Systematic Review/Meta-Analysis

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Histopathological features of chest wall masses: a systematic review

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Abstract

Chest wall masses can be caused by trauma, infections, inflammation, or cancer. These tumors can be benign or malignant and originate from different structures of the chest wall. This systematic review aimed to investigate the histopathological characteristics of chest wall masses. The study followed the PRISMA guidelines. PubMed, Scopus, and Web of Science databases were searched for case series that reported the histopathological features of chest wall masses, without any restrictions on the date. The risk of bias was assessed using the JBI critical appraisal tools. Nine studies were included in the final review. Studies included a total of 1,279 patients with chest wall masses, with diverse age ranges. Biopsy methods such as fine-needle aspiration biopsy (FNAB), cutting needle biopsy, and surgical resection biopsy were used to evaluate the pathology of the masses. The rate of malignancy in chest wall masses varied depending on the biopsy method used, ranging from 27.12% in needle biopsy to 47.16% in surgical resection biopsy. The overall rate of malignancy in chest wall tumors was 31.27%. About one-third of the chest wall masses are malignant, emphasizing the importance of accurate diagnosis and appropriate treatment selection. Choosing the proper biopsy method is crucial for achieving successful outcomes and reducing mortality rates. Further research with larger sample sizes and improved reporting is needed to enhance our understanding of chest wall tumor pathology and improve patient outcomes.

Keywords: neoplasms, pathology, systematic review, thoracic wall

Introduction

The chest wall is a structure comprised of various tissues, such as bones (ribs, spine, and sternum), soft tissues, muscles, and nerves.

HIGHLIGHTS

- Accurate diagnosis is important for effective management and underscores the critical role of selecting an appropriate biopsy method.
- Around one-third of the chest wall tumors are malignant.
- The malignancy rate based on needle biopsy was 27.12%, while the rate based on surgical resection was 47.16%.
- The lower sensitivity and specificity of the needle biopsies compared to the surgical ones may be due to the limitation of this technique, sampling problems, and tumor heterogeneity.
- Metastatic lesions (predominantly originating from the breast), sarcomas, and lung cancers were the most prevalent malignant masses, while lipomas were the most prevalent benign masses in cases of chest wall masses.

It has a crucial function in supporting the vital organs within the thorax. Also, it plays a pivotal role as the respiratory pump and the stability of the shoulders and arms. Chest wall tumors (CWTs) are rare lesions accounting for less than 5% of thoracic malignancies[1]. Research proved that CWTs tend to be smaller and benign in younger patients while typically larger and more aggressive in older ones[2]. Different categorizations are provided for CWTs based on tissue origin, site of formation (primary and secondary), and benign and malignant tumors[3]. Since they can arise from different anatomical structures, these tumors generally exhibit a heterogeneous histology[4]. Based on the origin, they are placed in two categories: primary, which originates from the thorax itself,

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and secondary, which is either the result of direct invasion of adjacent anatomical structures or hematogenic and lymphatic diffusion. A study involving 181 cases demonstrated that the majority of these tumors are primary (69%), with most originating from soft tissue (59%). Secondary tumors are often caused by the breast (45%) and the lungs (42%)[5]. However, other studies have reported a higher prevalence of secondary tumors (62.5%)[4,6]. Almost half of the CWTs are malignant[7]. A variety of factors can give rise to chest wall masses including trauma, infections, inflammation, or cancer, and there are hypotheses suggesting that diet, genetics, and lifestyles can have effects on their development[4]. Typically, CWTs come up with pain, palpable mass, or both. The severity of symptoms is correlated with the tumor's location, size, and underlying cause[8]. Accurate diagnosis and effective treatment require a proper understanding of tumors, particularly in rare cases with complex and heterogeneous tissues. Advanced radiological tools are employed to diagnosis of CWTs, locate the mass, and assess the potential characteristics; however, they are not sufficient on their own. It is essential to determine tissue pathology and tumor staging to develop an appropriate treatment approach[9]. Various options exist for biopsy and tissue pathology determination depending on the condition. Therefore, conducting studies in this area is increasingly necessary to assist the multidisciplinary team in completing the protocol and making an appropriate decision based on patients and tumor properties.

