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Original research article

The utility of fine needle aspiration cytology of mass lesions in children with histopathological correlation wherever possible

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Abstract

Introduction: Fine needle aspiration cytology (FNAC) is a well-established preliminary diagnostic modality and is a vital part of diagnostic armamentarium in modern cytology. However in comparison with its utilization in adult patients, FNAC of pediatric head and neck mass lesions has been slow in gaining popularity. "Child is not a miniature adult" Pediatric tumors show a distinctive incidence, histology and biologic behavior from those in adults. FNAC is still widely underused for studying pediatric mass lesions of diverse locations, despite its high diagnostic yield.

Objective: To study the incidence, distribution, cytomorphology of various types of paediatric masses in a tertiary care hospital.

Method and Materials: 658 cases of mass lesions of the paediatric age group [0-12years] were studied for cytomorphology through FNAC.

Results: FNAC was performed on 12,224 cases in 3 years out of which 658 (5.58%) cases were ≤ 12years of age. Male to female ratio was 1.22:1. Majority of the mass lesions were Non-Specific Inflammatory lesions accounting for 399 cases (60.6%). Specific Inflammatory lesions accounted for 85 cases(12.9%). Among neoplastic mass lesions majority were benign with 48 cases (7.3%) and 22 cases (3.4%) were malignant. Cyto-Histopathological correlation was available in 55 cases with Sensitivity, Specificity, PPV, NPV, DA of 100%, 97.95%, 85.71%, 100%, 98.18% respectively.

Conclusion: FNAC is a rapid, easy, reliable, minimally invasive technique and has an expanding diagnostic potential in the pediatric population. Along with a reassurance of benignity, confirmation of malignancy can be achieved and treatment initiated. Our study generated results which were concordant to other studies in pediatric population. Histopathological examination is mandatory in suspicious cases.

Keywords:FNAC, paediatric tuberculosis, paediatric tumors

Introduction

Fine needle aspiration cytology (FNAC) is a well-established preliminary diagnostic modality and is a vital part of diagnostic armamentarium in modern cytology. However in comparison with its utilization in adult patients, FNAC of pediatric mass lesions has been slow in gaining popularity. Until recently the application of FNAC to pediatric population was largely ignored by Indian and American pediatric literature. Previous reports have studied its utility mainly in head and neck lesions, lymphadenopathy, malignant neoplasm or neoplasm of particular organ.

FNAC is still widely underused for studying pediatric mass lesions of diverse locations, despite its high diagnostic yield (overall sensitivity and specificities between 90% and 100%), rapidity, safety and scarce contraindications and complications [1, 2].

Pediatric tumors show a distinctive incidence, histology and biologic behavior from those in adults. We now recognize that children, including the embryo, fetus, infant and all life stages until the completion of adolescence, are often at a different and increased risk from environmental hazards from that of adults, for reasons mentioned below:

1. Children often have different, and sometimes unique, exposures to environmental hazards from those of adults.
2. Due to their dynamic developmental physiology children are often subjected to higher exposures to

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pollutants found in air, water and food. These exposures may be handled quite differently by an immature set of systems to the way they are dealt with in adults[3].

Furthermore, the developmental component of a child's physiology is changing: maturing, differentiating and growing in phases known as "developmental windows". These "critical windows of vulnerability" have no parallel in adult physiology and create unique risks for children that can alter normal function and structure.

Despite strong body of literature, cytopathological approach for diagnosis of pediatric tumors is not universally accepted among clinicians and pathologists. However several studies have shown that in hands of well-trained team and good collaboration with pediatrician, radiologist and cytopathologist, fine needle aspiration (FNA) is a highly accurate approach for quick preliminary as well as final diagnosis [4, 5].

Pediatric FNACs account for less than 5% of aspiration biopsies examined with an overall efficiency rate of about 89%. Usually all FNACs are performed for diagnosis of mass lesion identified clinically, either by palpation or radiographic imaging.

Only 2% of patients with malignancy are in pediatric age group. Even though the leading cause of death is malignant lesions in developed countries, in developing countries like India, it is still due to infectious causes rather than mass/ neoplastic lesions and FNA is a valuable tool in segregating lesions in rural setup also. In India FNA in children was started in 1980s. In 1988 Verma K *et al.* studied 1632 FNA material aspirated from children and concluded that accuracy of tumor diagnosis was very high. Except for occasional false negative cases, there were no false positive cases giving 100% specificity[6].

