

COMPUTER TOMOGRAPHY IMAGING FEATURES OF TUMORS AND SUSPECTED NODAL METASTASES IN HYPOPHARYNGEAL CANCER

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SUMMARY

Hypopharyngeal cancer is a malignant tumor derived from the malpigi-covered epithelium of the hypopharynx, accounting for 5% of all head and neck cancers, neck ganglion metastasis is a poor prognosis. **Objective:** To characterize the tumor and cervical nodal of patients with hypopharyngeal cancer on a computed tomography scan.

Subjects and research methods: Describe a series of cases, including 40 patients are diagnosed hypopharyngeal cancer and treated at K3 Tan Trieu hospital in 2024-2025.

Results and discussion: On CT imaging, a hypopharyngeal tissue mass was identified in all patients (100%), increase density (95%), strong drug absorption (92%), unknown boundaries (97.5%), and heterogeneous density was present in 100% of lesions. The piriform sinus is the most common (82.5%), with the majority of large tumors occupying the entire piriform sinus (40%). Cervical ganglion metastases on CLVT include irregular drug penetration characteristics (100%), loss of umbilical node structure (86.7%), central necrosis (86.7%), the ratio of longitudinal/transverse diameter < 2 accounts for 96.5%, the diameter of the transverse node axis > 1cm accounts for 48.3%. Group II and III Lymph nodes metastasize the most (64.3%). At the time of diagnosis, 72.5% of cases had suspected metastases, including 25% classified as N2b Stage.

Keywords: hypopharyngeal cancer, lymph nodes, nodal metastases, CT scanner

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I. OVERVIEW:

Hypopharyngeal cancer is a head and neck cancer, accounting for 4-5% of head and neck cancers, and is a malignant tumor that mainly originates from the malpigi epithelium layer of the mucosa covering the hypopharynx. Cervical lymph node metastasis is a severe prognostic factor, this is also the main route of spread and distant metastasis of hypopharyngeal cancer, because the lymphatic network in this area is very developed. Diagnosis is determined based on histopathology, diagnosis of the disease stage in general and T and N stages in particular based on clinical and imaging diagnosis, CT scan of cervical with contrast injection with a slice thickness of 4-5mm is a means of assessing the size, invasiveness of adjacent tissues, neck lymph node metastasis. Thus, CT scans are extremely important, helping surgeons orientate conservative or surgical treatment. In surgery, CT scans help surgeons choose the access route and resection boundary, ensuring the principle of removing all tumors, determine the groups of cervical nodes to be removed, and preserve maximum function for patients, the groups of cervical lymph nodes that need to be removed, and preserving maximum function for the patient. Therefore, we conducted this study to *characterize tumor lesions and metastatic suspected lymph nodes on computed tomography (CT) of patients with hypopharyngeal*

cancer. From there, we provide more valuable data to support the diagnosis, treatment, and prognosis of diseases.

II. STUDY OBJECTS AND METHODS

2.1. Materials

Including 40 patients with hypopharyngeal cancer treated inpatient at the Ear- Nose- Throat Department - K3 Tan Trieu Hospital. Period from January 2024 to June 2025. Selection of patients diagnosed with cancer of the throat, pathological anatomy results, complete archival records. Exclude patients who have had previous chemotherapy, radiation, surgery.

2.2. Study design

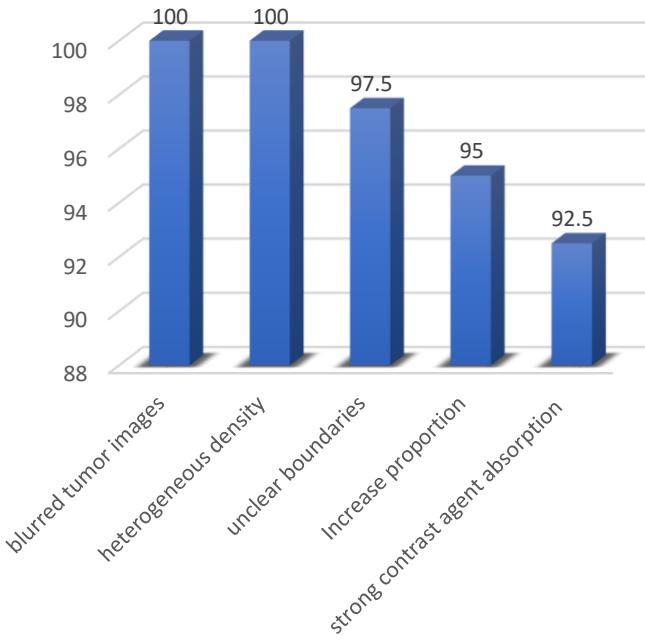
The research method describes a series of cases, convenient sampling methods, data collection by retrospective medical records. Using SPSS 20.0 software to process and analyze data according to medical statistics method. Research parameters: tumor, cervical lymph nodes, CT scan.