Methods

This study was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement[10].

Eligibility criteria

The inclusion criteria were as follows:

- Clinical studies that reported the pathological characteristics of all chest wall masses without limitations regarding the pathological feature, malignancy, or region

The exclusion criteria were as follows:

- Review articles, letters, commentaries, book chapters, and *in vitro* studies.
- Animal studies.
- Conference abstracts.
- Languages other than English.

Information sources and search strategy

This study is registered with PROSPERO (CRD42024597584) For this systematic review, two independent authors conducted a comprehensive search across the PubMed, Scopus, and Web of Science databases to identify articles reporting on chest wall masses up to 4 August 2022. No filters were applied to any of the search parameters, including the date, study type, or language. Additionally, backward and forward citation searches of all included studies were performed. The search strategy for Pubmed included a combination of the following approaches: ("Thoracic Wall"[Mesh] OR "Chest Wall"[Title/Abstract] OR "Thoracic Wall"[Title/Abstract]) AND ("Neoplasms"[Mesh] OR Tumor*[Title/Abstract] OR Neoplasm*[Title/Abstract] OR Cancer[Title/Abstract] OR Malignant*[Title/Abstract] OR Mass[Title/Abstract]) AND ("Pathology"[Mesh] OR Pathology*[Title/Abstract])

Selection process

All articles identified through electronic and manual searches were imported to EndNote, version 20 (Clarivate), and then, duplicates were removed. Two authors independently assessed the title and abstract of the articles, excluding those that seem irrelevant. Subsequently, the authors reviewed the full texts of the remaining articles. Any discrepancies were addressed by discussion or by consultation with another author.

Data extraction

Previously designed Microsoft Office Excel forms were used for data extraction. Two reviewers independently extracted the following information from each included study, which was double-checked by another author. Any disagreements were resolved through discussion between the two reviewers or by consulting with a third reviewer. The following data were extracted from the studies[1]: the basic information about the study, including the first author's name and publication year[2]; characteristics of the participants, including sample size, age, sex, and biopsy methods; and[3] the histopathological findings of the masses, including whether they are benign or malignant and their subgroups, with the exact count of each group.

Quality assessment

Two reviewers independently appraised the risk of bias (RoB) and the quality of the included articles using the Joanna Briggs Institute's (JBI) critical appraisal tool for case series, and disagreements were resolved by discussion between reviewers or by consulting with a third reviewer. This checklist includes ten questions about the inclusion criteria, the condition measuring and identification methods, consecutiveness, the clear reporting of the demographics and clinical information of the participants, the clear reporting of the follow-up results, an obvious reporting of clinical demographics, and appropriate statistical analysis.

Results

Study selection

As shown in Figure. 1, among 1,907 records, 21 of them remained for full-text evaluation. After evaluating the full texts, eight studies were excluded because they did not report the pathological findings of the chest wall masses[11–18], three studies were written in languages other than English[19–21], and one of them was excluded because it only discussed malignant masses[22]. Finally, nine studies were reviewed in the results.

Study characteristics

Nine case serie studies were included in our study (Table 1). A total of 1,279 patients were enrolled in these studies. The patients' age range was from 5 months to 86 years old. Among these individuals, there were 595 women and 684 men. Patients with chest wall masses were included in studies, and different localization methods such as chest radiology, computed