FNAC has an increasingly important role in expeditious diagnosis of childhood malignancies, similar to its value in work up of mass lesions in adult population. It is also extremely beneficial in work up and diagnosis of benign and malignant abdominal and thoracic lesions in pediatric group. Majority of these are small round cell tumors of childhood (SRCT).

Initially FNAC was mainly used by pediatric oncologists in the evaluation of cancer recurrences in patients with already diagnosed malignancy. Now there has been a more widespread shift towards diagnostic modality in general pediatric population and FNAC as first diagnostic modality in work up of mass lesions in children for providing a rapid diagnostic result, thereby aiding in proper triage and management of patients [7, 8].

The advantages and technical features are similar to those of FNAC in adults and includes rapid diagnosis, minimal morbidity and mortality, low cost and high accuracy. Because of its low cost, it is also being used to differentiate between benign and malignant lesions in the primary care units of many underdeveloped countries.

With the increasing costs of medical facilities, any technique which speeds up the process of the diagnosis and limits the physical and psychological trauma to the child will be of tremendous value.

Methodology

Method: After thorough clinical examination consent was obtained either from the Parents or Guardians after explaining the procedure in their vernacular language.

Cases were divided clinically into palpable and non-palpable masses. Palpable lesions were subjected for direct aspiration and USG guidance in non-palpable and deep-seated lesions. Puncture site was marked. With aseptic precaution 22-23G needle for superficial lesions and lumbar puncture needle of same thickness for deep seated lesions fitted with 10ml syringe, is introduced immediately under radiological guidance and aspiration was done under negative pressure. Sedation was used whenever necessary. Sample was expelled on slides, air dried and stained with Giemsa or fixed in 95% ethanol and stained with Papanicolaou's stain Hematoxylin and Eosin. Special stains were used wherever required.

Design of study: Cross sectional study.

Inclusion criteria

All pediatric patients less than or equal to 12 years, who presented with mass lesions either clinically or found out radiologically and FNACs done are included.

Exclusion criteria

1. Age more than 12 years.
2. Patients with contraindication to FNAC procedure. Example: Bleeding diathesis.

Results

The present study comprised of 658 Fine Needle Aspiration Cytology smearsaspirated from children less than or equal to 12 years with mass lesions encountered inthe Department of Pathology, Karnataka Institute of Medical Sciences, Hubballi duringthe period 1st April 2013 to 31st March,2016 in a three-year study.Out of

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the total number of 12,224fine needle aspirations during the study period, 658 were aspirations in our study groupconstituting 5.38% of all aspirations.

Among 658 cases, Males were more commonly affected with 365 cases (55%)and females accounted for 293 cases (45%). Male to Female ratio was 1.22:1.In the present study the youngest patient was a 1-month-old baby and the eldestpatient was 12 years old. Mean age was 7.2 years with Standard Deviation of 3.3 years and most frequent age of patient was 12 years. School Going children accounted for majority of the cases with mass lesions with360 cases (55%) followed by Pre-School children with 196 cases (30%) and Infants and Toddlers with 102 cases (15%).Majority of the aspirations were done from Head and neck area comprising 81.98% of all aspirations. Majority of aspirations were done from lymph nodes comprising 70.82% in the present study followed by bone and soft tissue comprising 10.95%.

All the Pediatric lesions were broadly classified into inflammatory, neoplastic and other lesions which were non-neoplastic and non-inflammatory. The aspirates which could not be interpreted because of inadequate material and any other obscuring factor were classified as unsatisfactory for evaluation. The Table No. 9 and Graph 4 shows different types of such lesions in pediatric age group in the present study.

Table 1: Distribution of Pediatric FNAC into Main subtypes

		1St April, 2013To 31stMarch,2014	**1St April, 2014To 31st March, 2015**	**1St April, 2015To 31stMarch, 2016**	**Total%**	
Inflammatory	Non- Specific	123	149	127	399	60.6
	Specific	35	21	29	85	12.9
Total		158	170	156	484	73.5
Neoplastic	Benign	19	16	13	48	7.5
	Malignant	6	6	10	22	3.4
	Total	26	22	23	70	10.9
Others		33	27	32	92	14
Unsatisfactory		6	3	3	12	1.8
Total		222	222	214	658	100

Majority of lesions were inflammatory lesions comprising 484 cases accounting for 73.5% of all lesions. Among the inflammatory Mass lesions, lesions were classified as Specific and Non-Specific based on type of inflammatory lesion. The specific inflammatory lesions accounted for 85 cases (12.9%) and include Tuberculosis, Hashimoto's Thyroiditis, and Sialadenitis. All other lesions were categorized as nonspecific inflammatory lesions and accounted for 399 cases (60.6%) and included various reactive lymph nodes, acute lymphadenitis and abscesses. Nonspecificinflammatory lesions were more common (60.5%) than specific inflammatory lesions (13%).

