

Study of Magnetic Resonance Image in Quantitative diagnosis of sellar cystic lesion in Maharashtra Population

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Abstract

Background: The use of enhanced MRI shows the relationship between the lesion and the optic chiasm more clearly. MRI is the best choice of the diagnosis of sellar lesions. To analyze the signs of various types of sellar cystic lesions and use the overall analysis by conventional film-reading and the large log-likelihood study in differential diagnosis respectively, and to study MRI quantitative diagnosis in sellar cystic lesions. This retrospective study was conducted at our institution on suspected sellar cystic lesions being assessed by Magnetic Resonance Imaging, between July 2014 and March 2016. **Methods.** This study comprises 84 cases of the sellar cystic lesions. All patients were underwent plain and enhanced MRI examination. The signs of sellar cystic lesions including morphology, location, component, bleeding, liquid - liquid surface, the optic chiasm and third ventricle involvement, both sides of the cavernous sinus is invaded or not and the mode and degree of enhancement, etc. To large log- apply the likelihood study criterion, all the signs according to the appearance frequency will be converted to scores, which as the reason of differential diagnosis. **Results:** Conventional film-reading were correlated with large log-likelihood study for quantitative diagnosis in sellar cystic lesions using log-likelihood study formula and chi-square test to compare the two methods, $p < 0.05$ was statistically significant. The correct diagnosis of cystic pituitary tumor, craniopharyngioma, Rathke's cyst by large log-likelihood study were 35, 27, 12 cases; while by conventional film-reading method were 32, 25 and 9, respectively. **Conclusions:** The film-reading accuracy of large log-likelihood study in differential diagnosing cystic pituitary tumor, craniopharyngioma, Rathke's cyst is higher than conventional methods,

Key Words: MRI; pituitary gland; sellar cystic lesions, Rathke's Pouch

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INTRODUCTION

Sella is located in the middle cranial fossa and above the sphenoid body with the saddle-like shape; the main structures include sella, saddle diaphragm, pituitary gland,

pituitary stalk, cavernous sinus, suprasellar cistern and the hypothalamus. MRI is the best choice of the diagnosis of sellar lesions.¹ According to statistics literature², nearly 10 types of diseases can occur in the saddle, including craniopharyngiomas, pituitary tumors, Rathke's cyst, chordoma, pilocytic astrocytoma, epidermoid cyst, and arachnoid cyst, etc. MRI has high soft tissue resolution and multi-dimensional imaging, which makes it accurately show the site, size, shape and involvement of adjacent structures of the lesion. The use of enhanced MRI shows the relationship between the lesion and the optic chiasm more clearly. It can show the infiltration of cavernous sinus and carotid arteries. However, the exact diagnosis of sellar lesions with MRI is difficult. As too many kinds of sellar tumors make the imaging features complex because same disease shows different signs and the same sign can be seen

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in different diseases. Generally, sellar lesions contain diseases with cystic component as pathological features, including cystic macroadenoma, craniopharyngioma, Rathke's cyst and arachnoid cyst³. As the prognosis, surgical approach of each disease is different with the pathological features and biological behavior, accurate preoperative diagnosis is very important. Traditional imaging diagnosis is a typical empirical method, generally based on the sellar lesion's appearance in MRI, such as shape, location, internal components, signal characteristics, visibility of normal pituitary gland, whether the cavernous sinus and suprasellar region involved or not, wall thickness and enhancement pattern. But the importance of the above signs in arriving at the final diagnosis is subjective to inter observer variability. Large log-likelihood study is a probabilistic estimation method, also known as the maximum likelihood method, which is one of common mathematical model of the computer-aided diagnosis. The frequency of various signs of disease is converted to scores then the type of disease is discriminated according to the total scores. To study the value of differential diagnosis of large log-likelihood study compare to the conventional methods, and to improve the diagnostic accuracy of sellar cystic lesions with preoperative MRI.

METHODS AND MATERIAL

The study was carried out in the Department of Radio diagnosis, DR. Ulhas Patil, Medical College, Jalgaon; Maharashtra, India. The patients were aged between 20 to 76 years.