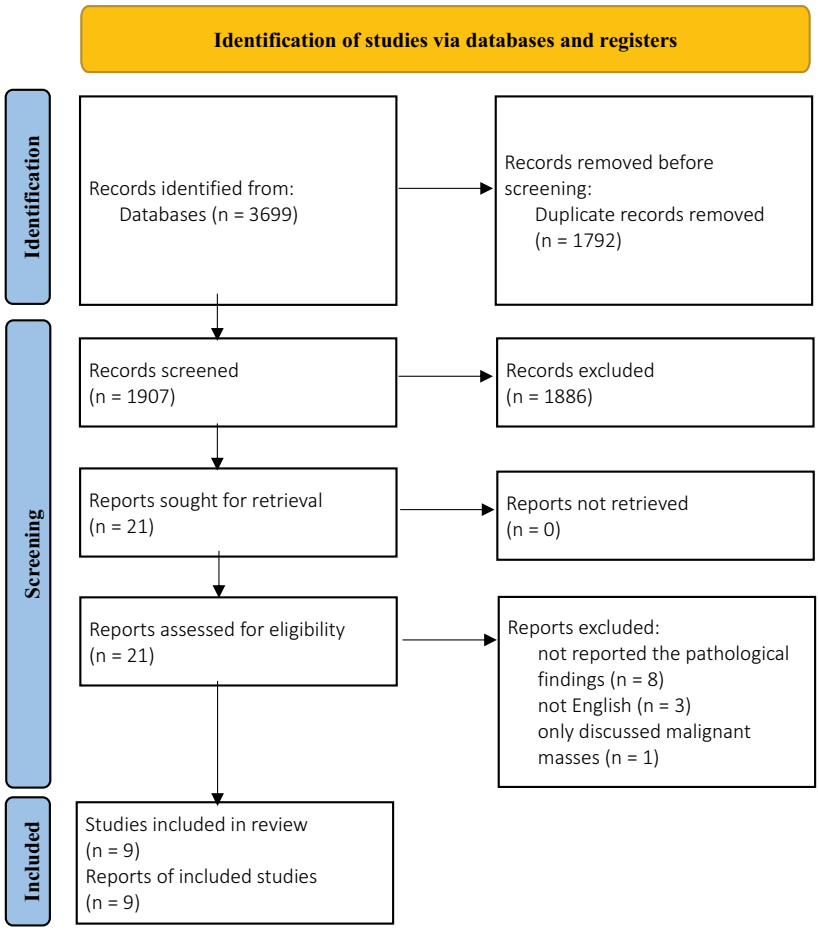

Figure 1. PRISMA flow diagram. *From*: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/.

tomography (CT) scan, magnetic resonance imaging (MRI), and positron emission tomography (PET) were used. To evaluate the pathology of the mass, fine-needle aspiration biopsy (FNAB), cutting needle biopsy, and incisional biopsy were applied.

Risk of bias in studies

The results of RoB are presented in Table 2. Five studies did not clarify the performance of statistical analysis, so the answer to this question was unclear. Generally, we could not find a considerable bias in a great number of studies, and none of them were excluded due to the high risk of bias.

Results of individual studies

Cakmak *et al*. evaluated 86 patients with chest wall mass in three groups of bone, soft tissue, and cartilage-originated masses. The results showed that 32 (soft tissue = 5, cartilage = 11, bone = 16) masses were malignant, and 54 (soft tissue = 36, cartilage = 12, bone = 6) were benign[23].

In Chudacek *et al*.'s study, among 57 chest wall masses, 41 were malignant, and 16 were benign[24].

The results of the Dharmaraj et al. study showed that, among 20 patients with chest wall mass, 14 and six of them had malignant and benign masses, respectively[25].

Goel *et al*. performed fine-needle aspiration cytology (FNAC) on 227 patients with chest wall lesions. The results revealed that there were 81 malignant and 146 benign lesions[26].

In Goyal *et al*.'s study, among 726 patients who were subjected to chest wall FNAC, 358 of them were diagnosed as inflammatory and 368 as neoplastic lesions. Of the neoplastic lesions, 153 were malignant, with a majority of carcinomas[27].

Kolta *et al*. conducted a prospective observation study to evaluate the role of MRI in comparison between benign and malignant chest wall masses in correlation with pathology. The histopathological findings confirmed the benign nature of the lesions in 13 patients, while 18 lesions were malignant[28].

Özuslu *et al*. enrolled 94 patients with resected chest wall tumors. Among them, 16 patients had primary malignant chest wall tumors, 11 patients had metastatic chest wall tumors, and 67 patients had benign chest wall tumors[29].