III. STUDY RESULTS

3.1. Characteristics of hypopharyngeal cancer lesions on CT scan :

3.1.1. Tumor characteristics on CT scan:

Tumor characteristics on CT scan



100% of tumors have a have blurred tumor images, heterogeneous density; 95% have increased density compared to the surrounding tissue, strong contrast agent absorption 92.5 % , unclear boundaries 97.5%.

3.1.2. Location of hypopharyngeal cancer :

Location of hypopharyngeal cancer		N	%	
Pyridium sinus	The entire piriform sinus	16	48,5	
	The outer wall	15	45,5	
	The inner wall	2	6	

Location of hypopharyngeal cancer	N	%
The posterior wall of the hypopharynx	7	17,5
Total	40	100

Pyridium sinus accounts for 82.5%, of which tumors of the entire piriform sinus account for the majority 48.5%; followed by the outer wall of the piriform sinus 45.5%, the inner wall accounts for only 6%; the posterior wall of the hypopharynx accounts for 17.5%.

3.1.3. Characteristics of tumor spread:

Characteristics of tumor spread	N	%
The tumor is still localized in the hypopharynx	20	50
The tumor spreads outside the hypopharynx	20	50
Total	40	100

In 50% of cases, the tumor is still localized in the hypopharynx, and in 50% of cases, the tumor spreads outside the hypopharynx. The most common inward spreading direction, the most commonly invaded structures are the arytenoid cartilage/arytenoid plate/epiglottic cartilage, accounting for 62.5%. The second most common direction of spread

is anterior spread, invading the thyroid cartilage/cricoid cartilage/cricothyroid membrane, accounting for 27.5%. In 12.5% of cases, it spreads to the esophageal muscle, and in 5% of cases, it spreads to the prevertebral fascia.

3.1.4. *Tumor size:*

Tumor size	N	%
< 2cm	7	17.5
2cm -4cm	23	57.5
>4cm	10	25
Total	40	100

The majority of tumors are detected when the tumor size is $\geq 2\text{cm}$ and $< 4\text{cm}$, accounting for 57.5%.

3.2. Characteristics of suspected metastatic lymphadenopathy on CT scan

3.2.1. *Characteristics of suspected metastatic lymph nodes on CT scan:*

Characteristics of suspected metastatic lymph nodes	N	%
Strong contrast enhancement	29	100
Loss of umbilical ganglion structure	26	86,7

Characteristics of suspected metastatic lymph nodes	N	%
central necrosis	26	86,7
Vertical axis/horizontal axis ratio of the ganglion < 2	28	96,5
The diameter of the horizontal axis of the ganglion $> 1\text{cm}$	14	48,3%

There were 29/40 cases of suspected lymph node metastasis on CT scan at the time of examination, accounting for 72.5%. The typical features of suspected metastatic cervical lymph nodes are strong contrast enhancement (100%); loss of umbilical ganglion structure (86.7%); central necrosis (86.7%), vertical axis/horizontal axis ratio of the ganglion < 2 accounts for 96.5%, the diameter of the horizontal axis of the ganglion $> 1\text{cm}$ accounts for 48.3%.

3.2.2. *Groups of metastatic lymph nodes on CT scan:*

<i>Groups of metastatic lymph nodes</i>	N	%
II	7	25
III	2	7,1
IV	1	3,6
II+III	18	64,3
Total	29	100

Group II and group III lymph nodes are the most monitored for metastasis at the time of diagnosis, especially 64.3% of suspected metastases at the same time of group II and III lymph nodes; 25% of suspected metastases of group II nodes; 7.1% of suspected metastases of group III nodes.

3.2.3. Grading of cervical lymph nodes on CT scan:

<i>Grading of cervical lymph nodes</i>	N	%
N1	9	31
N2a	3	10,4
N2b	10	34,5
N2c	7	24,1
N3	0	0

<i>Grading of cervical lymph nodes</i>	N	%
Total	29	100

At the time of detection, the majority of cases had suspected metastases, accounting for 72.5%; In which, the N2b stage accounted for 34.5% at most, 31% of N1 nodes, 24.1% of N2c nodes, no cases of N3 nodes.