Neoplastic lesions comprised 70 cases (10.9%) and about two third of themwere benign lesions (7.3%). Overall, benign lesions constituted 48 cases of all lesions and malignant lesions 22 cases (3.4%).

'Other' lesions constituted 92 cases (14.4%), which include thyroglossal cyst, Colloid Goitre, epidermal inclusion cyst, gynecomastia etc. which were non-inflammatory, nonneoplastic and represent some developmental aberrations or lesions due to hormonal changes.

About 1.8% (12) smears were unsatisfactory for evaluation most of which were because of scant or absent material in fine needle aspiration.

In the present study, all Pediatric mass lesions were broadly classified into eight subtypes based on cytomorphology as shown in Table 10 and Graph 5. Inflammatory lesions were the most common with 484 cases (73.5%) followed by cysts which accounted for 83 cases (12.6%). Epithelial lesions, Pleomorphic/Large cell lesions, Spindle cell lesions, Clear cell lesions, Round cell lesions accounted for 4.9%, 2.5%, 2.1%, 1.85%, 0.6% of cases respectively in descending order of Frequency. 12 cases (1.85%) were Unclassifiable/Unsatisfactory for reporting majority of which were because of scant aspirate from un-cooperative children.

Table 2: Broad classification of pediatric lesions based on cytomorphology

Total%		
Inflammatory	484	73.5
Epithelial	32	4.9
Spindle cell	14	2.1
Round cell	4	0.6
Clear cell	12	1.85
Pleomorphic/Large cell	16	2.5
Cysts	83	12.6
Unclassifiable/Unsatisfactory	12	1.85
Total	658	100

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Most of the lesions in Salivary Gland were Sialadenitis (78.9%) with 3 cases ofMucus Retention cyst and a solitary case of Pleomorphic Adenoma.In Thyroid gland were Colloid Goitre and Nodular Goitre accounted for 14 caseseach with 32.55% each. Hashimoto's Thyroiditis accounted for 25.6 % of cases. There were 4 cases of Thyroglossal cyst.Most of the lesions in the breast were fibroadenoma (91.66%) . with one case ofgynecomastia in male.Among the neoplastic lesions majority were benign tumors accounting for 68.57%and included Lipoma, Haemangioma, pleomorphic adenoma, Fibroadenoma, unclassified benign spindle cell tumors, osteochondroma, Giant cell tumor of tendon sheath and Enchondroma**.**Among 22 malignant tumors, most of the malignant tumors were haemato-lymphoidin origin with 54.54%. The spectrum of malignant lesions includes Non-Hodgkin's Lymphoma, Hodgkins'slymphoma, Leukemic infiltrates, Ewings Sarcoma, Osteosarcoma, LCH, Clear cellsarcoma, Malignant spindle cell tumors and Mixed Germ cell tumor.Cyto-histopathological correlation was available in 55 cases as shown in Table 3. There were 48 truenegative cases and 6 true positive cases. However, there was one False Positivecase of round cell sarcoma which was later diagnosed as Masson's Haemangioma.

Table 3: Cyto-Histopathological correlation (N = 55)