Eight patients with chest wall tumors were admitted in the study of Qi *et al*. After mass resections, postoperative pathological reports showed that two patients had benign costocartilage tumors, and six had malignant tumors, which included one squamous cell carcinoma of the lung, one lung adenocarcinoma, one malignant lymphoma of the chest wall, two chest metastasis of breast cancer, and one chest wall neurofibrosarcoma[30].

Table 1

The characteristics and pathological findings of the included studies

Study	N (Female / male)	Age (Mean ± SD)	Biopsy method (N)	Histopathological findings	
				Malignant	Benign and non-tumor
Sagar2000[31]	30 (9/21)	43.5 ([14–66])	FNAB[23]	Bronchogenic carcinoma (squamous cell carcinoma: 5/19; adenocarcinoma: 3/19; small cell anaplastic carcinoma: 2/19); non-Hodgkin lymphoma: 1/19; thymoma: 1/19; well-differentiated thymic carcinoma: 0/19; primitive neuroectodermal tumor: 1/19: Ewing's sarcoma: 1/19: malignant germ cell tumor: 1/19: metastases: 2/19: malignant neoplasms not otherwise specified: 2/19	Granulomatous inflammation: 2/4 (tuberculosis acid fast bacilli positive: 2/4); benign fibrous mesothelioma: 1/4; schwannoma: 1/4
			Cutting needle biopsy[20]	Bronchogenic carcinoma (squamous cell carcinoma: 3/13; adenocarcinoma: 1/13; small cell anaplastic carcinoma: 2/13); non-Hodgkin lymphoma: 0/13; thymoma: 2/13; well-differentiated thymic carcinoma: 1/13; primitive neuroectodermal tumor: 1/13; Ewing's sarcoma: 0/13; malignant germ cell tumor: 1/13; metastases: 0/13; malignant neoplasms not otherwise specified: 2/13	Granulomatous inflammation: 4/7 (tuberculosis acid fast bacilli positive: 2/7; tuberculosis acid fast bacilli negative: 2/7); benign fibrous mesothelioma: 2/7; schwannoma: 1/7
			Both modalities	Bronchogenic carcinoma (squamous cell carcinoma: 5/23; adenocarcinoma: 3/23; small cell anaplastic carcinoma: 2/23); non-Hodgkin lymphoma: 1/23; thymoma: 2/23; well-differentiated thymic carcinoma: 1/23; primitive neuroectodermal tumor: 1/23; Ewing's sarcoma: 1/23; malignant germ cell tumor: 1/23; metastases: 2/23; malignant neoplasms not otherwise specified: 2/23; undiagnosed: squamous cell carcinoma: 1/23; malignant thymoma: 1/23	Granulomatous inflammation: 4/7 (tuberculosis acid fast bacilli positive: 2/7; tuberculosis acid fast bacilli negative: 2/7); benign fibrous mesothelioma: 2/7; schwannoma: 1/7
M.cakmak 2016[23]	86 (30/56)	46.18 ± 10.16	Incisional biopsy[15]	**Cartilage**: Chondrosarcoma: 11/11	**Cartilage**: Chondroma: 7/12; chondroblastoma: 2/12; fibrous dysplasia: 2/12; chondromyxoid fibroma: 1/12
				Bone tissue: Osteosarcoma: 16/16	**Bone tissue**: Osteochondroma: 5/6; giant cell tumor: 1/6
				Soft tissue: Liposarcoma: 1/5; MFH: 1/5; leiomyosarcoma: 1/5; plasmacytoma: 1/5; lymphoma: 1/5	**Soft tissue**: Lipoma: 12/36; fibrolipoma: 6/36; ganglioneuroma: 2/36; leiomyoma: 2/36; cystic hygroma: 1/36; hemangioma: 1/36 inflammatory: tuberculosis abscess: 4/36; hydatid cysts: 2/36; nonspecific abscess: 6/36;
J. Chudacek 2015[24]	57 (18/39)	61 ([16–86])	Chest wall resection	**Primary cancer (N: 13)**: Chondrosarcoma: 4/13; fibrosarcoma: 2/13; angiosarcoma: 1/13; osteosarcoma: 1/13; pseudosarcoma: 1/13; Malig. histiocytoma: 1/13; multiple myeloma: 1/13 **Lung tumor-infiltrating chest wall (N: 19)**: Spinocellular: 8/19; adenocarcinoma: 7/19; large cell: 2/19; sarcomatoid: 2/19 **Metastatic tumor (N: 9)**: mammary: 2/9; clear-cell renal cancer: 2/9; melanoma: 2/9; pulmonary adenocarcinoma: 1/9; solitary fibrous tumor: 1/9; malignant thymoma: 1/9	Chondroma: 9/16; elastofibroma: 3/16; pseudotumor: 2/16; neurinoma: 2/16
B. Dharmaraj 2021[25]	20 (12/8)	57	Surgery	Sarcoma: 8/13; breast cancer /phyllodes tumor: 3/13; metastatic thyroid carcinoma: 1/13; thymic cancer: 1/13	Neurofibroma: 1/6; lipoma: 1/6; schwannoma: 1/6 giant cell tumor: 1/6; desmoid fibromatosis: 2/6
A. Goel 2001[26]	227 (1/1.3)	5 mons. to 86 yrs.	FNAB	Carcinoma: 57/81; Ewing's/malignant round-cell tumors: 6/81; NHL: 2/81; plasma-cell tumor: 4/81; chondrosarcoma: 1/81; malignant melanoma: 2/81; mixed germ-cell tumor: 1/81; neuroendocrine tumor: 1/81; malignant nerve-	Inflammatory (N: 68/126) (acute/organizing abscess: 38/126; tuberculosis/granulomatous: 21/126; cysticercosis: 8/126; filariasis: 1/126); lipoma: 38/126; epidermal inclusion cysts: 8/126; spindle-cell lesions/tumor: 6/126;

