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(RESEARCH ARTICLE)

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Surgical approach to evaluate neck mass in children concerning management protocols

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Abstract

Background: Neck masses in children are not common presentations in Head-neck specialized practice but when present they createpotential diagnostic dilemmas for consulting surgeon. These children may present as havingapparently simple harmless mass in the neckbut there are several alarming diagnostic possibilities. Attending surgeons should concern about the wide range ofdifferential diagnoses.

Objective: Differential diagnosis and management of Neck masses in children differ from those in adults. A systematic approach to diseases and judicious investigation protocol is crucial to ensure appropriate assessment and management. This prospective study was undertaken to assessmanagementprotocol for the evaluation process of neck mass in case of children.

Methods: This is a prospective study of 6 yearsin the tertiary hospital based in Dhaka between 2016 and 2022. 385 (131, girls, 254 boys) patients aged between 2 years to 14 years were reviewed. The history, physical examination findings, imaging reports (USG, color Doppler, CT, and MRI)FNAC, and the histopathology report are taken into consideration as managementprotocol for the evaluation process.

Results: In this studyauthors observed congenital masses were most commonly found in this age group, followed by Infectious and neoplastic masses, at a rate of 57.40%, 27.53%, and 15.06% respectively. Thyroglossal Cyst constituted 33.48% of congenital masses. Non-Hodgkin lymphoma was the most frequent type of malignancy (50%). The lateral neck was the most affected site (47.01%).

Conclusion: The diagnosis can be reached with a brief history and prompt physical examination. Ultrasound and Color duplex study should be the first choice for evaluation. Fine needle aspiration cytology followed by excisional biopsyfind out the tissue of origin. FNAC can guide the surgeon initially to reach the disease and give the clue for the next steps on evaluation. CT SCAN & MRI should be avoided if not clearly indicated as both need sedation in case of children and CT emits radiation effect.

Keywords: Children; Ultrasonography (USG); Fine needle aspiration cytology (FNAC); Color duplex study; lymphadenitis; Pediatric neck mass (PNM); Cervical neck mass.

1. Introduction

Childhood Neck masses are not a common presentation in Head-Neck surgical practice. These masses are often harmless benign-looking but they can elicit significant parental tension and make them anxious. They also create diagnostic dilemmas for surgeons as there is wide range of differential diagnoses, which require meticulous specialized

