraffinoma apparent and cosmetic appearance in both cases was good.

DISCUSSION

The appearance of paraffinoma after nasal surgery is a rare complication, yet one which may have extremely serious repercussions [11]. In the literature, few cases have been reported in which this complication has occurred after rhinoplasty [12,13,16,17]. However, its occurrence might be more frequent than is initially thought, since some cases may have gone unnoticed as a result of having been incorrectly diagnosed as a post-surgical mucous cyst [14,15].

Histological analyses of paraffinomas in the literature describe similar patterns to those reported by Rettinger et al. [1]: numerous pseudocysts of different size ("Swiss cheese" pattern), circular empty spaces surrounded by collagen fibers and granulation tissue, composed of lymphocytes, plasma cells, and giant multinuclear cells. This is typical of a foreign body reaction yet does not confirm the nature of the substance causing it. It might also be compatible with other kinds of granulomatous lesions. The ideal technique to ensure that the postrhinoplasty mass was caused by the gauze with Vaseline used for packing is analysis of its content by ATR-FTIR.

At our Department of Otorhinolaryngology - Head and Neck Surgery, University of Valladolid (Río Hortega University Hospital) nasal packing was commonly performed using gauze soaked in Terramycin Pfizer® ointment until the appearance of the second case of paraffinoma. Ointment composition per one gram is: oxytetracycline hydrochloride, 30 mg; polymyxin B sulfate, 10.000 U; liquid vaseline and stringy vaseline as excipients. We currently use some of the mineral oil-free methods proposed by Weber et al. [2]: silicon strips, ointment-free ribbon gauze, rubber fingerstalls, special suturing techniques, foam or cellulose packing. As well as achieving good internal stabilization after operations, involving the cartilaginous-bony skeleton of the nose and correct hemostasis, the ideal procedure would also improve postoperative wound healing causing no additional trauma, fibrin accumulation, adhesion formation, foreign body reaction or injury on removal. Among mineral oil-free methods, we have failed to find an ideal system for postrhinoplasty packing. For the moment we empirically use whichever we feel to be most suitable in each individual case.

Between 2001 and 2003, when our cases of paraffinoma occurred, 418 interventions requiring packing were performed. No cases of this complication had been detected in the ten-year period reviewed. This, together with the scarce number of cases reported in the literature [12-17] has led us to conclude that this complication is rare after rhinoplasty. Despite this, however, the possibility of serious consequences as well as legal responsibility forces us to adopt preventative measures, mainly avoiding the use of mineral oils for post-surgical nasal packing.

To establish diagnosis of this complication, histological demonstration of paraffinoma or additional detection using special stains or nuclear magnetic resonant spectroscopy [2] has been deemed necessary. In our view, conventional histological analysis together with ATR-FTIR characterization of samples obtained in surgery is the most reliable method for ensuring diagnosis.

The semi-solid consistency of the analyzed sample is a characteristic feature of paraffin and Vaseline, whereas its nearly

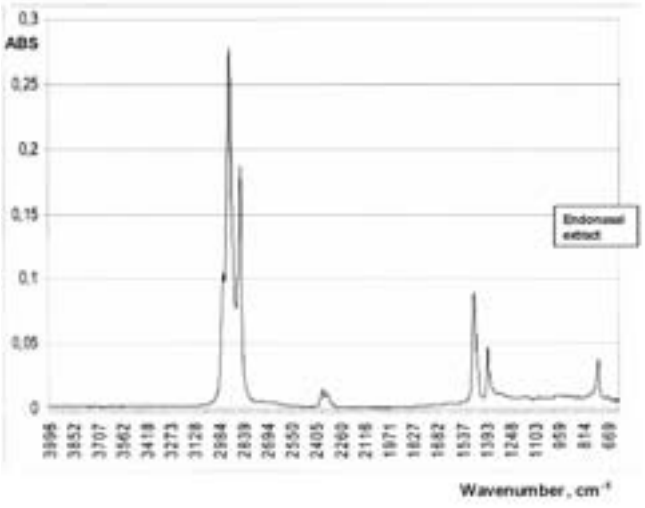

Figure 2. Characterization of the tumor extract by ATR-FTIR.

transparent appearance is a characteristic feature of Nujol. The FTIR spectrum obtained for the sample under study is the Vaseline one, and its comparison with those from the other substances analyzed shows that it is nearer to Nujol than to Paraffin. The reason for its analogies with Nujol should be sought in the low molecularity of the analyzed sample (caused by the significant participation of hydrocarbon chains of 12 and 14 carbons in its composition) and the presence of some antioxidant, preserving its transparent or milk-like appearance (since no yellow tonality for the sample has been observed) (Figure 2).

Despite their widespread use and supposed stability (paraffin, *parum affinis* = little affinity), hydrocarbon oils are not innocuous, particularly in the nasal area. For paraffin wax vapors there is no stated standard, although in 1975 the ACGIH recommended a VUL of 0.2 mg/m^3. Occasional hypersensitivity reactions have been reported. Chronic exposure can result in dermatitis, wax forecloses, follicles, blackheads, melanodermia, papules and hyperkeratosis. Scrotal carcinoma in wax pressers exposed to crude oil wax has been reported. There is also some documentation on other malignancy occuring in the exposed areas of worker exposed to finished paraffin. Scrotal carcinoma, which appears in workers exposed for ten or more years, began with hyperkeratosis similar to a blemish that develops into squamous cell carcinoma. This can metastasise the inguinal region and the lymphatic pelvic ganglions.

We believe that the use of low-molecular weight Vaseline chemically similar to harmful Nujol for clinical purposes might involve a greater risk than the use of paraffin, and that the presence of additives in both must be closely observed. The presence of tensoactives such as CTAB, of proven carcinogenic properties and whose FTIR scan is very similar to Vaseline's, could prove particularly dangerous.

There is no standard procedure for nasal paraffinoma resection, as the surgical technique applied may vary depending on lesion size, location and adherence to neighboring tissue. We used an open rhinoplasty (case 1) and an external approach (case 2), which are the surgical techniques adopted by other authors [(1)].

Finally, we suggest the term "petroleum oilomas" to cover the group of paraffinoma-like lesions produced by petroleum derivative oils.

CONCLUSIONS

1. ATR-FTIR characterization is totally reliable and selective to establish the diagnosis of paraffinoma.
2. Postrhinoplasty paraffinoma is rare. However, it is a serious complication, difficult to treat and may lead to both legal as well as therapeutic problems.
3. We propose restricting the use of mineral oil ointments in endonasal packing. The most favorable alternative should be used in each case.
4. We propose the name "petroleum oilomas" to designate this group of lesions.

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