CASE REPORT

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Lung Embolism with Liquid Silicone

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ABSTRACT: A lung embolism was reported in a case involving death following repeated injections of liquid silicone for aesthetic reasons. The liquid extracted from the sites of injection was identified as methylsilicone using infrared spectrophotometry, and the presence of silicone in vacuoles in the lung was verified by scanning electron microscopy with energy dispersive X-ray analysis (EDXA). A study has been carried out with rats after intravenous and subcutaneous injections of methylsilicone.

KEYWORDS: pathology and biology, liquid silicone, embolisms, methylsilicone, lung

Adverse effects of silicone gels, liquids, and rubber used in medicine, especially in plastic reconstructive surgery, have been reported such as chronic inflammatory reactions [*1*] and fibro-histiocytic reactions in the injection site of the breast [*2*]. In addition, silicone may migrate through the subcutaneous tissue to areas as far away as the inguinal region [*3*]. Repeated injections of silicone liquid were followed by extensive granulomatous mastitis and a remarkable proliferation of vacuolated histiocytes in the sinuses and medulla of axillary lymphatic nodes [*4*]. Migration can also lead to subcutaneous tissue and skeletal muscle where a histiocytic infiltration and numerous round to oval spaces with tiny droplets of liquid silicone can be seen [*5*]. In some cases of implants with prostheses filled with silicone gel, it has been observed that the gel can flow through the intact capsule and produce histiocytic reactions similar to those produced by liquid silicone [*6*]. There are cases described in the literature in which breast cancer has occurred after liquid silicone injections, although a

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relationship between the two has not been proven [7]. We have only found one documented report of respiratory failure leading to death after injections of silicone oil (polydimethylsiloxane) [8].

It has been observed experimentally that subcutaneous injections of silicone liquid (dimethylpolysiloxane) in rats and mice produced an accumulation of macrophages full of silicone [9]. In mice injected subcutaneously and intraperitoneally with liquid silicone, macrophages full of silicone in regional lymphatic nodes and foci of atrophy of adipose tissue were observed at 2 weeks; at 14 weeks from the intraperitoneal injection accumulations of silicon-laden macrophages were found in the adrenal gland [10]. The accumulation of this type of vacuolated histiocytes, together with inflammatory reaction, has been called "siliconoma" [11], although according to some authors, it is due to impurities [12].

We report a case of death by pulmonary embolism produced by silicone which was the result of a fatal complication after an operation done outside the hospital environment on an individual who wanted to modify the shape of his body. We have tried to reproduce the case experimentally in rats.

Case Report

A comatose, dyspneic 37-year-old transsexual man, with gynecomastia, was admitted to a hospital. His skin and mucosa were pale and his pupils lazy; punctations were visible in both hips (possibly a result of the injection of silicone for hip augmentation). Upon auscultation, the stertorous sound of large bubbles could be heard in both sides of the thorax. The presumed diagnosis was pneumonia as a result of aspiration of vomit.

The patient was initially treated with Vitamin B, furosemide, and methylprednisolone, followed by adrenaline, diazepam, and intravenous fluid containing sodium bicarbonate and calcium chloride. He was intubated by the nasogastric route, and a urethral catheter was also inserted. Upon respiratory failure, assisted ventilation with intubation was begun. Two hours later the patient failed to recuperate from cardiorespiratory arrest.

According to information obtained the individual was a transsexual person who had undergone manipulation to modify his external appearance. This was proved by his evident gynecomastia.

At autopsy, multiple recent punctations were observed on both hips. About 5 mL of a dense liquid were collected on cutting in this zone and also a sample of cardiac blood; both specimens were preserved for toxicological analysis. Fragments of lung were preserved in formalin for histopathological study.

Histopathological Study

The fragment of lung had a smooth, gray blue surface and was soft on cutting.

Lung sections were embedded in paraffin, cut at 6 μm, and stained with hematoxylin and eosin and Van Gieson stain. Cryostat sections were stained with Sudan III.

