A Comparison of Biopsy Through a Parasternal Anterior Mediastinotomy Under Local Anesthesia and Percutaneous Needle Biopsy for Malignant Anterior Mediastinal Tumors

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Abstract: The various methods of treating the numerous types of anterior mediastinal neoplasms are undergoing refinements; however, prior to the commencement of any treatment, an accurate histologic diagnosis must be established. We conducted a retrospective analysis of biopsies performed through a parasternal anterior mediastinotomy (PAM) on 21 patients with an anterior mediastial mass suspected of being malignant by computed tomography (CT) and other clinical information. Patients with possible localized thymomas were excluded. Mediastinotomy, which enables relatively large tissue samples to be taken, was performed through the bed of the second or third costal cartilage under local anesthesia. In 19 of the 21 patients (90%), the histologic diagnosis made from the mediastinotomy biopsy was identical to the final diagnosis. Conversely, although the tissue obtained from needle biopsy was sufficient for a histologic diagnosis in 11 of 12 patients, the histologic diagnosis made from the needle biopsy was the same as the final diagnosis in only 5 of 10 patients (50%). Thus, diagnostic accuracy was significantly higher in the mediastinotomy biopsies than in the needle biopsies ($P = 0.0318$). Moreover, the mediastinotomy biopsy specimens revealed subtypes of lymphomas and germ cell tumors. All of the patients from whom a mediastinotomy biopsy had been taken began appropriate therapy without delay according to the histologic diagnosis. These results suggest that the PAM approach should be chosen as the preferred method of biopsy for suspected malignant anterior mediastinal tumors.

Key Words: biopsy, anterior mediastinal tumor, anterior mediastinotomy

Introduction

Malignant tumors arising from the anterior mediastinum comprise of a variety of histologic types, including

germ cell tumors, thymomas, thymic carcinomas, and malignant lymphomas.[1,2] Recently, the survival rates of patients in whom these neoplasms are treated with combined therapy, often including preoperative chemotherapy or radiotherapy, have improved. To select the most appropriate preoperative therapy, determination of the exact histological diagnosis is essential. Percutaneous needle biopsy of mediastinal masses, guided by computed tomography (CT) or sonography, is widely performed;[3–8] however, the specimens obtained do not always give sufficient histologic information, such as the tumor subtype, to enable a correct therapeutic plan to be made. For this reason, we have been performing biopsies for suspected malignant tumors of the anterior mediastinum through a parasternal anterior mediastinotomy (PAM) under local anesthesia using the method reported by McNeil and Chamberlain.[9] This report describes our experience of performing biopsies through a PAM.

Patients and Methods

Between October 1986 and May 1997, 21 patients with suspected anterior mediastinal malignant tumors underwent biopsies via PAM. There were 4 women and 17 men ranging in age from 18 to 69 years, with a mean age of 35 years.

Patient Selection

Patients with an anterior mediastinal mass were evaluated by CT and magnetic resonance imaging (MRI), often in the setting of clinical symptoms such as recurrent nerve palsy or superior vena cava syndrome. If the findings of this evaluation, including serum tumor marker values, suggested malignant disease and the lesion was situated behind the anterior chest wall, a PAM biopsy was performed to obtain a histologic

diagnosis. Cases of suspected clinically localized thymoma of stage I or II were excluded because violation of the tumor capsule by incisional biopsy could jeopardize the excellent surgical results expected with this lesion. Cases of suspected metastatic disease with an obvious primary site were also excluded, as these diseases can be diagnosed easily in reference to the primary lesion.

Surgical Technique

All of the patients underwent PAM biopsy under local anesthesia with light sedation. Each patient was placed in the supine position, and a transverse skin incision about 4 cm long was made over the second or third costal cartilage. The pectoralis major muscle was divided in the line of incision over the cartilage, which was then removed. The internal mammary vessels were preserved whenever possible. The pleura was separated from the sternum and mediastinum, and opened if there was inadequate exposure or severe adhesions. The target tissue was excised using a scalpel and forceps to ensure that a specimen with a diameter of more than 10 mm was obtained. When the pleura was opened, a chest tube was temporarily placed through the wound, and removed after expansion of the lung with coughing, at the time of wound closure. Finally, a chest radiograph was taken to check for any evidence of a pneumothorax after the biopsy.