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management. The childhood neck masses are classified into three broad categories according to etiology - Congenital, Inflammatory, and neoplastic (Table I).[1] Many of the pediatric Neck masses (PNM) seen in specialized practice occur as a result of inflammatory or infective processes primarily in upper aero-digestive tract but secondary invasion of the organism may inflame persistent congenital abnormalities or a neoplastic one.PNM is mostly congenital in early childhood.These congenital malformations may not be evident at birth but had been growing persistently with the growth of the child. Reactive lymphadenitis is most common in infancy and early childhood with 40–55% of adolescents in response to URTI. Rapidly developed masses are inflammatory including reactive lymph nodes and consequently lymphadenitis lead to abscess formation.[2]These Inflammatory processes subside within four weeks if addressed with proper antibiotic therapy on time without any delay. Cervical mass that persists beyond six weeks needs further step-by-step systematic evaluation. Any rapidly growing mass should be immediately referred to Head- Neck Surgeon if thought to be life-threatening that affects the airway or has features suggestive of deep neck abscess formation.[3]Upper respiratory tract infection should be excluded in case of children present with reactive lymphadenitis. Associated symptoms like Pain, fever, tenderness, congested skin and restricted neck movement are the features suggestive of reactive lymphadenitis and subsequent abscess formation. Mass that grows very slowly for several months to years is suggestive of neoplastic one or congenital.[4]Malignant neck mass in children is apparently harmless, presents as an asymptomatic irregular non tender swelling usually in posterior triangle. Constitutional symptoms - weight loss, low-grade fever, or drenching night sweating (B symptoms) are included as red flag features concerning malignancy.[5] **Examination:** Congenital swellings are firm/tense or cystic, globular and fluctuation may be present. The location of the mass providesvital cluesfor clinical diagnosis. Midline masses are mostly congenital. Thyroglossalcyst is the commonest midline congenital neck mass, which moves upwards with tongue protrusion and swallowing, but the dermoid cysts has no movement, are closely adherent andtethered to the overlying skin.[6] Masses commonly arise from the lateral neck are cavernous haemangioma,branchial cyst. **Palpation:** Small, mobile, mildly tender swelling suggestive of reactive lymphadenitis. The possibility of suppurative lymphadenitis rises when there is a local rise of temperature, fluctuation, skin congestion, induration or severe tenderness and restricted neck movement. Features concerned for malignancy are asymptomatic, non-tender, firm, irregular masses that are immobile lies in posterior triangle of neck. Neck nodes less than 1 cm in size are considered as reactive in children but gradually increasing nodal size is indicative of malignancy. Lymph nodes 3 cm in size or greater that persists for a longer period beyond six weeks or in spite of antibiotic therapy should be evaluated with medical imaging and cytological exclusion that provides guidance for tissue biopsy.[7] Ear, nose and throat examination should be performed to exclude URTI. **Investigations:** Ultrasonography (USG) is an easily available, cheaperimaging modality that can be done in mother's lap, not make the child anxious. Site, size, depth, consistency, blood flow of a cervical mass can be achieved by 12 kHz ultra high frequency USG. For this reason, ultrasound is the preferred initial imaging modality in children with neck mass. USG can identify increased vascularity of the mass that can differentiate benign and malignant neck node and can provide guidance for fine needle aspiration cytology (FNAC). USG is the initial imaging modality to address any thyroid gland swelling. It is also mandatory to confirm the existence of the thyroid gland is in the normal position prior to excise thyroglossal duct cyst.[7,8] CT scancauses radiation emission and should be avoided in children unless a malignancy or deep cervical abscess is suspected. CT SCAN & MRI should be avoided if not clearly indicated as both need sedation in case of children. FNACis a very important diagnostic tool that is required to confirm diagnoses in many cases and guide treatment. While the patients are thought to have suppurative lymphadenitis empirical antibiotic therapy should be applied immediately. A 7 to 10-days course of amoxicillin and clavulanate combination is a justifiable appropriate coverage for the most commonly responsible organisms in the upper aero-digestive tract.[8]These empirical therapy can mostly resolve and subside the suppurative inflammation and reduces the risk of incision drainage under general anesthesia and the hazard of regular dressing in children. If the patient nonresponsive to antibiotics or if the mass persists more thansix weeks,serological screening with gene xpert is warranted to exclude nodal tuberculosis. Referral to a head and neck surgeon for making decision concerning surgical management in a tertiary hospital has imminent importance for all suspected congenital neck mass. Judicious use of investigations may avoid unnecessary stress and exertion for patient and parents. Fine-needle aspiration cytology (FNAC) provide critical diagnostic information. In children Excision biopsy is needed to confirm the tissue diagnosis.Color Doppler study of neck vessels should be advised in suspected case of vascular malformation like cavernous haemangioma. When USG detect increased blood flow in the mass, Doppler study is warranted to identify whether the mass is vascular in origin or notand to see the feeding vessels. These color Doppler study also provide information and show clear demarcation between the vessels wall and the capsules of mass.[8,9] This crucial information curtail the need for further imaging modalities. These also help in **planning dissections plane during surgery.**

