Descriptions of therapeutic arthrocentesis and of synovial fluid in a Nahuatl text from prehispanic Mexico

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SUMMARY Paracelsus is considered to have been the first to record the viscid quality of the synovial fluid. However, his contemporary Bernardino de Sahagún, a Franciscan friar who came to Mexico shortly after the Spanish conquest, obtained from elderly Aztec Indians who spoke only Nahuatl the descriptions of therapeutic arthrocentesis and of the viscid nature of the synovial fluid. They compared the fluid from the knee joint to the viscid fluid from the leaves of the nopal cactus (*Opuntia* sp.). We here record their description and confirm the accuracy of their comparison.

It is generally considered that the Swiss Renaissance physician Phillipus Aureolus Theophrastus Bombastus von Hohenheim, better known as Paracelsus (1493–1541), was the first to note the presence of a viscid fluid within the joint cavity.^{1, 2} Paracelsus was a brilliant man who collected as many admirers as critics during his lifetime. He was a wanderer who alienated many of his colleagues and who, despite being a great medical practitioner for his time, never decided whether his main interest was natural science, magic cabalistic knowledge, or alchemy.^{3, 4}

Very different from Paracelsus was his contemporary Bernardino de Sahagún (1499–1590) (Fig. 1), a Franciscan friar who arrived in Mexico in 1529 only 8 years after the conquest of Tenochtitlan, the Aztecs' capital, by Hernán Cortés. He immediately dedicated himself and continued to do so until his death, to the acquisition and classification of information on many aspects of the Indian cultures of central Mexico (the Nahuatl cultures). The method he used was highly advanced for his time.⁵ He developed questionnaires covering all matters that he wanted to investigate. These questionnaires included questions on rites, priests and gods, festivities and customs, family relationships, legends, education, child raising, medicine, nutrition, botany, animals, metals, ethnic origin, literature, and even the Indian version of the history of the Spanish conquest.⁵

His method was first applied at Tetepulco, a place close to present-day Mexico City, where he had the elders of the region answer the questionnaires by reference to their own paintings and manuscripts. The version of the old Indians was transcribed by various young Indians who had learned to write the Nahuatl language in alphabetic characters. The material obtained was extensive and valuable. The first draft a document known as the *First*

Fig. 1 Friar Bernardino de Sahagún (1499–1590)

Memorials, enabled Sahagún to develop other more complete questionnaires, which he applied in Mexico-Tlatelolco. They resulted in a new draft, and it was accidentally divided in two codices which, on the requisition of the Spanish King Phillip II, are now both in Madrid. The material was personally revised by Sahagún as well as by experts whom he appointed to revise each subject.

The final collection, which amounted to a selection, has 2 versions, one the Florentian codex which includes Nahuatl and Spanish versions side by side, and the other the Spanish version proper, which is known as 'General History of the Things of the New Spain', the latest edition of which was published in 4 volumes in 1956.⁶ Medical topics in the last 2 versions were reviewed by 8 Nahuatl physicians who corrected the manuscript. However, they can also be found both in the Tetepulco and Mexico-Tlatelolco's drafts as well as in the Florentian codex. The medical aspects of this material have recently been studied by López-Austin,⁷ who divided it, after Sahagún, into a part pertaining to human diseases, a part pertaining to medicines, and a part pertaining to the anatomy of the human body. López-Austin's study⁷ goes back to the *First Memorials*, which he translated from Nahuatl. There are 2 texts on 'Diseases of the Body'. Both were obtained in Tetepulco and appear to have come from different informants or at least from the answers to different questionnaires.⁷ A third text that appears in the Florentian codex was revised and completed by the 8 'referee' Indian physicians.⁷ The first of these 3 texts, which consist of a list of diseases with their corresponding treatment, reads as follows:

FORMATION OF VISCID FLUID IN THE KNEES

It is cured by bleeding with a pointed thorn. Something comes out that is akin to the viscid fluid of the nopal.

Several notions are present in this Nahuatl text. Although it was compiled in Sahagún's time, the method by which it was obtained strongly suggests that it derives from considerably older times. Thus, having obtained this information so promptly after the conquest of Mexico from elders who spoke only Nahuatl, Sahagún made certain that European knowledge or notions had not permeated the information he called. Indeed, since he was not a physician, it is unlikely that Sahagún would have known about the viscosity of the synovial fluid and, even less so, about the possibility of performing an arthrocentesis to relieve it. In fact the first European physician to arrive in Mexico was Dr Francisco Hernández, in 1571.⁸ Not only does the Tetepulco text describe the viscid character of the synovial

fluid, but it also compares it to the fluid which comes out of succulent leaves of the nopal cactus (Fig. 2). The nopal (*Opuntia* sp. and *Opuntia cochinillifera*) was indigenous to America, from where it was later transplanted to Europe, North Africa, and Asia owing to the fact that its tender leaves serve as a breeding ground for the cochineal insect, source of a much appreciated red dye.⁹ This cactus has an edible fruit and its most tender leaves are also eaten. When the leaves are cut, much viscid fluid drains from them, and, when they are boiled in salt water for eating, the viscid material floats on the surface of the boiling water and thus can be got rid of. This viscid fluid from the nopal is commonly known as the 'saliva' of the nopal.

Majno¹⁰ has recently shown that ancient remedies and notions can sometimes be confirmed by present-day experiments. We have determined the viscosity of the juice of the nopal and compared it with that of synovial fluid obtained from patients with various diseases. Nopal leaves were minced and allowed to

Fig. 2 Nopal cactus (*Opuntia* sp.)

drain on a grid. The fluid collected was centrifuged for 30 minutes at 2000 rpm and the supernatant was studied. Viscosity of this and the synovial fluids was determined in an Ostwald viscometer and expressed in relation to that of water. From the findings presented in Table 1 it can be seen that the viscosity of the juice from the nopal was within the range of viscosity of the synovial fluid found in various conditions and actually very close to their mean (17.9).

Probably more even important than the description of the viscid nature of the synovial fluid is the description of therapeutic arthrocentesis done to relieve its abnormal formation in the knee. That the collection of fluid was considered abnormal can be inferred from the inclusion of this text among those relating to the Diseases of the Body and by offering a cure for it. The type of thorn used for the arthrocentesis is not specified, but there certainly was no paucity of thorny plants (including the nopal) in the dry sunny climate of the Mexican highlands.

We have previously described how the Indians of prehispanic Mesoamerica had recognised Heberden's nodes¹¹ and osteoarthritis of the knees with the resulting genu varum¹² and depicted these and many other illnesses in ceramics.^{13, 14} Such portrayal of illness was probably not merely accidental but it was probably a part of a cultural complex of prehispanic medicine which included practical and empirical notions with theoretical, religious, and magic concepts.^{15, 16}

'History and disease must be, like mind and body, inseparable',¹⁷ and the history of rheumatic diseases

is likewise that of man. The quest for their relief has been universal, as universal as they are. Men who lived in America before the arrival of Columbus both suffered them and took part in this quest.

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Table 1 Relative viscosity of the nopal juice as compared to that of synovial fluid

		Relative viscosity*
Nopal (<i>opuntia</i> sp.) juice		19.5
Synovial fluid		
Disease	Mucin Clot	
Ankylosing spondylitis	I	46.0
Gout	I	25.7
Traumatic synovitis	II	14.5
Rheumatoid arthritis	III	9.6
Behçet's syndrome	III	7.9
Gout	IV	3.6

* Mean of 3 measurements.