IV. DISCUSSION

4.1. Tumor characteristics on CT scan of hypopharyngeal cancer patients

In our study, 100% of patients had CT scans of the neck with intravenous contrast, with 3mm thick slices from the skull base to the upper mediastinum, we recorded 100% of blurred images of the tumor area in the hypopharynx, 100% of tumors increased density on CT scan, similar to Nguyen Quoc Dung, higher than the study of Nguyen Thanh Minh (2026) recorded 87% of patients, according to Zhang (2021) 92% of hypopharyngeal tumors had a slight increase in density compared to the surrounding soft tissue [1] , [2] , [3] . The hypopharyngeal area is rich in blood vessels, the tumor grows rapidly, the surrounding is the mucosa, so it is easy to

swell, many masses have fibrosis, so the damage is usually an increase in density. This is an indirect but sensitive image, allowing us to suspect an abnormal mass in the hypopharynx even when the tumor is small and cannot be observed on endoscopy.

There are 92.5% of cases of strong contrast agent absorption and often heterogeneous absorption, with areas of increased density interspersed with areas of decreased density (non-injected tumor film is about 45-50 HU, increased to about 85-120 HU after injection), the result is lower than Nguyen Quoc Dung (100%), higher than Pham Chinh Truc (67.5%) [1] , [4] . The phenomenon of contrast agent absorption reflects abnormal vascular proliferation, neovascularization in cancerous tissue, combined with central tissue necrosis and stromal fibrosis, typical histological features of squamous cell carcinoma. The explanation for this difference is that our study had a small sample size, a high rate of late stage tumors (T4), leading to microvascular necrosis and poor contrast absorption. Evaluating the state of contrast enhancement helps us distinguish malignant tumors from benign

tumors/inflammatory tissue, helping to clearly define the tumor boundaries. In our study, 97.5% of cases had unclear tumor boundaries, consistent with the nature of malignant tumors that always tend to spread around.

To classify tumor stages, we need to rely on tumor size and the degree of tumor invasion into neighboring tissues. Based on CT, we can measure tumor size relatively accurately, which is difficult to determine clinically. In our study patients, tumors of ≥ 2 cm and < 4 cm size accounted for the highest proportion (57.5%), followed by tumors of ≥ 4 cm size (25%). This result is similar to Nguyen Thanh Minh, tumors \geq of 2 cm and < 4 cm accounted for the highest proportion (87.5%), but tumors \geq of 4 cm accounted for a lower proportion (2.5%) [2] . Although there is a difference in tumor size ratio between the two studies, this situation is consistent with the disease model of hypopharyngeal cancer, patients are detected with tumors when the tumor size is large, causing pain and difficulty swallowing for the patient.

4.2. Characteristics of suspected metastatic lymph nodes of hypopharyngeal cancer on CT scan

Evaluation of cervical lymph node metastasis requires the use of imaging diagnostic tools to determine the location, size, and number of suspected metastatic lymph nodes, whether unilateral or bilateral, which cannot be fully assessed by clinical examination alone. The presence of the number, location, and size of lymph nodes partly reflects the malignancy of the tumor. The classic features for diagnosing benign and malignant lymph nodes on CT scans are based on the criteria: size greater than 15mm in axial slices; decreased density in the central region of the lymph nodes; and some other classic signs that can be mentioned such as shape, border, and enhancement.

Regarding the nature of contrast absorption, benign lymph nodes often have the characteristic of uniform contrast absorption, except for the hilum of the lymph nodes with reduced density. Metastatic lymph nodes often have heterogeneous contrast absorption, with necrosis, bleeding or cystic degeneration, and necrotic lymph nodes show a localized decrease in density on CT [5]. In our study, 29 cases of suspected metastatic lymph nodes were recorded on CT. All cases of suspected metastatic cervical lymph nodes had 100% strong

contrast absorption, which is a manifestation of neovascular proliferation of malignant lymph nodes; 86.7% loss of hilum structure shows invasion and destruction of the hilum of the lymph nodes by cancer cells; 86.7% central necrosis is a characteristic criterion for malignant lymph nodes, reflecting blood perfusion disorders and necrosis of tumor tissue. Compared with author Nguyen Chinh Truc, 71.4% loss of lymph node sinus structure; 100% strong heterogeneous contrast absorption, this is the most common sign [4]. International authors have similar conclusions, lymph node necrosis in head and neck cancer is the most valuable sign, with a specificity of 95-100% [6].

Regarding the shape of the lymph nodes and the border, in our study 96.5% of the lymph nodes had a longitudinal/transverse axis ratio <2 , resulting in the lymph nodes losing their bean shape and becoming round instead. Benign lymph nodes are often bean/oval/disc shaped, the longitudinal/transverse axis ratio is ≥ 2 , and the clear border suggests benign lymph nodes, while metastatic lymph nodes are often round due to cancerous tissue invading the lymph node tissue and expanding the lymph node capsule, the longitudinal/transverse axis ratio <2 is a sign of malignant lymph nodes. As the disease progresses, the lymph node capsule no longer contains the lymph

nodes, and the lymph node margins are irregular and unclear [7].