Comparison to Percutaneous Needle Biopsy

The results of 12 consecutive fine needle biopsies performed for anterior mediastinal lesions by the Department of Internal Medicine in our hospital during the same period were also reviewed. The tissue for these patients was obtained using a 14-gauge Tru-Cut biopsy needle (Baxter Healthcare, Deerfield, IL, USA) guided by fluoroscopy, CT, or sonography. All of the specimens from the PAM and needle biopsies were evaluated and diagnosed by the same pathologists. Diagnostic accuracy between the PAM biopsies and the needle biopsies was compared by Fisher's exact probability test, and a P-value of less than 0.05 was considered significant.

Results

Table 1 summarizes the results of the PAM biopsies. In 19 of the 21 patients (90%), the histologic diagnosis from the PAM biopsy was consistent with the final diagnosis. In the other two patients, the PAM biopsy specimens did not provide a final diagnosis. In one of these patients (case 5), only necrotic tissue was obtained by

the PAM biopsy, and a lung biopsy specimen obtained through another procedure subsequently revealed an immature teratoma. In the other patient (case 11), only a small volume of tissue was obtained by the PAM biopsy because the tumor was unusually firm, and we were unable to determine if the specimen represented invasive thymoma or Hodgkin's disease. The specimen from a resection performed through a median sternotomy subsequently confirmed Hodgkin's disease. Histologic subtypes were readily determined by PAM biopsy specimens of non-Hodgkin's lymphomas in cases 7, 8, 9, and 10.

Table 2 summarizes the results of the needle biopsy specimens. Although histologically diagnostic tissue was obtained from 11 of the 12 patients, the histologic diagnosis was the same as the final diagnosis determined from radical resection, PAM biopsy, lymph node biopsy, or autopsy specimens in only 5 of 10 patients (50%). Thus, the diagnostic accuracy of the PAM biopsies was significantly higher than that of the needle biopsies ($P = 0.0318$). Moreover, the false diagnoses made from some of the needle biopsy specimens may have caused serious problems in selecting the appropriate therapy. On examining the specimens from cases 23 and 29, it was not possible to distinguish between seminoma and nonseminoma, or between malignant lymphoma and lymphocyte dominant thymoma, respectively. In case 30, a diagnosis of small cell carcinoma was made by needle biopsy, but upon lymph node biopsy the tumor proved to be a malignant lymphoma. Figure 1 shows the differences in microscopic findings between the PAM and needle biopsies in case 29 on whom we performed a PAM biopsy after failing to determine an exact diagnosis by needle biopsy. We also obtained adequate material for immunohistochemical staining from the PAM specimens, this being an important consideration for diagnosing germ cell tumors such as yolk sac tumors and choriocarcinoma (Fig. 2).

There were seven pneumothoraces (33%) caused by opening the pleural cavity in the PAM biopsy patients, all of which were recognized during the surgical procedure and treated as described above. No pneumothorax occurred in the patients undergoing needle biopsy. No patient in our series developed major bleeding requiring blood transfusion or wound infection. All of the patients who had undergone PAM biopsy began appropriate therapy according to the histologic diagnosis without delay.

Discussion

In 1966, McNeil and Chamberlain first described performing an anterior mediastinotomy to obtain a histologic diagnosis of lesions located in the anterior and

Table 1. Profiles of the 21 patients who underwent parasternal anterior mediastinotomy (PAM) biopsy

Case	Age/sex	Histologic diagnosis made from the PAM biopsy	Final diagnosis	Pneumothorax
1	21/M	Yolk sac tumor	Yolk sac tumor	−
2	27/M	Yolk sac tumor	Yolk sac tumor	−
3	27/M	Yolk sac tumor	Yolk sac tumor	−
4	19/M	Immature teratoma	Immature teratoma	+
5	30/M	Necrotic tissue	Immature teratoma	+
6	21/M	Seminoma	Seminoma	−
7	18/F	Malignant lymphoma (non-Hodgkin, T cell)	Malignant lymphoma (non-Hodgkin, T cell)	−
8	22/F	Malignant lymphoma (non-Hodgkin, T cell)	Malignant lymphoma (non-Hodgkin, T cell)	+
9	22/M	Malignant lymphoma (non-Hodgkin, B cell)	Malignant lymphoma (non-Hodgkin, B cell)	−
10	25/M	Malignant lymphoma (non-Hodgkin, B cell)	Malignant lymphoma (non-Hodgkin, B cell)	+
11	27/M	Invasive thymoma or Hodgkin disease	Malignant lymphoma (Hodgkin disease)	−
12	45/F	Invasive thymoma	Invasive thymoma	−
13	47/M	Lung cancer (sq)	Lung cancer (sq)	−
14	63/M	Lung cancer (sq)	Lung cancer (sq)	−
15	47/M	Lung cancer (lg)	Lung cancer (lg)	−
16	65/M	Lung cancer (sm)	Lung cancer (sm)	+
17	44/M	Metastatic cancer (colon cancer)	Metastatic cancer (colon cancer)	−
18	69/M	Metastatic cancer (undiff.)	Metastatic cancer (undiff.)	−
19	21/M	Mature teratoma	Mature teratoma	+
20	28/M	Tuberculoma	Tuberculoma	−
21	57/F	Tuberculoma	Tuberculoma	+

lg, large cell carcinoma; sm, small cell carcinoma; sq, squamous cell carcinoma; undiff., undifferentiated carcinoma

