*Rev. Inst. Med. trop. São Paulo*
*7(2):82-86, março-abril, 1965*

*UDC 616.995.122.22*

# EXPERIMENTAL EMBOLIZATION OF THE PULMONARY ARTERY BRANCHES OF DOGS BY ADULTS *SCHISTOSOMA MANSONI*

Humberto MENEZES (1)

**SUMMARY**

The Author working with dogs, produced embolism with later organization and recanalization of the intra-pulmonary branches of the pulmonary artery with dead adult *Schistosoma mansoni* worms. The pathogenesis of the "bilharzial *Cor pulmonale*" is discussed and the role of the dead worms in it is emphasized.

## INTRODUCTION

The pulmonary lesions in cases of bilharziasis became of increased interest after the paper, on the subject, by SHAW & GHAREEB [18].

Along with these Authors, almost all pathologists that have studied this matter consider the ova as the principal etiologic agent of the so called "chronic schistosomotic *Cor pulmonale*" [2, 4, 6, 14]. JAFFÉ [13] and BARROS et al.[1] believe the vascular lesions to be a result of allergic mechanisms, while FARIA [8] refers to alterations such as diffuse endarteritis, and hyaline and fibrinoid degeneration of the vessel walls as being due to toxic or allergic reactions. These lesions would increase the permeability of the blood vessel walls, resulting in serous and fibrinous inflammation of the intima.

MAGALHÃES FILHO [15] gives emphasis to the primary lesions produced by the Schistosomula in their migration through the lungs, before attaining the portal circulation.

The present paper deals with the pulmonary vascular lesions induced in the lungs of dogs by embolization with dead worms.

## MATERIAL AND METHODS

One female and two male dogs with a mean weight of 6.3 kg, were anesthetized with intravenous injection of Thionembutal (100 mg/3 kg).

The left pulmonary artery (inferior pulmonary field) in two animals and the right pulmonary artery (inferior pulmonary field) in the other were catheterized, and 500 lyophilized adult worms were injected, suspended in sterilized saline solution; 400,000 U. of Penicillin-procaine were injected into each dog and this dose was repeated 24, 48 and 72 hours later.

## RESULTS

One animal died 9 days later with broncho-pneumonia, one was sacrificed by intraveous injection of 10 ml of sulphuric ether, after 28 days, and the last was sacrificed by exsanguination, under anesthesia by Nembutal, 60 days after the pulmonary embolization. In every case the heart and lungs were taken in one block and the bronchial tree injected with neutral 10% formaline.

Grossly the lesions were masked by the broncho-pneumonic areas in the first dog but in the second animal that was sacrificed 28 days later, scanty areas of consolidation of the parenchyma, with a mean diameter of 0.5 cm could be palpated in the left lower lobe.

---

Presented partially in the V Congress of the International Academy of Pathology — London, June 1964.

Departamento de Patologia, Faculdade de Medicina de Ribeirão Prêto, São Paulo, Brasil.

(1) Associate Professor

The lesions in the lung of the third dog, killed after 60 days, were rare and consisted of small areas of fibrosis and cicatricial retraction of the pleura in the inferior lower right lobe.

All the suspect areas were embedded in paraffin, sectioned at 5 $\mu$ and stained by *Hematoxylin-eosin*, *Gomori* trichromic and the *Verhoeff van Gieson* for elastic tissue.