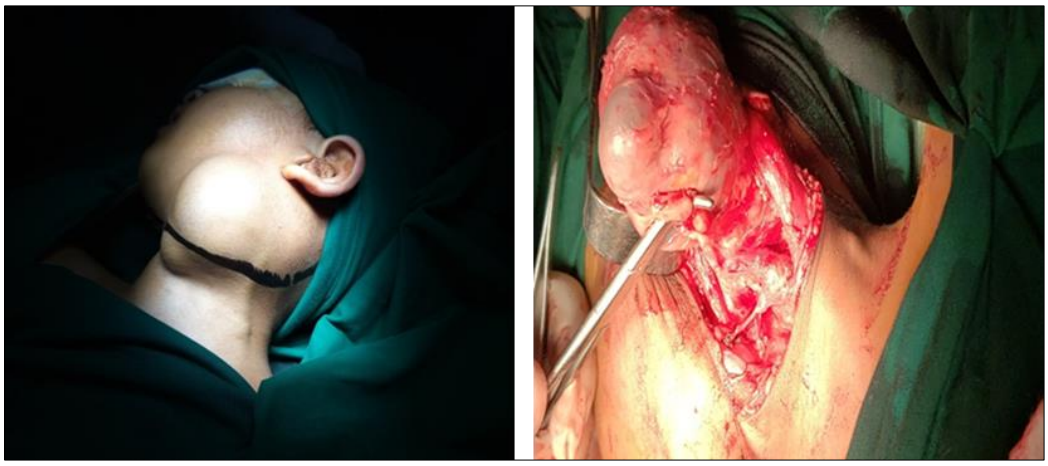

Figure 1 5 years old boy presented with a large dermoid cyst. Pictures showing huge size of cystic mass after dissection

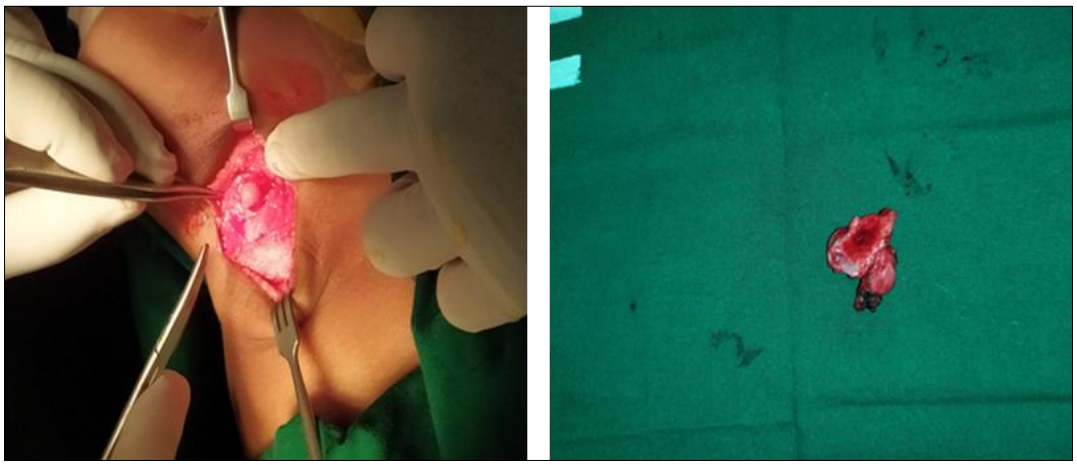

Figure 2 10 years old girl with midline thyroglossal duct cyst underwent sistrunk's operation, picture showing body of hoyid bone with muscle and cyst

Figure 3 3.5 years old girl having cavernous haemangioma lies just over IJV. Several reactive lymph nodes found at lower end of IJV. The dissection plane and mass evaluated by colour doppler study of neck vessels

Figure 4 3 years old girl from a far remote wetland presented with posterior triangle swelling. FNAC & histopathology revealed Hodgkin's lymphoma. There was numerous enlarged node involving level V and extending to levelII

2. Material and methods

This is a prospective study of 385 cases of adolescent patients who were operated in the two tertiary hospitals of Bangladeshbetween 2016 to 2022. A total of 385 patients (girls: n=131, 34%; boys: n=254, 66%) aged between 2 years to 14 years were included in the study. The duration of the study period was 6 years from 2016 to 2022. The study was conducted in two large tertiary care hospital in Bangladesh. The history, physical examination findings, imaging reports (USG, color Doppler, CT, and MRI)FNAC, and the histopathology report are taken into consideration as management protocol for the evaluation process. All patients had undergone surgery, excision and biopsy for final evaluation which is also the ultimate treatment and management protocol in almost all cases unless malignancy.Study design: Cross-sectional purposive study. Sample size: 385 patients. Sampling technique: Simple random sampling Study period: 6 years (2016-2022).Study places: Bangladesh Medical College Hospitals and Samorita Hospital, Dhaka, Bangladesh.

