



# Annual Trend of Metastatic Lung Tumors in Japan

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## Abstract

**Objectives:** The Japanese Association for Thoracic Surgery conducts annual thoracic and cardiovascular surgery surveys. We analyzed the data of patients who underwent surgery for metastatic lung tumors to characterize annual trends.

**Methods:** This retrospective study analyzed the distribution of primary sites, mortality rates, and surgical methods in patients with resected metastatic lung tumors registered by the Japanese Association for Thoracic and Cardiovascular Surgery between 1996 and 2013.

**Results:** The number of resections for metastatic lung tumors increased annually from 2118 in 1996 to 7829 in 2013. The proportion of thoracoscopic surgeries increased from 22.7% in 1996 to 79.6% in 2013. Following the implementation of tracking for hospital mortality rates in 1997, the 30-day and hospital mortality rates were 0.2% and 0.3% and 0.1% and 0.2% in 1997 and 2013, respectively. The primary sites of resected metastatic lung tumors in 1996 were colorectum, kidney, breasts, lungs, bones, soft tissue, ear/nose/throat, uterus, testes, and ovaries in 46.8%, 8.0%, 6.9%, 5.6%, 5.3%, 4.5%, 4.0%, 2.7%, 1.8% and 0.5%, respectively. The proportions of metastases from the breasts, bones, soft tissue, and testicles decreased by at least 0.9% and those of metastases from the colorectum, ear/nose/throat, hepatobiliary system, pancreas, and uterus increased by 1% or more from 1996 to 2013.

**Conclusion:** Although the number of resection surgeries for metastatic lung tumors increased markedly, the mortality rates remained acceptable. Although surgery is necessary for patients with a definite diagnosis of metastatic disease, whether thoracic surgery improves the prognosis in all patients with primary cancer should be considered.

**Keywords:** Metastatic lung tumor; Mortality rate; Thoracic surgery; Video assisted thoracic surgery

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## Introduction

The improvements in the diagnosis and treatment of malignancies have led to improvements in prognosis, which is expected to be associated with increases in the number of metastatic lung tumors. Whether the number of resected metastatic lung tumors changes annually based on the organ of origin remains unclear. The changes in surgical procedures over the years are also a focus of interest. The Japanese Association for Thoracic and Cardiovascular Surgery (JATS) conducts annual surveys for thoracic and cardiovascular surgeries. We analyzed the data of patients who underwent surgery for metastatic lung tumors to examine annual trends in the patient and tumor characteristics in a study based on the open recruitment of academic research subjects using the annual JATS reports.