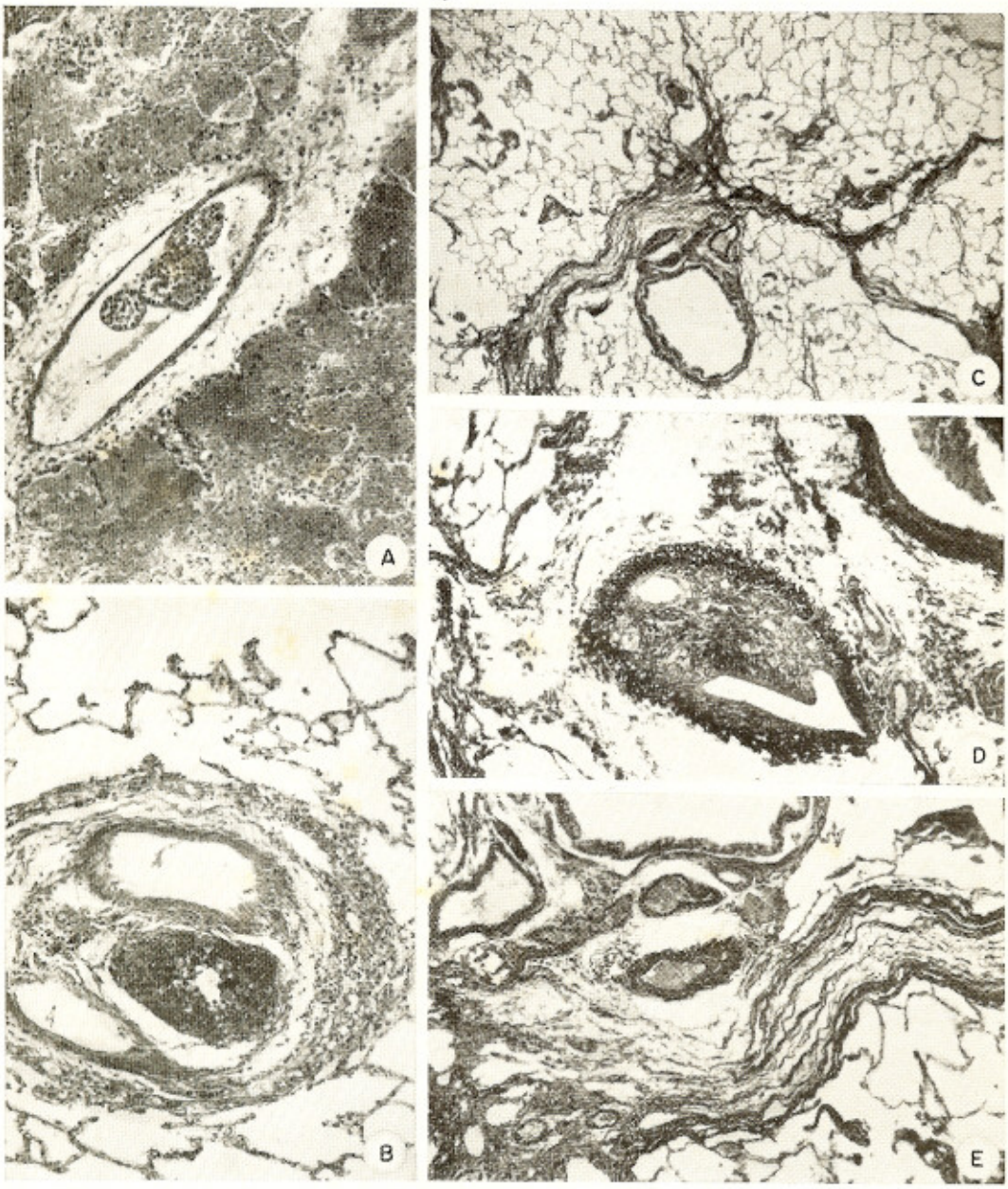


Fig. 1 — A) Adult worms in a branch of the pulmonary artery of the dog that died 9 days after the embolization (H.E., 45×); B) Remnants of parasite in a recanalized branch of the pulmonary artery of the dog killed after 29 days of the embolization (H.E., 160×); C) Fibrosis of the lung in the dog sacrificed 60 days after the pulmonary artery embolization (Verhoeff van Gieson, 45×); D) Recanalization of a pulmonary artery branch in the lung of the dog killed after 90 days (Verhoeff van Gieson, 120×); E) Partial obliteration and recanalization of another branch of the pulmonary artery of the same dog (Verhoeff van Gieson, 70×).

As control it was used the other lung of each animal, where neither gross nor microscopic abnormalities were seen.

In the first dog the broncho-pneumonic lesions dominated the histologic picture but in the middle of some of these areas we could see, within the blood vessels, worms with swelling of their bodies (Fig. 1A). No vascular or parenchymatous lesions, attributed directly to the presence of the worms, could be observed.

In the animal sacrificed after 28 days the phenomen of embolization by the bodies of the parasites was the more dominant picture.

Obliterative endarteritis with organization and recanalization was observed. The remains of parasites could be sometimes seen in the lumen of the blood vessels surrounded by macrophages and leucocytes (Fig. 1B).

The elastic externe lamellae of the vessels were generally well preserved but the internal elastic lamellae were disrupted and recanalization took place at the periphery of the granulomatous reaction.

The lung tissue of the animal killed 60 days after the embolization shows areas of parenchyma with thin bands of fibro-collagenous tissue, following the course of small blood vessels that go from the most superficial bronchiolar-vascular connective tissue to the pleural surface (Fig. 1C).