3. Results

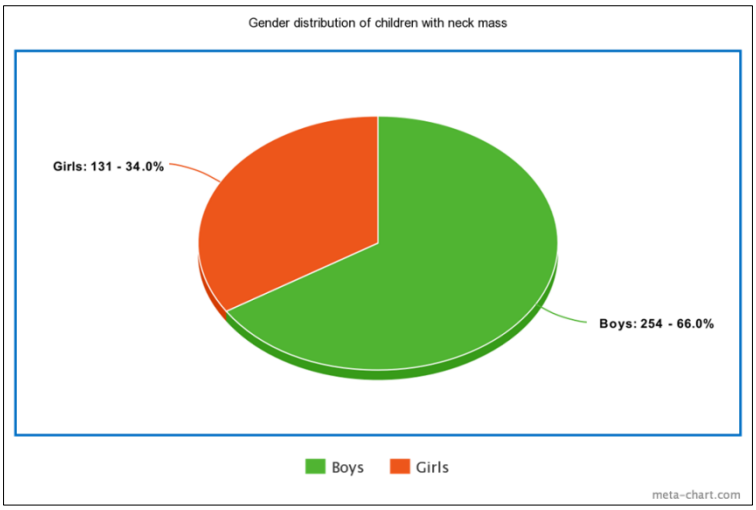

Figure 5 Graphical presentation for gender distribution of neck mass in children(n-385)

Neck mass in boys (64%) are all most 2 times more than girls (34%)

Table 1 Classification of neck mass in children and prevalence(n-385)

Neck mass	Total number	Percentages
Congenital	**221**	**(57.40%)**
Thyroglossal cyst	74	(33.48)
Recurrent Thyroglossal cyst	14	(6.33)
Cystic hygroma	7	(3.16)
Hemangioma	29	(13.12)
Branchial cyst	61	(28.05)
dermoid cyst	36	(16.28)
Infectious	**106**	**(27.53%)**
Reactive lymphadenitis	64	(60.36)
Granulomatous lymphadenitis	42	(39.62)
Neoplastic	**58**	**(15.06%)**
Non-Hodgkinlymphoma	29	(50)
Hodgkin lymphoma	24	(41.37)
papillary ca. thyroid	2	(8.62)

60% mass are congenital, 25% are infectious origin and 15% are neoplastic shown in table I.

Table 2 Frequency of incidence for Neck Mass in children to different Locations

Location	Level		Percentage
lateral neck masses	levels II, III & IV	181	47.01%
midline	Level VI	131	34.02%
Submandibular and submental	Level I(level Ib&Ia)	24+7	6.23%+1.81
posterior cervical	level V	31	8.05%
Carotid triangle	level VI	12	2.85%

The incidence of lateral neck masses is more than mid-line mass shown in Table II.

4. Discussion

A total of 385 pediatric patients (girls: n=131, 34%; boys: n=254, 66%) aged between 2 years to 14 years were included in the study. Male dominancy of nearly 2:1 was observed in the study population. In this study 57.40% patients found congenital, 27.53% were infectious and 15.06% were neoplastic (Table I). The study done by Torsiglieri AJJr there were 55% congenital lesions, 27% inflammatory lesions, and 11% malignancies. These incidence rates are almost similar to our findings. The patients were referred to authors from primary and secondary health care center for surgical evaluation and specialized management. A brief history and systematic physical examination, radiological and cytological examination followed by histopathological confirmation are essential in the evaluation process. The masses were divided into Three main categories: congenital,infectiousandneoplastic. These categorical divisions are also acceptable in world literature. The most prevalent congenital mass isthyroglossal cysts, 33.48% (74/221) in this study. Branchial cyst (28.05%), dermoid cyst (16.28%) are also frequently seen on the lateral side of the neck. The study conducted byErikci Vet all revealed 54.2% of children had thyroglossal cyst, 34.7% children with branchial cyst and 11.1% with dermoid cyst, which supports the findings in our study. Excision of any congenital neck mass requires