Inclusion criteria: This study comprises 84 cases of the sellar cystic lesions pathologically proved by surgery or aspiration biopsies. The inclusion criteria of cystic lesions: (1) completely cystic (2) cystic and solid: a single cystic area occupying over 1 / 3rd area of the tumor size (3) multiple cystic components: the total size of cystic areas at least 1 / 3rd of the tumor size. The main clinical symptoms are blurred vision, endocrine abnormalities, headache, polydipsia and polyuria, growth retardation.

Exclusion criteria: The patients having head injury, previous history of cystic surgery, history of epilepsy, immune compromised patients were excluded from the study

Methodology : 84 cases of sellar cystic lesions as follows: (1) 40 cases of pituitary tumors, of which 11 cases were completely cystic, 29 cases were solid and cystic, 25

males and 15 females, (2) 29 cases of craniopharyngioma, of which 9 cases were completely cystic, 20 cases were solid and cystic. 15 males and 14 females, (3) All 15 cases of Rathke's cyst were completely cystic. 6 males and 9 females. Every patient underwent plain and enhanced MRI examination, MRI model is 1.5T, scanning sequences included: T₁WI, spin-echo sequence (SE), TR / TE: 500/12ms; T₂WI, a fast spin echo sequence (FSE), TR / TE: 4029/112ms; diffusion-weighted sequence (DWI): TR / TE: 6265 / 101ms, matrix 256 × 256, slice thickness 3-5mm. All patients underwent enhanced MRI; contrast agent is gadolinium-DTPA (Gd-DTPA), a dose of 0.1\ mol/kg body weight. Duration of study was April 2016 to May 2018.

Statistical Analysis: The MRI signs of all 84 cases of sellar cystic lesions were analyzed statistically, the signs including shape (snowman-shaped, lobulated, oval), location (intrasellar, suprasellar, intrasellar and suprasellar), component (complete cystic, solid and cystic), bleeding, fluid-fluid levels, visibility of normal pituitary gland, compression of the optic chiasm and third ventricle, whether both sides of the cavernous sinus invaded or not, the manner and degree of enhancement. According to the frequency of the indicators, signs will be converted to scores by using large log-likelihood study criterion. Then the score of a definite case was calculated according to the specific MRI appearance on the basis of the differential diagnosis⁴. Use SPSS 18.0 for Windows statistical software and Excel 2003 to analyze the data, all the data are described by number of cases and frequency, and use chi-square test to compare the two methods, p < 0.05 was statistically significant. Ratio of Male and Females were 2:1

OBSERVATION AND RESULTS

Table-1. Study of probability signs of sellar cystic lesions observed in MRI and number cystic macro adenoma and craniopharyngioma, cysts in Rathke's pouch pharyngioma, cysts in Rathke's pouch were classified with percentage.

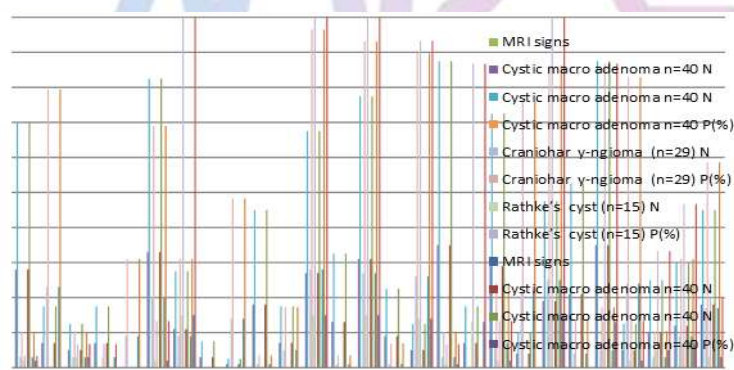
Table-2. Scoring criteria of probability was noted

Table-3. Score of MRI signs of sellar cystic lesions at different location were noted

Table-4. The results of 3 groups using conventional film reading and the large- like hood was studied pathologically observed cystic lesions were classified as macro adenoma and craniopharyngioma, Rathke's cyst was higher than other cystic lesion.