(*Continued*)

Table 1

(Continued).

Study	N (Female / male)	Age (Mean ± SD)	Biopsy method (N)	Histopathological findings	
				Malignant	Benign and non-tumor
				sheath tumor: 1/81; epithelioid leiomyosarcoma: 1/81; AML infiltrate: 1/81; malignancy, not otherwise specified: 3/81; consistent with dermatofibroma: 1/81	chondroma: 3/136; benign adnexal tumor: 2/126; hematoma: 1/126;
Surbhi Goyal 2014[27]	726 (376/350)	1–93-years-old	FNAB	Carcinoma 135/153 (scar site recurrence in breast carcinoma (73/135); metastatic carcinomas (62/135)); primary sarcomas (8/153), hematological neoplasms (6/153), and miscellaneous group (4/153)	Inflammatory: 358 (tuberculosis mycobacterial: 234; pyogenic abscess:66; parasitic: 56; fungal abscess: 2); non-malignant neoplastic lesion: 215 (lipoma (121/215); vascular malformation/lesion;vascular malformation/lesion; epidermal cyst (57/215); primary spindle-cell mesenchymal tumor; calcinosis cutis (2/215); keloid (3/215)
Kolta et al. 2021[28]	31 (16/15)	([3–72])	US- or CT-guided biopsies	18	13
B Ali Özuslu et al. 1998[29]	94 (3/91)	22.85 ([12–69])	Surgical resection	**16 Primary malignant:** (Ewing's sarcoma: 5, myeloma: 4, chondrosarcoma: 3, malignant fibrous histiocytoma: 2, osteogenic sarcoma: 1, Hodgkin's lymphoma: 1); **11 metastatic tumor:** (bronchogenic carcinoma: 5, renal cell carcinoma: 2, gastrointestinal carcinoma: 1, thyroid carcinoma: 1, nasopharynx carcinoma: 1, synovial cell sarcoma: 1)	Fibrous dysplasplasia: (19/67), hemangioma: (9/67), chondroma: (6/67), osteochondritis: (6/67), osteochondroma: (5/67), lipoma: (5/67), hydatid cyst: (4/67), eosinophilic granuloma: (3/67), fibroma: (2/67), dermoid cyst: (2/67), cystic hygroma: (2/67), desmoid tumor: (1/67), osteoblastoma: (1/67), chondroblastoma: (1/67), schwannoma: (1/67)
Yu qi et al. 2014[30]	8 (3/5)	54.62 ± 8.91 ([34–65])	Excisional (Surgical resection)	**6** (including 1 with squamous cell carcinoma of lung, 1 with lung adenocarcinoma, 1 with malignant lymphoma of chest walls, 2 with chest metastasis of breast cancers, and 1 with chest wall neurofibrosarcomas)	**2** (benign costicartilage tumors)