surgical expertness and sound knowledge of fascial spaces in neck and anatomy of relevant surgical field. The Surgical team should be familiar with such types of congenital mass, surgical anatomy and relation of diseased tissue to surrounding vital structures. If the surgical team not aware about complete and meticulous dissection of pathological tissue and if any remnants of the pathology left behind in surgical field, mass will recur from the residual tissue.[10] In this study authors found 14 cases 6.33% (14/221) of recurrent thyroglossal cyst in 5 to 9 years of age that recurred within a year. During revision surgery we had found the hyoid bone were remain intact, not dissected at all as well as core of tongue muscles. These primary surgery were done in secondary care hospital by amateurs. As a result residual thyroglossal tract remain intact in the field lead to recurrence of the cyst. These findings are similar to the study done by O'Neil LM et all who have found 7% recurrent TGDC. Haemangioma is another congenital mass found frequently in this study. Authors included 29 cases (13.12%) 29/221 presented at younger age group as low as 3.5 years. Among them Cavernous haemangioma encountered more. Patients in this age group having large heamangioma creates a surgical challenges for the surgeon and team , alsolimit the range of imaging modalities. The authors greatly depends on utilization of color coded doppler study of neck vessels. This color coded doppler study provides imaging picture of vascularbed in relation to feeding vessels – specially the internal jugular vein and its tributaries. The clear demarcation in between the capsule of haemangioma and the wall of great vessels makes the surgical team confident enough to dissect the mass without any injury to the vessels.[11]These vascular masses often lie just over the IJV and its tributaries (Image-III). These literature data are matched to the study taken by Waner M et all and Ahuja AT et all. The incidence rateof malignancy is high when the mass is greater than 3 cm in size at presentation. So malignancy should be ruled out quickly where persistent mass 3 cm or greater in size over a period of 6 weeks or longer. Non-Hodgkin lymphomacommonly found at 3 to 7 years of age group but Hodgkin lymphoma seen between 7 to 13 years of age. In our study we had found a 3 years old girl having Hodgkin's lymphoma revealed on FNAC & histopathology, which is a very rare occurrence according to world literature. This patient needs immunohistochemistry- CD-3, CD-15, CD-30, PAX-5 for furtherconfirmation before receiving chemotherapy.[12] Hodgkin lymphoma is a rare malignancy in young children but common in adolescents.In our study, the most frequently seen neoplastic disease were NHL50% (29/58), Hodgkin lymphoma (39.41%) (24/58) and the median age at diagnosis was 8 years (range: 2-14 years). Nahar K et all found Non-Hodgkin Lymphoma (59%) and Hodgkin Lymphoma (41%) in their study which is consistent with our study. Among all neck masses, malignancy was detected in 15% (58/385) of the cases studied, which was consistent with the literature data found in study done by Unsal O et all, where among all neck masses, malignancy was detected in 15.3% cases. In our study 27.53% of infectious neck masses, non specific reactive lymphoid hyperplasia was detected more in 64 cases (60.36 %). Granulomatous lymphadenitis was detected in 42 (39.62%) infectious mass lesions. These patientsdiagnosed as nodal TB. These findings matched to the study performed by Mundi I et all. The family Concern in the decision to perform a biopsy is crucial and unavoidable.If empirical antibiotic therapy is not effective and the suspicion of infection still persists, the patient should be evaluated for TB neck node. Neck node is the commonest site for extra pulmonary TB in case of children.[13] Features suggestive of malignancy need rapid management without any delay. Such types of the patient require referral to pediatrician and oncologist. Histological sampling can be performed initially by FNAC in cent percent of patients. The location of the mass is indicative ofmany diagnostic clues. The incidence rate of malignancyis higher in posterior triangle of neck (level V). The location of the PNMhave studied are provided in Table II. The incidence rate oflateral neck masses (47.01%) (levels II, III and IV, followed by midline (34.02%), submandibular (6.23%) (levelIb), and posterior neck (level V) (8.05%) found in this study. We have found the incidence of lateral neck mass is more frequently occurs in comparison to mid line & posterior neck mass and mass in other location (Table II). These findings were also similar to the study done by Unsal O et all, where most frequently found mass were lateral neck masses (44.9%) followed by midline (16.3%), submandibular (14.3%) (level IB), and posterior cervical (12.2%) (level V) neck. Watchful waiting for up to six weeks is recommended for patients with a neck mass. The use of empirical antibiotics is widely accepted, in patients thought to have suppurative lymphadenitis. A7 to 10-day course of amoxicillin and clavulanate combination is considered as appropriate coverage for theinvolved organisms in this region. If the condition not improved with antibiotics or if the mass persists longer than 4 weeks, serological screening with gene xpert for identification of atypical organismsespecially mycobacteria is warranted.[14] Medical imaging especially USG, CT or MRI may be considered as a part of the evaluation and management process. In this study, USG was preferred as an imaging modality in most of the patients.USG should be considered as an aid to diagnosis andhas been preferred because of its cost-effectiveness, no exposure to radiation, and no need for anesthesia. USG can differentiate between neoplastic and reactive lymph nodes in 83% cases.[15]USG is the initial imaging modality of choice for any patient with neck swelling but Color Doppler ultrasound is the imaging modality of choice for the evaluation ofsuspected vascular masses on the pediatric neck. It provides crucial information regarding vascularity of the mass, and its relationship to the major neck vessel.[16] Magnetic resonance imaging (MRI) is considered as gold standard imaging for vascular and lymphatic malformations.MRI does not emit radiation but sedation is required for the paediatric population in case of both the CT & MRI, thusdecrease its utility. Although rarely requested, CT imaging is preferred in the evaluation of the relationship of the lesion to bony structures and in staging, while MRI is preferred in the evaluation of the mass to deep complex cervical spaces (parapharyngeal, retropharyngeal regions) and neurovascular or vital structures.Radiation exposure should be avoided in children unless a malignancy or deep cervical