Table 1: (No of patients 84)Classification probability of MRI signs of sellar cystic lesions with percentage

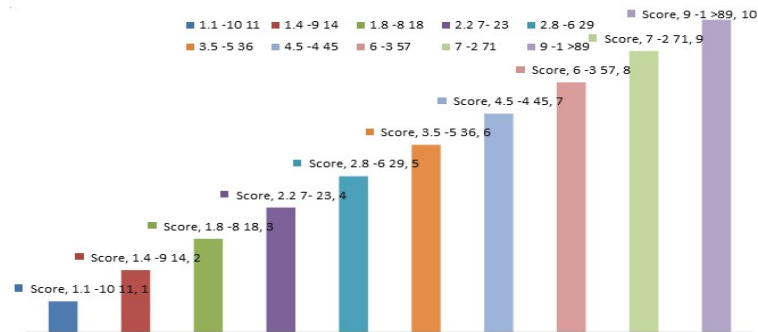
MRI signs	Cystic macro adenoma n=40		Craniopharyngioma (n=29)		Rathke's cyst (n=15)		
	N	P(%)	N	P(%)	N	P(%)	
Shape	Snowman shaped	28	70	3	10.3	2	3.3
	Lobulated	7	17.5	23	79.4	0	0
	Oval	5	12.5	3	10.3	3	6.7
Location	Intersellar	7	17.5	0	0	3	6.7
	Suprasellar	0	0	9	31	0	0
	Suprasellar and intrasellar	33	82.5	20	69	2	13.3
Components	Completely cystic	11	27.5	9	31	15	100
	Mainly cystic (central cyst)	3	7.5	0	0	0	0
	Mainly cystic (cyst on the edge)	1	2.5	14	48.3	0	0
	Solid majority (central cyst)	18	45	1	3.5	0	0
Bleeding	Solid majority (cyst on the edge)	7	17.5	5	17.2	0	0
	Absent	27	67.5	28	96.5	15	100
Fluid level	Present	13	32.5	1	3.5	0	0
	Absent	31	77.5	27	93.1	15	100
Normal pituitary	Present	9	22.5	1	6.9	0	0
	Visible	5	12.5	26	89.7	14	93.3
Optic chins and third ventricle	Not visible	35	87.5	3	10.3	1	6.7
	Under the optic chiasm	7	17.5	0	0	13	86.7
	Optic chiasm compression	29	72.5	7	24.1	2	13.3
Cavernous sinus	Third ventricle compression	4	10	22	75.9	0	0
	Normal	19	47.5	25	86.2	15	100
Enhancement	Wrapping (either side)	21	52.5	4	13.8	0	0
	Uniform	35	87.5	5	17.2	13	86.7
Wall thickness	Heterogeneous	5	12.5	24	82.8	2	13.3
	No	10	25	3	10.4	5	33.3
	Thin (2num)	12	30	9	31.0	7	46.7
	Thin(2num)	18	45	17	58.6	3	20



Graph 1: Classification probability of MRI signs of sellar cystic lesions with percentage

Table 2: (No of patients 84)The Scoring criteria of probability

Frequency	Score	Frequency	Score
1.1	-10	11	1
1.4	-9	14	2
1.8	-8	18	3
2.2	-7	23	4
2.8	-6	29	5
3.5	-5	36	6
4.5	-4	45	7
6.0	-3	57	8
7.0	-2	71	9
9.0	-1	>89	10



Graph 2: The Scoring criteria of probability

Table 3: (No of patients 84) Study of score of MRI signs of sellar cystic lesions at different location

	MRI signs	Cystic macro adenoma n=40	Craniopharyngioma (n=29)	Rathke's cyst (n=15)
Shape	Snowman shaped	8	0	1
	Lobulated	2	9	-10
Location	Oval	1	0	9
	Intrasellar	2	-10	9
	Suprasellar	-10	5	-10
Components	Suprasellar and intrasellar	9	8	1
	Completely cystic	4	5	10
	Mainly cystic (central cyst)	1	-10	-10
	Mainly cystic (cyst on the edge)	6	7	-10
Bleeding	Solid majority (central cyst)	7	-4	-10
	Solid majority (cyst on the edge)	2	2	10
	Absent	8	10	-10
	Present	5	-4	10
Fluid level	Absent	9	10	-10
	Present	3	-2	10-2
Normal pituitary	Visible	1	10	9
	Not visible	9	0	1
Optic chins and third ventricle	Under the optic chiasm	2	-10	-10
	Optic chiasm compression	9	4	10
	Third ventricle compression	1	9	-10
Cavernous sinus	Normal	7	9	9
	Wrapping (either side)	7	1	1
Enhancement	Uniform	9	2	5
	Heterogeneous	1	9	7
Wall thickness	No	4	0	3
	Thick (>2mm)	5	5	
	Thin (<2mm)	7	8	

Table-4: (No of patients 84) Comparison of diagnostic accuracy between accuracy conventional film reading and the large log-likelihood study of the 3 cystic lesions.