Abbreviation used in table: FNAB: fine-needle aspiration biopsy; US: ultra-sonography; CT: computed tomography; NHL: non-Hodgkin lymphoma; AML: acute myeloid leukemia; MFH: malignant fibrous histiocytoma.

In order to compare the diagnostic yield of FNAB and cutting needle biopsy in thoracic lesions, Sagar *et al*. enrolled 30 patients with chest wall mass. The results revealed that a total of seven patients had benign lesions, including granulomatous inflammation, benign fibrous mesothelioma, and schwannoma, while 23 patients had malignant lesions[31].

Results of syntheses

In this study, a total of 1,258 cases of chest wall masses were examined. Out of these, 394 cases were classified as malignant. Within the malignant subset, metastatic lesions (predominantly originating from the breast) represented the largest proportion. Sarcomas (such as chondrosarcoma, osteosarcoma, Ewing sarcoma, etc.) were the second most common, followed by primary lung cancers (including squamous cell carcinoma, adenocarcinoma, and small cell anaplastic carcinoma) ranked third.

Furthermore, in this systematic review, we identified 864 cases as benign or non-tumor. Among these, 446 pathologies were inflammatory cysts, whereas 418 were classified as benign neoplasms. Among the determined benign neoplasms, lipoma was the most prevalent, followed by chondroma.

Needle biopsy had been used in Sagar, Goel, Goyal, and Kolta's studies in order to evaluate the pathology of the masses, and 275 out of 1,014 (27.12%) were reported malignant in the studies. Five studies used surgical resection to assess the pathological features of the chest wall masses, and 125 out of 265 (47.16%) were reported malignant. The overall rate of malignancy was 31.27% (400/1,279).

Discussion

Thoracic surgeons encounter challenges in the diagnosis and treatment of chest wall tumors, especially in evaluating the histology of masses. The heterogeneity of the tissue and genotype makes a difference in the clinical course and also the response to the treatment. Therefore, it is important to accurately identify the tissue before treatment[32]. Needle biopsy and surgical resection are common methods employed for this purpose, but they present remarkable differences in accuracy and invasiveness. The main objective of this systematic review was to investigate the pathological characteristics of chest wall tumors and their rate of malignancy, providing surgeons a valuable insight for decision-making at crucial junctions of safety and accuracy in patient care. In our study, the malignancy rate based on needle biopsy was 27.12%, while the rate based on surgical resection was 47.16%. The overall rate of the malignancy rate, combining both biopsy methods, was 31.27%. This slight difference might be due to the lower sensitivity and specificity of the needle biopsies compared to the surgical ones. The weaker performance of needle biopsy compared to resection in these cases can have different causes, including the limitation of this technique, which causes false negative results due to

Table 2

The risk of bias of the included studies

Question Study	1	2	3	4	5	6	7	8	9	10
Cakmac[23]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Chudacek[24]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dharmaraj[25]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Goel[26]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	UC
Goyal[27]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	UC
Kolta[28]	Yes	Yes	Yes	No	No	No	Yes	Yes	No	Yes
Ozuslu[29]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	UC
Qi[30]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	UC
Sagar[31]	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	UC