Organ	FNAC	Histopathology	No of cases	Correlation	Type of correlation
Lymph node	ReactiveLymphadenitis	ReactiveLymphadenitis	6	Y	TrueNegative
	Tuberculous lymphadenitis	Tuberculous lymphadenitis	10	Y	True negative
	Leukemic infiltrates	Leukemic infiltrates	2	Y	True positive
	NHL	NHL	1	Y	TruePositive
Skin	Epidermal cyst	Epidermal cyst	4	Y	TrueNegative
	InfectedEpidermal cyst	InfectedEpidermal cyst	2	Y	TrueNegative
Salivary gland	PleomorphicAdenoma	PleomorphicAdenoma	1	Y	TrueNegative
	Ranula	Ranula	3	Y	TrueNegative
Thyroid	ThyroglossalCyst	Thyroglossal cyst	3	Y	TrueNegative
Bone & soft tissue	Ganglion	Ganglion	3	Y	True negative
	Schwannoma	Schwannoma	2	Y	True negative
	Fibromatosis coli	Fibromatosis coli	1	Y	True negative
	Malignant spindle cellTumor	Clear cell sarcoma	1	Y	True positive
	Lipoma	Lipoma	5	Y	TrueNegative
	Haemangioma	CapillaryHemangioma	4	Y	TrueNegative
	Osteochondroma	Osteochondroma	3	Y	TrueNegative
	Enchondroma	Enchondroma	1	Y	True negative
	Ewing's sarcoma	Ewing's sarcoma	2	Y	True positive
	Round cell sarcoma	Masson'shemangioma	1	N	False positive

Table 4: Statistical Analysis Cyto-Histopathological correlation

	Benign	Malignant	FNAC
Benign	(True Negative)48	(False Positive)1	49
Malignant	(False Negative)0	(True Positive)6	7
HP	48	7	55

The Statistical analysis as shown in Table 5showed a Sensitivity of 100%, Specificity of 97.95%, Positive Predictive Value of 85.71%, Negative Predictive Value of 100% and Diagnostic Accuracy of 98.18%.

Table 5: Diagnostic accuracy of FNAC in Paediatric age group

Sensitivity	100%
Specificity	97.95%
PPV	85.71%
NPV	100%
DA	98.18%

Discussion

The Benign lesions were more common than malignant lesions constituting 68.6% in the present study which is similar to results of Gamba P.G. *et al.*(81%). Inflammatory lesions are more common accounting for 73.4%. However older studies have shown comparatively a smaller number of inflammatory lesions like Suzzane *et al.* reported 36.84% and Wakely P.E *et al.*31.29%. This is because of more widespread use of FNA including inflammatory lesions in recent days as compared to more specific aspirates from malignant lesions in olden days. The same reason is true for decreased malignant lesions (3.2%) in the present study as compared to studies done by Suzzane *et al.*(33.33%) and Wakely

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P.E *et al.*(26.53%) in 1980s.

Table 6: Comparative analysis if overall features of Paediatric FNAC

Author		Suzzane *et al.*[9]	Wakely *et al.*[10]	Gamba P *et al.*[11]	Friere *et al.*[12]	Maheshwari *et al.*[13]	Present Study
Year of Study		1984	1988	1995	2008	2008	2016
No of FNAC's		57	107(112)	96(111)	50	558	658
Youngest Age		-	-	20days	3months	2 months	1month
Upper Age limit		18	16	17	14	14	12
Sex	Male	33	55	59	27	392	365
	Female	24	52	37	23	196	293
FNAC Category of Lesion	Inflammatory	21(36.84%)	46(31.29%)	90(81%)	20(40%)	-	484(73.5)
	Benign	4(7.02%)	16(10.88%)			381(64.8%)	48(7.5)
	Malignant	19(33.33%)	10(6.80%)			207(35.2%)	22(3.4)
	Cysts	13(22.81%)	39(26.53%)	12(10.8%)	20(40%)	-	92(14)
	Unsatisfactory	7(12.28%)	1(0.68%)	9(4.5%)	10(20%)	-	12(1.8)
Statistical Analysis	Error	FN (1)	FN(1),FP (2)	FP (4)	-	-	FP (1)
	Sensitivity	95%	97%	100%	90.9%	95.8%	100%
	Specificity	100%	97%	96%	100%	97.6%	97.95%

Also there is a shift in the ratio of benign to malignant tumors in recent years from 1:4.7 in the study conducted by Suzzane *et al.* and 1:2.4 in the study of Wakely*et al.* to 1:0.54 in the study of Maheshwari *et al.* and 1: 0.45 in the present study. This also highlights the more liberal use of FNAC in benign and inflammatory mass lesions.

A similar study was conducted by Howell LP *et al.* to know the changing trend of pediatric FNACs. This shows a similar trend in the present study with inflammatory lesions being the most common lesion (73.5%) followed by 'Others' accountingfor 12.6%. Epithelial accounted for 4.9%, Spindle cell lesions (6.10%) in the present study. Pleomorphic/large cell, Clear cell and Round cell accounted for 2.5%, 1.85% and 0.6% respectively. This indicates more general and widespread use of FNAC in pediatric age group.