The branches of the pulmonary artery at these sites show evident phenomena of organized and recanalized embolization. The elastic external lamellae are well preserved but the lumens of the vessels are occupied by collagenous connective tissue traversed by several small new-formed capillaries (Figs. 1D e 1E).

## DISCUSSION

There is no specific pathologic pattern for the bilharzial *"Cor pulmonale"*.

The same lesions can be seen in different pulmonary hypertensive diseases [6].

Clinically and hemodinamically the syndrome is similar to primary pulmonary hypertension [3, 7, 15, 19]. SHAW & GHAREEB [18] described the most important vascular lesion as an "obliterative arteriolitis" in which a few of the "canalizing capillaries are greatly dilated, resembling an angioma".

ROSSAL & THOMPSON [17] mentioned these "angiomatoides" as being due primarily to an organized embolus with posterior recanalization.

CLARK & GRAEF [5], describing cases of chronic pulmonary arteritis observed accurately that "the absence of early lesions in the pulmonary vessels does not permit reconstruction of these lesions from their inception" and that "the rich vascularization of the tissue surrounding the ovum and occluding the lumen might suggest this lesion to be the result of thrombosis with organization and canalization".

To MOSCHCOWITZ et al.[16] the pulmonary vascular lesions described as "plexiform", "endothelial hyperplasia", "angiomatoides cushion", "recanalized thrombus", "glomoid body", "arterio-venous shunts" are congenital vascular abnormalities not related to thromboembolization or pulmonary hypertension.

In the 282 cases studied by SHAW & GHAREEB [18], 86% had granulomatous lesions in the lungs and only 2.1% diffuse vascular lesions (Ayerza's syndrome). In the same material those Authors revealed the existence of adult worms in the lungs of 3.6% of the patients. Even recognizing the "extremely toxic" effects of the dead worms and the destruction of the vascular walls produced by them, they preferred to ascribe to the ova the very important vascular lesions seen in the cases of schistosomiasis with *Cor pulmonale*.

KENAWY [14] considers the syndrome of cardiopulmonary schistosomiasis as the result of an obliterative arteriolitis and that "the bilharzial ova are the wholly responsible, while the verminous infestation plays no part in producing the vascular changes".

My own observation of 200 cases of patients with schistosomiasis has shown an involvement of the lungs in 20% of them and only 2.0% with *"Cor pulmonale"*.

The rôle of the thrombo-embolism in pulmonary hypertension has been already emphasized [10, 11]. COELHO & CARVALHO [6] claim thrombosis in 33% of 24 cases of "schistoso-

motic *Cor pulmonale*". FARIA [9] observed thrombosis and recanalization of the thrombi in cases of "schistosomotic pulmonary arteritis".

It is my opinion that the majority of the cases described as bilharzial "*Cor pulmonale*" are cases of diffuse pulmonary arteritis of other causes, in patients with bilharziasis.

When primary bilharzial "*Cor pulmonale*" occurs it has a greater probability of being due to dead worms than to ova.

These later evidently complicate and aggravate the picture, bringing the granulomatous lesions from the pre-capillaries and capillaries to the arterioles, arteries and "venous structures", near the vessels with larger caliber.

The presence of recent granulomatous lesions produced by the ova, in older chronic vascular lesions (angiomatoides, organized embolization with recanalization) has induced the majority of the observers to consider the later as the result of the action of the former.

With the present experiment I have demonstrated that the adult worms are able to produce embolization and recanalization of the branches of the pulmonary artery. The lack of pulmonary hypertension along with lack of the ova didn't permit the reproduction of histologic picture identical to that seen in human cases. The reduced number of parasites used and the relatively short duration of the experiment are most probably the factors responsible for the absence of a hypertension in the pulmonary circulation of the dogs.

It must be recalled here the very interesting observation made by HEWITT & GILL [12] in mice which may also be very important if the same phenomena occur in man. They have shown that in infected animals the adults worms migrated from the portal system to the pulmonary arterial circulation ("lung shift") after treatment with Emetic Tartar and Miracil D.

## CONCLUSION

Dead adult *Schistosoma mansoni* worms, embolized in the pulmonary branches of the pulmonary artery of dogs are able of producing an organized and recanalized embolization that, after 60 days is indistinguishable from that induced by others causes.

## RESUMO

*Embolização experimental de ramos da artéria pulmonar de cães por formas adultas do* Schistosoma mansoni

Através de cateterismo, o Autor conseguiu a embolização de ramos da artéria pulmonar de cães, com exemplares adultos do *Schistosoma mansoni*.