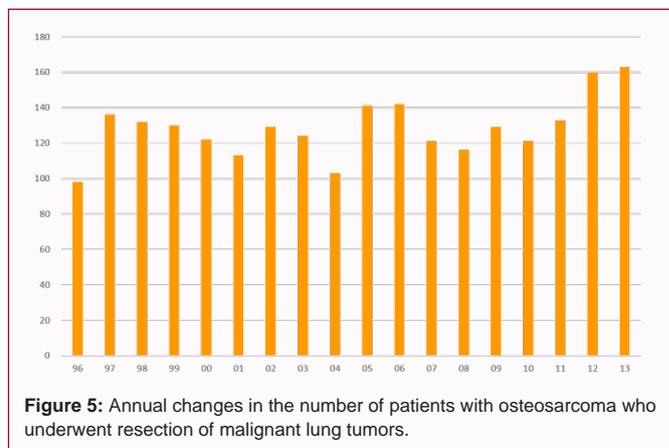
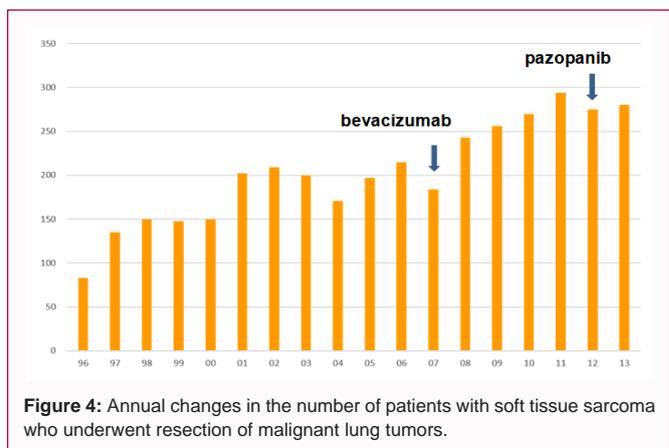
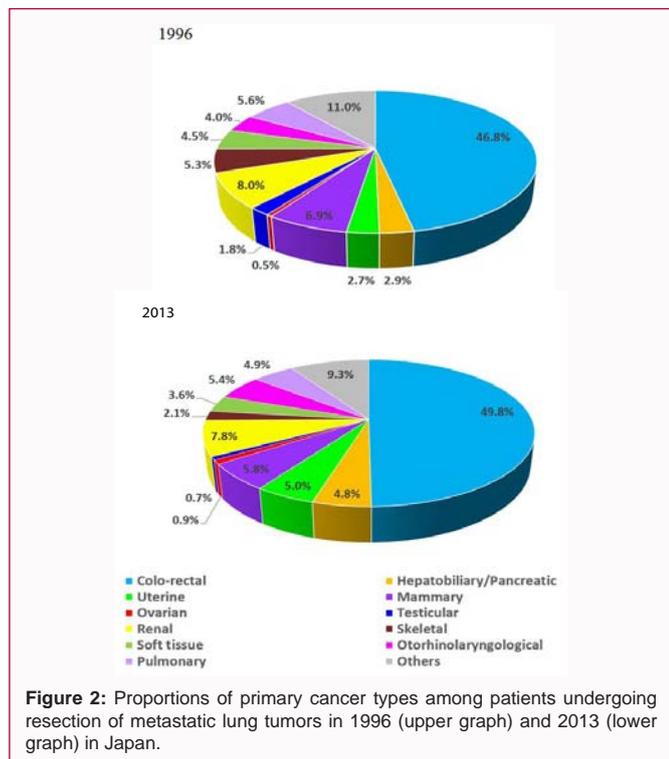
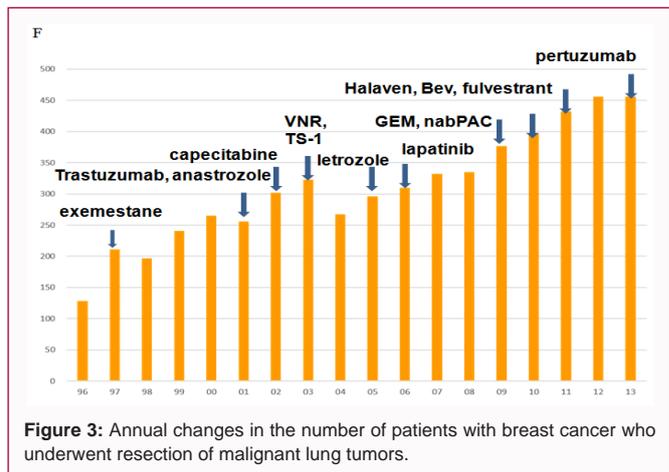
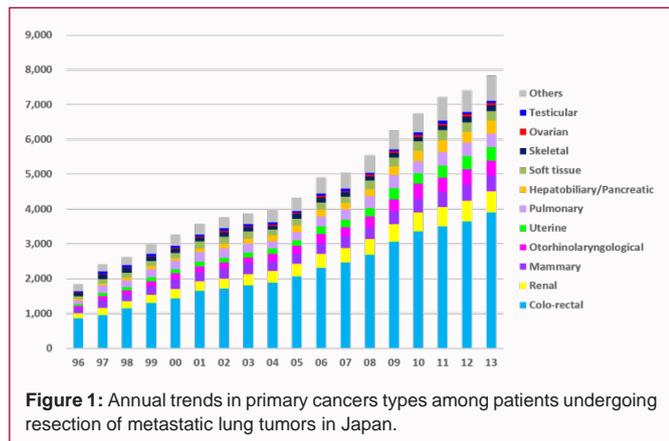
## Materials and Methods