abscess is suspected. The ionized radiation emitted by CT limits its field of application.[17]FNAC cannot diagnose 8.9% of pediatric neck masses andspecificity of FNAC were reported as 64.3%. FNAC can guide the surgeon initially to reach the disease and give the clue for the next steps on evaluation.Though FNAC can identify atypical cells, it cannot identify sub types of lymphoma. Excisional biopsies are preferred in cases where the tissue of origin can't be identified. Complete Surgical removal of the mass also offers an additional treatment advantage and should be considered as only treatment required in many cases especially congenital mass.If the swellingis not 3 cm or greater in size orlymph nodes have apparently benign look should not be considered for biopsy unless they have concerning features. A sound knowledge of surgical anatomy of neck spaces and common etiologies of pediatric neck masses can greatly reduce unnecessary investigations.[18] There is no proven standard protocol for managing pediatric neck masses. So the preoperative clinical evaluation of the patients was based on the collaborative approach of Head-Neck specialists, pediatricians, radiologists and histopathologists.

5. Conclusion

Unfortunately, there areno standard protocol for the management of childhoodneck mass. So management depends on step by step systematic approach to disease - prompt clinical assessment and judicious investigation. The diagnosis can be made with a brief history and thorough physical examination. Ultrasound and Color duplex study should be the first preference for imaging modality, andfine needle aspiration cytology for tissue sampling. FNAC is the first choice for tissue diagnosis. CT scan & MRI should be avoided if not clearly indicated as both need sedation in children and CT emits radiation effect.Enlarged lymph nodes that persist for longer than six weeks or enlarge during a course of antibiotics should be evaluated by a head and neck surgeonandexcision biopsy is recommended.

Compliance with ethical standards

Disclosure of conflict of interest

There is no funding for this original research study and no conflict of interest in between the authors.

Statement of informed consent

Informed consent was obtained from all individual participants included in this study.

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