The pulmonary parenchyma was altered by numerous small vacuoles which occluded the capillaries. Large vacuoles similar to those in capillaries were present in alveolar spaces. There were noticeable intraalveolar macrophages, some filled with dark pigment, while others presented vacuoles in the cytoplasm and positive Perls reaction for iron. Numerous epithelial cells had peeled into the alveolar spaces (Fig. 1). Sudan III staining was not positive in the frozen section.

The alterations described in this case correspond to a lung embolism produced by the substance contained in the intraalveolar and capillary vacuoles.

Analysis

A general toxicological analysis of the blood specimens gave negative results.

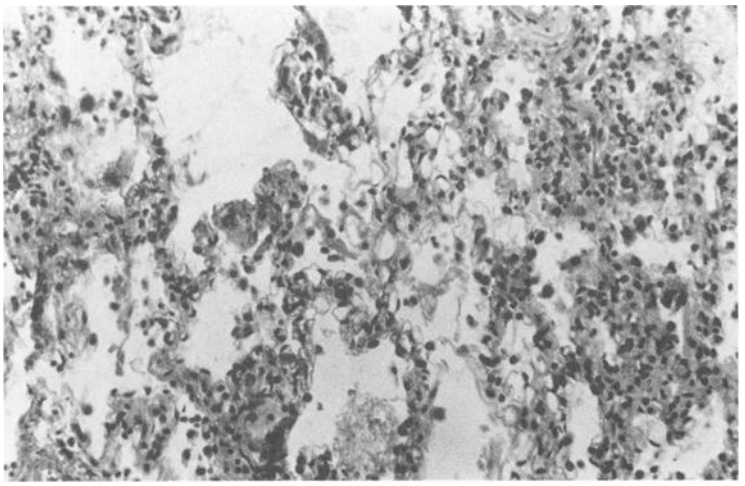

FIG. 1—*Pulmonary capillaries filled with silicone vacuoles in human lung. Hematoxylin and eosin (×200).*

Infrared Spectrophotometry

A fraction of the sample of liquid collected from the hips was solved in *n*-hexane and studied by infrared spectrophotometry in a Perkin Elmer 1420 spectrophotometer using a tablet of KBr to which 50 μL of the solution in *n*-hexane was added. The spectrum obtained corresponded to that of methylsilicone (see spectrum, Fig. 2). A *n*-hexane blank was run to delete interferences.

Lung specimens fixed in formaldehyde were studied by scanning electron microscopy (SEM) and energy dispersive X-ray analysis (EDXA). The specimens were washed to remove formaldehyde, dehydrated in ethanol, treated with ether, and air-dried. SEM and EDXA were performed after gold vacuum metalizing of the lung specimens (Fig. 3). The EDXA spectrum showed a single peak for silicon at 1.739 keV and a peak for gold at 2.121 keV corresponding to the metalization.

Experimental Procedure

We tried to reproduce the case experimentally in rats.

Male Wistar rats weighing 300 g were given commercial methylsilicone (Panreac) and emulsified with water (v/v) through the following routes:

1. Subcutaneous route

Lot 1: three rats were given 1 mL in the dorsal zone. After three days they were decapitated.

Lot 2: three rats were given 5 mL through various punctations; after two weeks the treatment was repeated and the rats were killed five days later.

2. Intravenous route

Three rats were given 1 mL in the caudal vein; they died from 30 to 270 min later.

3. Control group without treatment

Lung specimens from all the animals were frozen and sectioned by cryostat. Similar lung specimens were fixed in formaldehyde and embedded in paraffin. Fixed portions were taken from EDXA analysis. Cryostat sections were stained with Sudan III and paraffin sections were stained with hematoxylin and eosin.