This retrospective study analyzed the distribution of primary tumor sites and 30-day and hospital mortality rates in patients with resected metastatic lung tumors who were registered to the JATS by various institutions across Japan between 1996 and 2013 [1-18]. The 30-day mortality rate was defined as death within 30 days after surgery regardless of the patient's geographic location and included patients who had been discharged from the hospital at the time of death. The hospital mortality rate was defined as death within any time interval after surgery in patients who had not been discharged from the hospital. The surgical methods, especially the proportion of video-assisted thoracoscopic surgeries among all surgeries, were examined retrospectively.

## Results

### Annual changes in the number of resections for metastatic lung tumors

The number of resections for metastatic lung tumors increased annually from 1844 in 1996 to



7829 in 2013 (Figure 1), with more than a four-fold increase between the first and the last year of the study period. The three most frequent primary tumors remained the same throughout the study period and included colorectal, renal, and breast cancers, in descending order. Colorectal cancer was overwhelmingly the most frequent primary cancer, accounting for approximately 50% of the resection cases for metastatic lung tumors. The remaining frequent primary tumors, in descending order, were lung cancer, osteosarcoma, and soft tissue sarcoma in 1996 and ear/nose/throat, uterine, and lung cancers in 2013 (Figure 2).

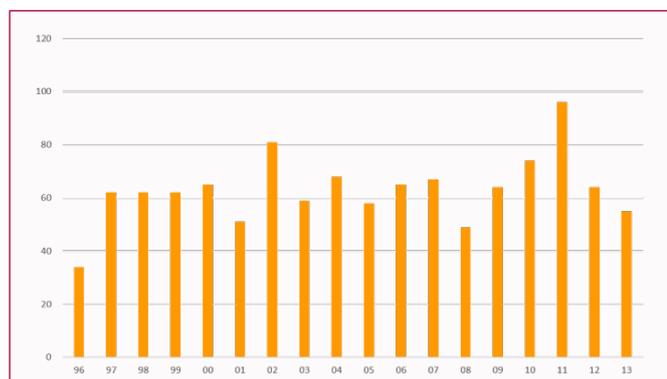
We next analyzed the changes in the proportions of specific cancers and found that the proportions of lung metastases from the breasts, bones, soft tissues, and testicles decreased by at least 0.9% and those from the colorectum, ear/nose/throat, hepatobiliary system, pancreas, and uterus increased by 1% or more throughout the study period.

We next examined the annual trend of proportion decreased primary site. The number of resected metastatic lung tumors

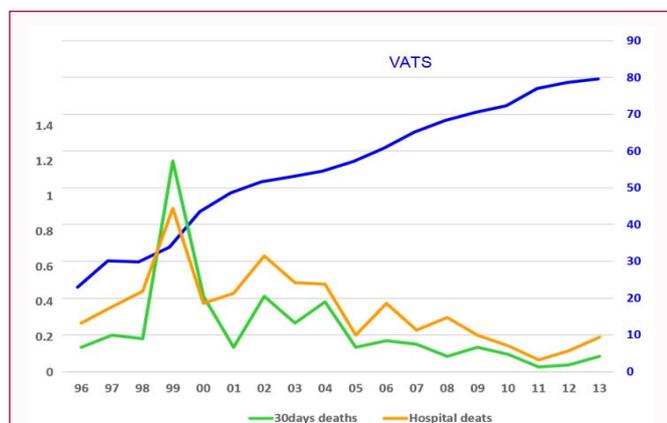
originated from breast cancer increased more than three times during the study period of 17 years (Figure 3). The number of resected metastatic lung tumors originated from soft tissue sarcoma also increased more than three times during the same period; however, the number of patients was originally small, and the rate of increase was slow (Figure 4). Conversely, the number of resected metastatic lung tumors originated from osteosarcoma and testicular cancer increased and decreased repeatedly but only slightly increased during the study periods. (Figure 5,6).