A evolução das lesões e sua relação com as encontradas no chamado "*Cor pulmonale*" esquistossomótico, é discutida.

## ACKNOWLEDGMENTS

To Dr. José PELEGRINO by supplying the lyophilized worms and to Dr. DALMO AMORIM and his staff for the catheterization of the animals.

## REFERENCES

1. BARROS, O. M.; GIANNONI, F. G.; MARIGO, E. & FRIZZO, F. J. — *"Cor pulmonale"* e miocardite esquistossomóticas. *Arq. Hosp. Santa Casa São Paulo* 2:33-72, 1956.

2. BOGLIOLO, L. — Pathological changes in mansoni bilharziasis. *Riv. anat. pat. e onc.* 23:269-297, 1963.

3. CAVALCANTI, I. L.; THOMPSON, G.; SOUZA, N. & BARBOSA, F. S. — Pulmonary hypertension in schistosomiasis. *Brit. Heart J.* 24:363-371, 1962.

4. CHAVES, E. — *Cor pulmonale* crônico esquistossomótico. II — Alguns aspectos das lesões vasculares pulmonares causadas pelos ovos de *S. mansoni*. *Rev. Inst. Med. trop. São Paulo* 2:163-170, 1960.

5. CLARK, E. & GRAEF, I. — Chronic pulmonary arteritis in schistosomiasis mansoni associated with ventricular hypertrophy. *Am. J. Path.* 11:693-706, 1935.

6. COELHO, R. B. & CARVALHO, J. A. M. — Lesões arteriais pulmonares na esquistossomose mansônica. *III Reunião Bienal Soc. Brasil. Patologistas, Imprensa Universitária Paraná*, 1962, p. 71-101.

7. COURA, J. R.; COUTINHO, S. G.; MORAES, H. M.; DIAS, L. B.; RODRIGUES, N. P. & SILVA, J. R. — Esquistossomose pulmonar. *Hospital* (Rio de Janeiro) 63:993-1012, 1963.

8. FARIA, J. L. — *Histopatologia da endarterite pulmonar esquistossomótica (S. mansoni)*. Tese. São Paulo, Rev. Tribunais, 1952.

9. FARIA, J. L. — Pulmonary vascular changes in schistosomal *Cor pulmonale*. *J. Path. & Bact.* **68**:589-602, 1954.

10. GIRELLI, L. & FALOMO, R. — Studi sulla patologia dell'arteria polmonare e dei suoi rami. *Riv. anat. pat. e onc.* **24**:651-676, 1963.

11. GOODWIN, J. L.; HARRISON, C. V. & WILCKEN, D. R. L. — Obliterative pulmonary hypertension and thrombo-embolism. *Brit. Med. J.* **1**:701-711; 777-783, 1963.

12. HEWITT, R. & GILL, E. — The "lung shift" of *S. mansoni* in mice following therapy with Tartar Emetic or Miracil D. *Am. J. Trop. Med. & Hyg.* **9**:402-409, 1960.

13. JAFFE, R. — Comunicaciones sobre la bilharziosis pulmonar. *Gac. Med. Caracas* **46**: 390-393, 1939.

14. KENAWY, M. R. — The syndrome of cardiopulmonar schistosomiasis (*Cor pulmonale*). *Am. Heart J.* **39**:678-696, 1950.

15. MAGALHAES Filho, A. — Pulmonary lesions in mice experimentally infected with *S. mansoni*. *Am. J. Trop. Med. & Hyg.* **8**: 527-535, 1959.

16. MOSCHCOWITZ, E.; RUBIN, E. & STRAUSS, L. — Hypertension of pulmonary circulation due to congenital glomoid obstruction of the pulmonary arteries. *Am. J. Path.* **39**: 75-93, 1961.

17. ROSSAL, R. E. & THOMPSON, H. — Formation of new vascular channels in the lungs of a patient with secondary pulmonary hypertension. *J. Path. & Bact.* **76**:593-598, 1958.

18. SHAW, A. F. B. & GHAREEB, A. A. — The pathogenesis of pulmonary schistosomiasis in Egypt with special reference to Ayerza's disease. *J. Path. & Bact.* **46**:401-429, 1938.

19. SPAIN, D. M. — *In* WRIGHT, R. A. & VEITH, I. — *Pulmonary circulation*. New York, Grune & Stratton, 1959.

Recebido para publicação em 12/1/1965.