Question 1: Were there clear criteria for inclusion in the case series?
Question 2: Was the condition measured in a standard, reliable way for all participants included in the case series?
Question 3: Were valid methods used for identification of the condition for all participants included in the case series?
Question 4: Did the case series have consecutive inclusion of participants?
Question 5: Did the case series have complete inclusion of participants?
Question 6: Was there clear reporting of the demographics of the participants in the study?
Question 7: Was there clear reporting of clinical information of the participants?
Question 8: Were the outcomes or follow-up results of cases clearly reported?
Question 9: Was there clear reporting of the presenting site(s)/clinic(s) demographic information?
Question 10: Was statistical analysis appropriate?

problems in sampling and tumor heterogeneity. Especially in cases where the size of the tumor is small or located near a vital organ, there is a possibility that an acceptable amount of tissue is not taken and accurate histopathological evaluation is not possible[33].

Both core needle biopsy (CNB) and open incision biopsy (IB) are commonly used in musculoskeletal system evaluation[34]. However, there is disagreement among pathologists regarding these two methods. Some consider the CNB method to be preferable, while two recent meta-analyses have demonstrated that the diagnostic accuracy of IB is higher[35,36]. Additionally, a recent study by Birgin and his colleagues investigating the histology of soft tissue sarcomas showed that the IB technique has greater accuracy than the CNB, along with fewer adverse events[37]. When it comes to primary bone or cartilage tumors, fine-needle aspiration biopsy is not the preferred diagnostic method[38,39]. On the other hand, in the histological examination of the cartilage, IB is regarded as the preferred technique. In the study of Klein *et al*., it was reported that 18% of the sampled were incorrectly classified as benign: 33.3% through the CNB group and 11.1% IB group. Additionally, CNB was not accurate in grading chondrosarcomas[34]. Instead, fine-needle aspiration biopsy tends to be utilized for assessing chest wall metastasis in tumors where malignancy is already known. For primary chest wall tumors that are over 5 cm and cannot be diagnosed through needle biopsy, incisional biopsy is the preferred diagnostic method. When planning incisions, it is crucial to consider future surgical procedures. In patients whose tumors are smaller than 5 cm, an excisional biopsy with a 1 cm margin can be carried out for diagnostic purposes. If a benign tumor or a malignancy that requires medical treatment, such as chemotherapy or radiotherapy, is detected, no further surgical intervention is necessary[23,40].

The results of this study add to the existing knowledge by providing an overall estimate of the malignancy rate in chest wall tumors. However, there are some limitations to consider. The number of included studies is relatively small, and the studies may have heterogeneity in patient populations, tumor types, and diagnostic methods. Additionally, we acknowledge limitations in reporting demographic information and statistical analysis in some of the studies. Last, for our review, we only considered studies that were published in English. However, we used a thorough search strategy with no restrictions based on the year of publication. Further research with larger sample sizes and standardized reporting would enhance the generalizability of the findings.

Conclusion

We found that approximately one-third of the chest wall masses are malignant. To successfully manage a chest wall tumor, the first and most important step is to diagnose it accurately. Choosing the proper biopsy method is crucial in determining the appropriate chest wall resection needed, depending on the tumor's histopathologic type. This treatment based on histopathologic characteristics is critical in achieving lower morbidity and mortality rates for chest wall tumors. This study will help researchers and clinicians diagnose types of chest wall tumors and prevent complications.

Ethics approval

The ethics committee of the Tabriz University of Medical Science reviewed and approved the study protocol (IR.TBZMED.VCR.REC.1401.063) on 17 July 2022.

Consent

Not applicable.

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Author's contributions

S.S., H.A., S.R., G.H., H.I., A.N., N.F., and B.G.: systematic search; study selection, data extraction, risk of bias assessment, preparing the figures, and drafting the manuscript; L.N. and M.M.: conceptualization; supervision and critically editing the manuscript. All authors approved the final version for submission.

Conflicts of interest disclosure

The authors declare no conflicts of interest.

Research registration unique identifying number (UIN)

This study is registered in PROSPERO (CRD42024597584).

Guarantor

Dr Negin Frounchi.

Provenance and peer review

Not invited.

Availability of data and materials

All data generated during this study are included in this published article.

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