**Annual trends in surgical methods for resection of metastatic lung tumors**

The proportion of thoracoscopic surgeries increased from 22.7%



**Figure 6:** Annual changes in the number of patients with testicular cancer who underwent resection of malignant lung tumors.



**Figure 7:** Changes in the proportions of patients who underwent video-Assisted Thoracic Surgery (VATS) and 30-day and hospital mortality rates during the study period between 1996 and 2013.

in 1996 to 79.6% in 2013 (Figure 7). The 30-day and hospital mortality rates were 0.2% and 0.3%, respectively, in 1997 and 0.1% and 0.2%, respectively in 2013 (Figure 7). Interestingly, we noted that in 1999, both the 30-day and hospital mortality rates were slightly elevated at 1.2% and 0.9%, respectively.

## Discussion

The increases in the number of patients with lung metastases from all primary sites, particularly the colorectum, might be explained by an increase in the number of patients with cancer due to the prolongation of life span afforded by improvements in therapies for malignant tumors.

According to the annual trends in cancer morbidity rates reported by National Cancer Center Japan, the morbidity rates have increased significantly in patients with colon, lung, prostate, and breast cancers. Consequently, the proportions of those with gastric and liver cancers have been decreasing recently [19]. The cancers with the highest morbidity rates are colon, lung, gastric, breast, prostate, pancreatic, and liver cancers, in descending order. Although the morbidity due to gastric cancer has increased, patients with metastatic lung tumors that originate from gastric cancer are less likely to undergo surgery due to multiorgan metastases or pleuritis carcinomatosa [20]. Although the morbidity in prostate cancer has increased during the study periods, metastatic lung tumors are less likely to be surgical indications due to the disseminated metastasis [21].

There are several reasons for the increased proportion of metastatic lung tumors during the study period. In patients with colorectal cancer, the increased proportion of metastatic lung tumors is likely due to the significantly increased morbidity and nodular metastases that are strong indications for thoracic surgery [22].

The likely causes in patients with liver cancer include early detection due to the follow-up of patients with chronic hepatitis and improvements with hepatoma therapy such as radiofrequency ablation [23]. In contrast, the prognosis of pancreatic cancer has not improved and there are currently no effective therapeutic agents. In our experience, the improvements in surgical outcomes in patients with metastatic lung tumors due to pancreatic cancer suggests that the diagnostic purpose should be to rule out primary lung cancer in these patients. Additionally, the improved operability of metastatic lung tumors in patients with head and neck cancers also implicates that the diagnostic purpose should be to determine if the lesion is metastatic in nature. Conversely, the early detection of uterine cancer by annual checkups reflects the improved prognosis and early detection of the metastatic lung tumors. In contrast, the decrease in the proportion of resected metastatic lung tumors in patients with breast cancer might be due to the development of new therapeutic approaches such as molecularly targeted therapies that led to reductions in the rates of surgery, and easy to becoming pleuritis carcinomatosa, despite the increased morbidity [24]. In osteosarcoma, the advances in preoperative chemotherapy to prevent pulmonary metastases and changes in limb salvage procedures should be considered as the underlying causes for the observed changes [25]. Conversely, there are no established treatments for soft tissue sarcomas, which are rare tumors, whereas testicular cancer responds well to BEP therapy (combined cisplatin with bleomycin and etoposide) [26], which might explain the low number of patients with these cancers undergoing thoracic surgery for metastatic lung tumors during the study period.

Notably, the number of video-assisted thoracic surgeries accounted for approximately 80% of the resections in the study cohort. Both the 30-days mortality and hospital mortality rates increased temporarily, those remain stable and close to the open chest surgery rate, suggesting video-assisted thoracic surgery might be useful for the resection of metastatic lung tumors.

## Conclusion

Although the number of patients undergoing surgery for metastatic lung tumors increased significantly, the mortality rates remained acceptable. Although surgery is indicated in patients with a definite diagnosis of metastatic disease, whether thoracic surgery improves the prognosis in all primary cancers should be considered.

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