and electron microscopic findings of the present study show no evidence to support the contention that myxoma of the heart evolves from cardiac thrombus nor that its cells are modified muscle cells. Although there is electron microscopic evidence that precollagent may be synthesized by the myxoma cells, the production of mucoprotein rich matrix does not help in identifying the cell or origin, since many cells are capable of synthesizing these substances. The presence, however, of numerous intracytoplasmic fibrils favors an endothelial or basoformative cell origin. This cell origin is strengthened even more by the existence of lipid droplets within the cytoplasm of the cells concerned.

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Discussion

Dr. Harris B. Shumacker, Jr. (Indianapolis): Dr. Symbas and his colleagues have made a significant contribution by relating their clinical experiences with this interesting, life-threatening, and operatively curable intracardiac tumor, and by describing their pertinent experimental observations.

All of our treated cases have been recognized preoperatively, and have done well, and have exhibited no evidence of recurrence.

As Dr. Symbas has mentioned, patients harboring these lesions ordinarily obtain professional aid because of cardiac dysfunction. In rare instances, however, they seek medical, and soon surgical help, because of other manifestations, as was the case with one of our patients, who suddenly developed frightening visual disturbances consequent to a retinal arterial embolus from a partially calcified myxoma.

Sometimes, too, the lesion can be identified by old and simple methods. If the tumor is pedunculated and contains calcium, one can, on the ordinary fluoroscopic screen, see it flip from atrium to ventricle and back again with each heart beat.

In my judgment, the greatest advance in the management of myxomas has perhaps been medical, rather than surgical. I refer to their precise, almost instant recognition by the simple bedside technique of echocardiography.

My institution was among the first to explore the use of ultrasound as a cardiac diagnostic tool, and I feel confident in saying that since the first myxoma was so studied, each one has been identified positively by this technique. So certain am I of its accuracy that I would operate with confidence on any lesion so diagnosed, without any other studies such as cardiac catheterization if operative intervention were fairly urgent. This has proven a life-saving measure. I recall well one patient, practically moribund when first seen, in whom immediate operation could be carried out after promptly establishing the diagnosis in this way. It is almost certain that she would not have survived long enough for other studies to have been done, such as cardiac catheterization.

Dr. Gilbert S. Campbell (Little Rock, Arkansas): Dr. Symbas and his associates are to be commended for their elegant experimentation and careful clinical studies, which clearly demonstrate the neoplastic nature of cardiac myxomata. Even though in half of their cases the tumor was just plucked, they report that all obtained a "gratifying and long-lasting" result. Others have not had such a happy experience.

Thus, as my colleague, Dr. Raymond Read reported last year, 16 patients are now known to have suffered 19 recurrences, after what was thought to be "successful" removal of the left atrial myxomata.

(Slide) This shows the resected tumor in one of our patients. You can see from the photograph that quite a bit of the atrial septal wall was removed with the tumor. He returned nine years later with obvious metastases in the chest wall. The following year he had parascapular metastases, and one year later he died. Autopsy revealed metastasis to the tongue, lungs, more tumor in the heart, and in the thoracic wall.

Another of Dr. Read's patients has had two local recurrences in the left atrium, and is now doing well nearly two years after his last operation, which was followed by a course of Adriamycin. We recommend radical excision of the atrial septum to reduce recurrence from multicentric foci. Extraseptal myxomata are more likely to recur, and on histological study these recurrences have what appears to be a progressively more malignant nature.

Strong efforts should be made to prevent myxomatous emboli, since they can invade locally. These tumors may be multiple and can spread to other heart chambers. Therefore, other chambers of the heart should be inspected at the first operative procedure. Since the malignant potential of these neoplasms has been established, postoperative study with echo cardiography is an excellent non-

invasive technique for following these patients (as suggested by Dr. Schumacker). This followup with echo cardiography needs to be very rigorous.

DR. ALLEN S. HUDSPETH (Winston-Salem): I think that this tumor probably is more common than we have thought in the past. I know the more echo cardiographic studies that are done of the cardiovascular system, I believe, the more you are going to see this tumor. All our patients are screened now with echo cardiography, particularly patients whose cardiologists are following with "mild mitral stenosis." I have removed two of these tumors in the past month, picked up like this, with mild symptoms.

I think the concept that's been mentioned also about the removal of the entire tumor along with part of the septum is important.

I want to show a couple of slides about the surgical aspects of removing these tumors. Removing the left atrial myxoma is a relatively simple operation. However, there are definite hazards associated with it. I think the main risk is air embolism. There is some risk of tumor embolism. The tumor may be fragmented, or incompletely removed.

I have tried various ways of removing these tumors, and I would like to show you the technique I have settled on as what I think is the easiest and safest way to do it.

(Slide) If you clamp the aorta, and use topical hypothermia, completely arrest the heart, then you can operate with leisure, in a bloodless, quiet field. If you don't do this, you may make some mistakes in removing this tumor. Most of these patients have a normal size heart. The right atrium is small, the left atrium is small, and the atrial septum is small; and if you go the various ways that we classically do to approach the septum, and so on, you may get disoriented. You can cut into this tumor, and so on, which might cause some difficulty.