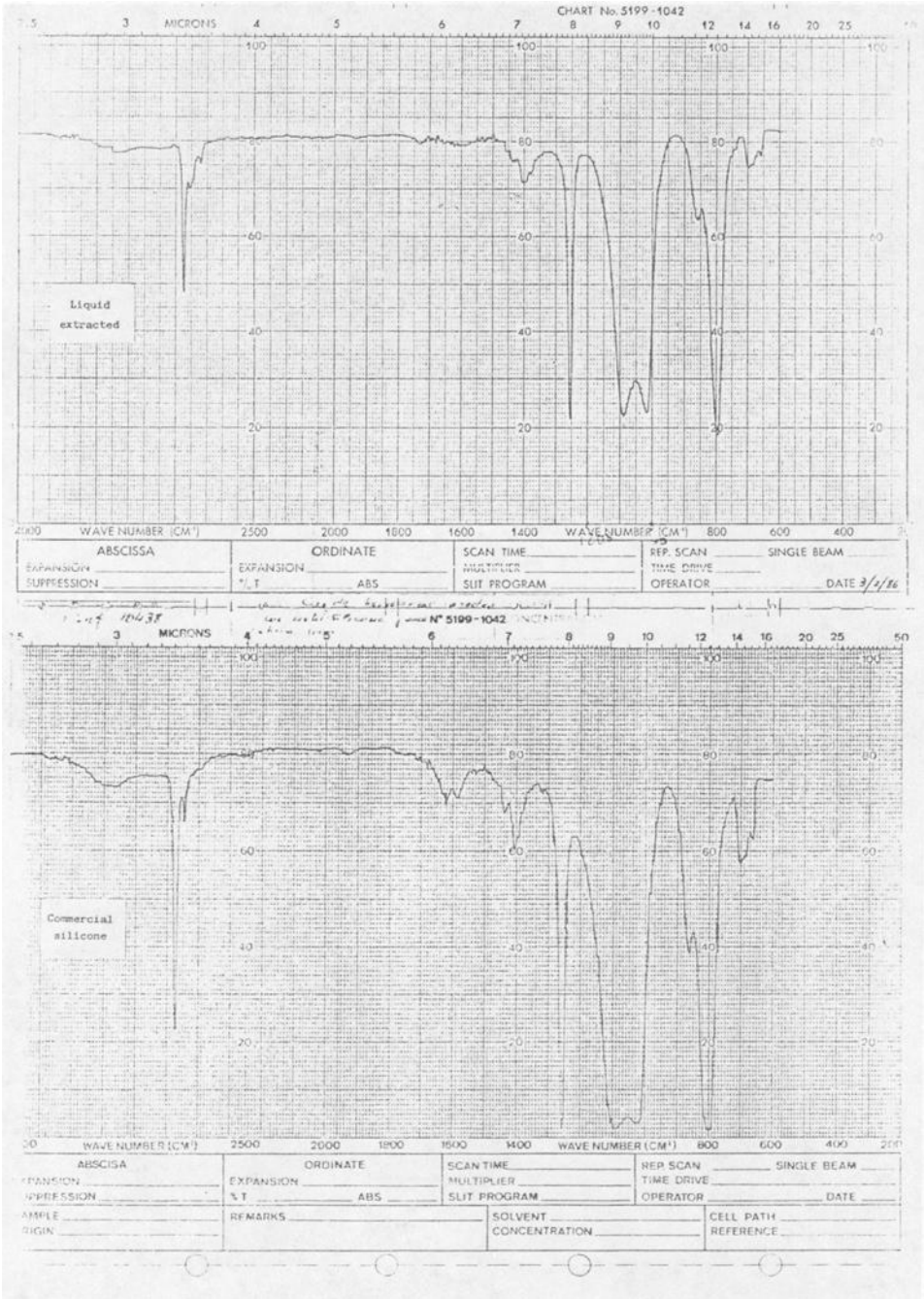

FIG. 2—*Infrared spectrum corresponding to the liquid extracted and to the pattern (commercial methylsilicone).*

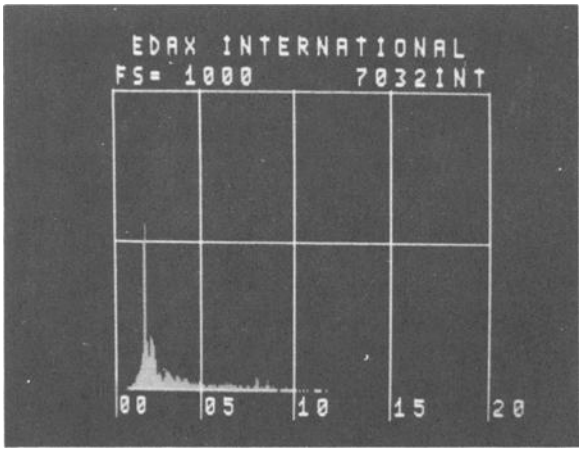

FIG. 3—*Spectrum obtained on applying the EDXA technique to a specimen of human lung. Peak corresponding to silicone (1.739 keV).*

Histopathological Study

The lung parenchyma of rats treated intravenously with methylsilicone present numerous vacuoles which occlude capillaries constituting an embolic process similar to that found in the human case in question (Fig. 4).