Table 2. Profiles of the 12 patients who underwent percutaneous needle biopsy

Case	Age/sex	Histologic diagnosis made from the needle biopsy	Final diagnosis
22	30/M	Immature teratoma	Immature teratoma[a]
23	20/M	Germ cell tumor	Seminoma[a]
24	17/M	Germ cell tumor	Yolk sac tumor[a]
25	20/M	Seminoma	Seminoma[a]
26	48/F	Thymic carcinoma	Invasive thymoma[a]
27	70/F	Invasive thymoma	Invasive thymoma[a]
28	49/M	Invasive thymoma	Invasive thymoma[a]
29	22/F	Malignant lymphoma or thymoma	Malignant lymphoma[b]
30	35/M	Small cell carcinoma	Malignant lymphoma[c]
31	34/F	Thymic carcinoma (sm)	Thymic carcinoma (sm)[d]
32	21/F	Small cell carcinoma or malignant lymphoma	Not known
33	73/M	Nondiagnostic tissue	Not known

Final diagnoses were determined by [a] radical surgery, [b] PAM biopsy, [c] lymph node biopsy, or [d] autopsy

superior mediastinum.[9] This surgical technique was devised to reach extrapleural lesions in the mediastinum or at the hilum of the lung through a small incision. Several authors[10–12] subsequently confirmed the diagnostic effectiveness of this procedure for mediastinal and pulmonary hilar lesions before the introduction of biopsies guided by CT and sonography. Although the recent widespread use of percutaneous mediastinal needle biopsy guided by CT or sonography has been well documented,[3–8] most do not specify the subtypes of
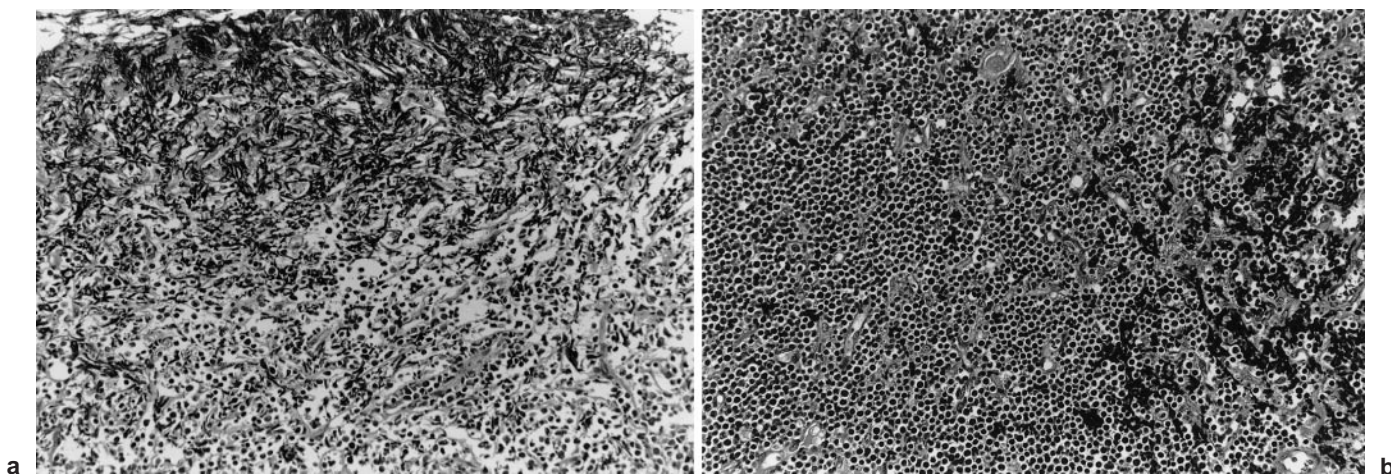
Fig. 1. a Microscopic findings of a needle biopsy specimen from case 28 shows the diffuse proliferation of small or medium-sized lymphocytes; however, it is difficult to distinguish between malignant lymphoma and lymphocyte predominant thymoma due to destruction of the tissue in this specimen. **b** Microscopic findings of a parasternal anterior mediastinotomy (PAM) biopsy specimen from the same patient shows diffuse proliferation of medium-sized lymphoid cells without epithelial cells or perivascular spaces. This specimen was able to be diagnosed as a malignant lymphoma of the diffuse, medium-sized T-cell type (H & E staining, original magnification ×200)
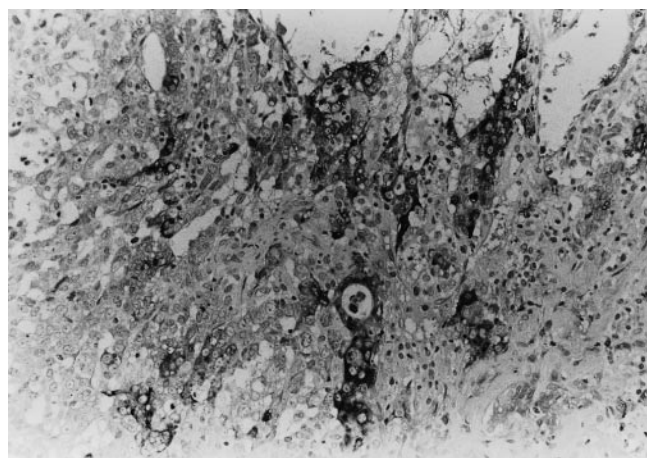
Fig. 2. Immunohistochemical study of a PAM biopsy specimen from case 2 shows positive α-fetoprotein staining in small cystic parts of the tumor which was diagnosed as a yolk sac tumor (original magnification ×200)