Regarding size, the assessment of abnormal nodes by size is difficult because there are many size criteria reported in the literature on cervical lymph nodes, ranging from 7mm to 3cm. In addition, these criteria may vary depending on the location of the node and the age of the patient, the node can be measured along the longitudinal or transverse axis. In clinical practice, the size of the node is not a reliable sign of malignancy, small nodes may contain small metastases that do not increase the size of the node and conversely, benign nodes can often be enlarged due to hyperplasia or inflammation. Our study recorded a transverse axis diameter $>1\text{cm}$ in only 48.3%, lower than the study of Pham Chinh Truc, which encountered 57.1% of cases. He evaluated the sensitivity and specificity for the cut-off value of short diameter $>1\text{cm}$ as 83.3%; 91.6%, respectively [4]. Curtin et al. evaluated the sensitivity and specificity of lymph nodes with a horizontal axis $>1\text{cm}$ as 88% and 39%, the threshold of horizontal axis of lymph nodes $>1.5\text{cm}$ had a sensitivity of 56% and a specificity of 84% [6]. The research results on sensitivity were almost the same, however, the specificity in the study of author Nguyen Chinh Truc was much higher than that of the study of foreign authors, possibly due to the small sample size of Vietnamese authors, which could

not represent the population of hypopharyngeal cancer patients in Vietnam.

Cervical lymph node metastasis is the main route of spread and distant metastasis of hypopharyngeal squamous cell carcinoma. Among 29 cases with suspected metastatic cervical lymph nodes (72.5%), N2b stage lymph nodes accounted for the most 34.5%, 31% N1 lymph nodes, 24.1% N2c lymph nodes, and no N3 lymph nodes appeared. Based on the size and number of metastatic lymph nodes, according to the 9th edition of AJCC classification, we classified the cN lymph nodes and recorded the following results: suspected metastatic lymph nodes with simultaneous group II, III lymph nodes accounted for 64.3%, metastatic lymph nodes with groups II, III, IV alone accounted for 7.1%; 3.6%, respectively. Comparing with domestic thesis, Nguyen Thanh Minh recorded that the rate of metastatic lymph nodes with group II accounted for the majority, 53.8%; Group III accounted for 46.2%, similarly, Nguyen Nhu Uoc recorded the most metastatic lymph node groups were group III 23%, group II and III 25.8%, group II 19%, groups I and IV recorded with low rates [2], [8], [7]. These are the lymph node groups with the highest risk of lymph node metastasis from cancers in the hypopharynx and larynx because the hypopharynx is an area with a developed lymphatic network, with few barriers like glottic cancer, so the possibility of lymph

node metastasis is high, so selective prophylactic lymph node dissection of groups II, III, IV is indicated in hypopharyngeal cancer even when there is no evidence of lymph node metastasis clinically cN0 [10].

V. CONCLUSION

Contrast-enhanced CT imaging of the neck plays an essential role in the diagnostic evaluation and pre-treatment planning of hypopharyngeal cancer. In this study, hypopharyngeal tumors were characterized predominantly by heterogeneous soft-tissue masses (100%) with heterogeneous density, strong contrast enhancement (92.5%), and 97.5% have unclear boundaries. The most common location is the piriform sinus, accounting for 82.5%, and the posterior hypopharyngeal wall, accounting for 17.5%. In piriform sinus tumors, large tumors occupy the entire piriform sinus, accounting for the majority, 48.5%; followed by the outer wall of the piriform sinus, 45.5%, and the inner wall, only 6%. It is noted that 50% of tumors spread outside the hypopharynx, with the most common direction of inward spread. The most commonly invaded structures are the arytenoid cartilage/arytenoid plate/epiglottic cartilage, accounting for 62.5%. The second most common direction of spread is anterior spread, invading the thyroid cartilage/cricoid cartilage/cricothyroid membrane, 27.5%.

There were 29/40 cases of suspected lymph node metastasis on CT scan at the time of examination, accounting for 72.5%. The typical features of suspected metastatic cervical lymph nodes are strong contrast enhancement (100%); loss of hilar structure (86.7%); central necrosis (86.7%), vertical axis/horizontal axis ratio of the ganglion <2 axis/horizontal axis ratio of lymph nodes <2 accounting for 96.5%, horizontal axis diameter of lymph nodes $> 1\text{cm}$ 48.3%. Among the suspected lymph node metastases, 64.3% of cases had simultaneous metastasis to group II, III lymph nodes; metastasis to group II, III lymph nodes was 25%; 7.1%, respectively. According to AJCC 2019 cN stage classification, N2b lymph nodes accounted for the most 34.5%.

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