Table 7: Comparative analysis proportion of paediatric mass lesions based on cytomorphological

	Howel L P *et al.*[14]		Present study
Duration and Year of Study	1985-1991	1992-1998	2013-2016
Inflammatory	51%	35%	73.5%
Epithelial	7%	18%	4.9%
Spindle cell	3%	18%	2.1%
Round cell	25%	12%	0.6%
Pleomorphic/ Large cell	-	-	2.5%
Clear cell	-	-	1.85%
Cysts	7%	8%	12.6%
Unclassifiable/ Unsatisfactory	7%	9%	1.85%

Conclusion

FNAC is a rapid, easy, simple, minimally invasive technique well accepted in the adult population. It is a relatively new technique for pediatric age group. However with Sensitivity of 100%, Specificity of 97.95%, Positive Predictive Value of 85.71%, Negative Predictive Value of 100% and Diagnostic Accuracy of 98.18%. In the present study as well as in some few previous studies, FNAC can be a reliable first line investigation in children. From this study it was clear that there is more widespread utilization of FNAC in children especially in enlarged cervical lymph nodes. Most of them were reactive lymph nodes which does not need further investigation. It is also useful screening method in the diagnosis of tubercular lymph nodes.Awareness of the cytomorphologic features and clinic-radiologic correlation may assist the cytopathologists in rendering a precise diagnosis of rare pediatric tumors as well. Overall FNAC in pediatric age group is as useful as in general population and greatest utility is seen in enlarged cervical lymph nodes.

References

1. Saad RS, Singh HK, Silverman FJ. Pediatric Tumors. In: Orell SR, Sterett GF (eds.) Fine needle aspiration cytology. 5th Edition. Edinburg:Churchill livingstone Elsevier publisher.2012;17:428-450.
2. Jain M, Majumdar DD, Agarwal K. FNAC as a diagnostic tool in Pediatric head and neck lesions; Indian J Pediatr. 1999;36:921-923.
3. Schoot VL, Aronson D, Behrendt H, Bras J. Fine-needle aspiration cytology in children with

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persistent or suspicious lymphadenopathy; J Pediatr Surg. 2001;36(1):7-11.
4. Kusumakumary P, Jacob R, Jothirmayi R, Nair MK. A profile of childhood malignancy- 10 year studies. Indian Pediatr. 2000;37:1234-8.
5. Suzzane R, Carlos N. Fine needle aspiration Biopsy in a pediatric population- Report of 64 consecutive cases; Cancer. 1984;54:1449-1453.
6. Iyer VK. Role of fine needle aspiration cytology in management of pediatric renal tumors; J Indian Assoc. Pediatr Surg. 2007;12(3):116-119.
7. Schalper JA. Pediatric Tumors. In: Bibbo M, Wilbur D (Eds.). Comprehensive Cytopathology. 3rd edition. Philadelphia: Saunders Elsevier Publisher. 2008;29:915-950.
8. Health C. Children Are Not Little Adults Children's Health and the Environment. Environ Heal. 2008.
9. Suzzane R, Carlos N. Fine needle aspiration Biopsy in a pediatric population-Report of 64 consecutive cases; Cancer. 1984;54:1449-1453.
10. Wakely PE, Kardos TF, Frable WJ. Application of Fine Needle Biopsy to Pediatrics; Human Pathol. 1988;19(12):1383-1386.
11. Gamba PG, Messineo A, Antoniello LM, Boccato P, Blandamura S, Cechetto G,*et al*. A simple exam to screen superficial masses: fine-needle aspiration cytology, ncol. 1995;24(2):97-9.
12. Freire WA, Augusto C, Maria E, Tubino P. Fine needle aspiration biopsy in the diagnosis of lymphadenopathies and solid tumors in children and adolescents; Rev Col Bras Cir. 2008;35(1):25-35.
13. Maheshwari V, Alam K, Jain A, Agarwal S, Chana RS. Diagnostic utility of fine needle aspiration cytology in pediatric tumors. Journal of cytology. 2008;25:45-9.
14. Howell LP. Changing role of Fine Needle Aspiration in the Evaluation of Pediatric Masses; Diagn Cytopathol. 2001;24:65-70.