In the rats treated subcutaneously, these lesions of the lung were not reproduced. At the sites of injection there was an inflammatory reaction with histiocytes whose cytoplasm was full of small vacuoles.

Staining with Sudan III in frozen sections was negative in both cases.

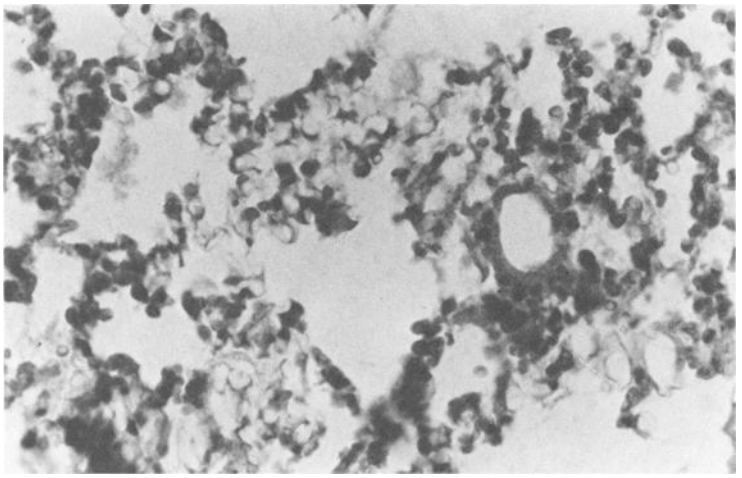

FIG. 4—*Silicone vacuoles filling pulmonary capillaries and alveolar spaces in rat treated intravenously with silicone. Hematoxylin and eosin (×400).*

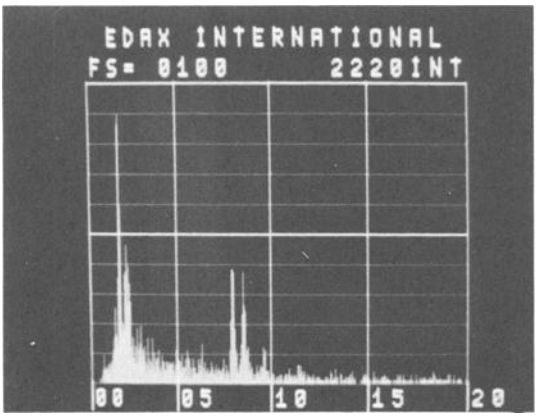

FIG. 5—*Spectrum obtained on applying the EDXA technique to a specimen of lung from rat treated intravenously with silicone. Peaks corresponding to silicone (1.739 keV), gold, copper, and zinc.*

Analysis

On applying the EDXA technique to the specimens of lung from the animals the following spectra were obtained:

1. Intravenous treatment

The spectrum obtained presented a peak corresponding to the element silicon at 1.739 keV and a peak corresponding to gold metalization at 2.121 keV (Fig. 5).

The peaks appearing at the right of the spectrum correspond to the elements copper and zinc which belong to the specimen mounts and which appeared on scanning through the tissue in all the specimens.

2. Subcutaneous treatment

The element silicon was not detected.

3. Control group

The element silicon was not detected.

Conclusions

The application of techniques of optic and electronic microscopy and of EDXA to the specimens of human lung show the presence of an embolism as a result of silicone oil which was identified as methylsilicone by infrared spectrophotometry. The intravenous application of this product to Wistar rats reproduces the histopathology and analytical picture; this is not achieved by subcutaneous administration even with large doses and repeated punctures in which only a local reaction is produced.

It can be concluded that the embolic accident was produced as a consequence of absorption of the grease by vascular route.

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