What I think is the best way to approach this structure here (indicating) is the right superior pulmonary vein. If you make a linear incision on the right superior pulmonary vein for about 1–1½ cm, you will look directly into the left atrium. And if the heart is empty, you can very readily see the edge of this tumor. Then I cut on to the right atrial free wall, and then cut directly into the septum; and this gives excellent exposure, even when the heart is small.

(Slide) You can then, very readily, by being partly in the right atrium, partly in the left atrium, cutting down the septum toward the fossa ovale—you can see and control the removal of this tumor very readily.

(Slide) As you see, you can with ease see exactly where you are. You can make this septal defect into a pretty linear defect, rather than a ragged hole. Then, once, this tumor is removed, the fossa ovale is here—they are virtually always attached to the fossa ovale—and then you can lift this out, and then, by the suture technique of your choice, start at this end of the atrial septal defect, come down onto the pulmonary vein, completely closing the septum, obviously using the normal precautions for removing air, and so on, from the left side of the heart, and then continue this suture closure of the right atrium.

(Slide) This shows this particular tumor removed. There is a good margin of normal atrial septum with this.

DR. JOHN L. OCHSNER (New Orleans): I'd like to share with you the blood supply of this tumor, which, as far as I know heretofore has not been described.

(Slide) As you know, there has been some question in the past as to whether this is a true neoplasm. This is an angiocardiogram just showing the typical tumor.

(Slide) The coronaries were injected, and you can see, at the beginning of the right coronary artery is a very large septal branch, going this way.

(Slide) Here you can see it then filling the tumor. This entire area (indicating) is the tumor.

(Slide) Here is the blush of the entire tumor at a later phase.

This, to us, proves without any doubt that this is a true neoplasm, and that it has a very large compensatory blood supply from a large septal branch off the right coronary artery.

DR. WATTS R. WEBB (Syracuse, New York): I think we have had a very excellent presentation and discussion of this entity, which has so many protean manifestations. I certainly agree with the previous speakers that we have gone to routine echo cardiography in any of the patients that have any abnormal presentation of mitral stenosis.

The other thing that we would like to add, and emphasize, as Dr. Ochsner has, is that the coronary arteriography is of great value to you in showing the tumor blush, and often seeing the multiplicity of vessels that may give you some hint ahead of time of the rare one of these that may be malignant. I can assure you, this is no place to try to do a radical resection of a malignant tumor, because you end up with more than you can possibly reconstruct, if you try to take it out. Fortunately, they are very radiosensitive.

The two tumors you have seen presented on slides are a little bit different from many. Many of them are very villiform, filamentous, and you can see when you look at them how easily and readily they would produce emboli.

One of the more unusual presentations that we've had was in a beautiful young girl who was having a peculiar syndrome of multiple, recurrent cerebral arteritis. We didn't know whether it was lupus or periarteritis nodosa, or what was going on, until finally one of the little episodes of arteritis apparently involved the dorsalis pedis. We got a biopsy of this,and the pathologist was able to say: This looks like myxoma of the heart.

Sure enough, we were then eable to demonstrate it by echo cardiography, and remove it, leading to a complete recovery.

DR. P. N. SYMBAS (Closing discussion): Dr. Shumacker, our cardiologists, too, are using the echocardiography for the diagnosis of this cardiac tumor as well as for the diagnosis of thrombus of the left atrium, particularly in patients with mitral stenosis but they also like to have angiocardiographic confirmation. Perhaps, echocardiographic demonstration of the tumor is sufficient for its diagnosis but in our institution is not used exclusively.

As far as the systemic embolization from this tumor which was mentioned by Dr. Webb, indeed, it is one of its manifestations but it was not seen in our group of patients.

Dr. Read's excellent report of malignant cardiac myxomas mentioned by Dr. Campbell enforces the hypothesis that myxoma of the heart are primary tumors.

Dr. Oschner's angiographic demonstration of large vessel feeding the myxoma is very interesting but I do not know whether we can use it as evidence to support the thesis that this cardiac tumor is a primary one. This is because Dr. Salyer in his recent report in the January issue of the *American Heart Journal* theorizes that cardiac myxoma originate from a thrombus in a low pressure cardiac chamber which is invaded by granulation tissue and its growth continuous due to influx of fluid into the lesion because of the differential pressure created between the new vessels of the thrombus and the cardiac cavity. So, he might use the observed by Oschner large vessel in favor of his hypothesis but I think our experimental work with our histochemical and electronmicroscopic findings strongly suggest that the myxoma of the heart is a primary tumor.

I appreciate Dr. Hudspeth's comments that we have to be very careful during the introduction of cardiopulmonary bypass because the greatest catastrophe that can occur during surgery of this curable lesion is a dislodgement of thrombus or tumor fragment and embolization into the brain. Time did not permit to go into operative details but we use some of his intraoperative maneuvers and sometimes in right atrial myxoma it is advisable to cannulate the inferior vena cava through the femoral vein and the superior through the axygos vein rather than through the right atrium so that with the introduction of the cannulus the tumor would not be fragmented and embolized.