lymphomas or germ cell tumors. We believe that larger specimens should be obtained without damage from patients with possible malignant tumors in the anterior mediastinum because of the variety of diagnostic possibilities in this region. Combined therapy for malignant tumors of the anterior mediastinum such as invasive thymomas,[13] germ cell tumors,[14] and malignant lymphomas[15] has improved the survival rates of patients with these diseases; however, before any such therapy can be commenced, a precise histologic diagnosis is essential. The volume of tissue in specimens obtained by needle biopsy is frequently inadequate to enable distinguishing between malignant lymphoma, small cell lung cancer, carcinoid tumor, and lymphocyte-predominant thymoma. Moreover, the tumor subtype of malignant lymphomas[16] and germ cell tumors[14] should be investigated by immunohistochemical techniques to aid in therapeutic decisions. Malignant germ cell tumors often have multiple components unlikely to be represented in a needle biopsy specimen.[3] Robinson et al.[17] demonstrated the fallibility of needle biopsies of anterior mediastinal masses. They described the case of a patient in whom a large mediastinal mass was diagnosed as a mediastinal carcinoid tumor from a percutaneous needle specimen; however, at surgical resection the tumor proved to be a B-cell lymphoma. On the other hand, we excluded any cases of suspected metastatic diseases from among the PAM biopsy candidates because metastases presenting as an anterior mediastinal mass are usually incurable and may be diagnosed easily be referring to information on the primary lesion.[18]

In our series 7 of the 21 patients developed a pneumothorax during the PAM biopsy, all of whom were treated effectively. Furthermore, no major complications delaying the commencement of appropriate tumor therapy occurred. McNeil and Chamberlain argued that PAM biopsy can be performed under local anesthesia or general anesthesia with endotracheal intubation.[9] We performed all the PAM procedures safely under local anesthesia and light sedation, with immediate conversion to general anesthesia available.

Elia et al.[16] reported that cervical mediastinoscopic biopsy under general anesthesia is useful for making a diagnosis of malignant lymphoma in the middle mediastinum. Relatively large samples can be obtained from lesions around the trachea by this procedure; however, masses occupying only the anterior mediastinum cannot be excised by this method. The thoracoscopic approach to mediastinal masses has also recently gained popularity,[19] and we have successfully resected benign mediastinal tumors using this approach.[20] Although histologic diagnoses could have been made by the thoracoscopic approach in many of our 21 PAM patients, we consider PAM biopsy preferable for anterior malignant tumors because thoracoscopy usually requires unilateral ventilation under general anesthesia. Moreover, thoracoscopic incisional biopsy may cause the pleural dissemination of malignant tumor cells.[21]

In conclusion, we believe the PAM biopsy to be an appropriate diagnostic procedure for patients with anterior mediastinal tumors suspected of being malignant, especially if the diagnosis obtained from other biopsy specimens is equivocal, because this procedure can be performed safely under local anesthesia.

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