Types of lesion	Conventional methods with percentage (%)	Large log-likelihood study with percentage
Cystic pituitary adenoma	80(32/40)	87.5(35/40)
Craniopharyngioma	86.2(25/29)	93.1(27/29)
Rathke's cyst	60(9/15)	80(12/15)
Average	78.6(66/84)	88.1(74/84)

DISCUSSION

The present study of MRI quantitative diagnosis of sellar cystic lesion in Maharashtra population. The most common cystic lesions are cystic macroadenoma, craniopharyngioma and Rathke's cyst. The information of the lesion (such as location, size, shape, internal composition and adjacent structures) play great role in the qualitative diagnosis, especially the MRI examination. The clinical symptoms of the three kinds of cystic lesions are non specific, such as headache, visual disturbances or pituitary dysfunction. It is valuable for differential diagnosis that 9 indicators of sellar cystic lesions were quantitatively analyzed by using large log-likelihood study, combined with clinical manifestations. The accuracy of large log-likelihood study was higher than the general film-reading method, although there has no statistically significant differences between them. The most common shape of pituitary tumor were of snowman-shaped (70%), and craniopharyngioma were lobular (79.4%), Rathke's cyst were oval (86.7%). And the differences between each other are statistically significantly (pituitary tumor vs. craniopharyngioma, $P=0.002$; pituitary tumor vs. Rathke's cyst, $P=0.041$; craniopharyngioma vs. Rathke's cyst, $P=0.009$; $\alpha=0.05$). The probability of cystic macroadenoma and craniopharyngioma located in the intrasellar and suprasellar were 82.5% and 69%, respectively. But there are no significant difference between them ($P=0.1885$; $\alpha=0.05$). Rathke's cyst originated from between the anterior and posterior lobe of the pituitary⁵ with relatively smaller size, so the majority of the lesion located in the intrasellar. According to our results, the probability of Rathke's cyst located within the intrasellar was 87.5%. Rathke's cyst is completely cystic without solid components, containing cholesterol, Mucopolysaccharide, necrotic cellular debris and hemosiderin⁶. Signal feature present study. The probability of bleeding and fluid level of pituitary tumor were 32.5% and 22.5%, respectively; while that of craniopharyngioma were respectively 3.5% and 6.9%. The signal intensity of the cyst fluid of craniopharyngioma was correlated with the protein, cholesterol and other contents in it. Most of the cystic area was high signal in T1WI because of the high protein and one or more of the following components: cholesterol, triglycerides, high-iron hemoglobin⁷. The signal intensity of Rathke's cysts was changed with the contents but usually uniformity. The contents were mainly protein and cholesterol, and the T1 relaxation time was mainly affected by the protein component. Mucopolysaccharide also showed high signal in T1WI⁸. Small cysts which showed as high signal on T1WI and located within intrasellar often prompted to think as Rathke's cysts⁹. In our data, Pituitary tumors vs craniopharyngioma ($P < 0.001$) and pituitary tumor vs

Rathke's cyst ($P < 0.001$) were statistically significant, Although Rathke's cyst may be extended to the suprasellar region, but the body of them were in the saddle and under the optic chiasm. While the main body of craniopharyngioma were in the suprasellar and often extended to upper areas such as the 3rd ventricle involved^[10], which is the common sign with the probability was 75.9%. The difference between Rathke's cyst and craniopharyngioma was statistically significant ($P < 0.001$). The optic chiasm often elevated when pituitary tumor involved the suprasellar, while the optic chiasm was descended when craniopharyngioma involving it. It is difficult to differential them when the optic chiasm cannot be seen because of giant tumor. Our data show there was no statistical significance between craniopharyngioma and pituitary.

Invasion of cavernous sinuses had characteristic for pituitary tumor that single side or both sides of the cavernous sinus been enveloped with expansive grown and achieved the cavernous sinus which outside of dura¹¹. The probability was 52.5% in our data. Only 4 cases of 29 cases in our group showed this sign. The probability of homogeneous enhancement of solid components in pituitary tumors was 87.5%, while that of craniopharyngioma was 82.8%, the difference between them was statistically significant ($P < 0.001$). Cyst wall thickness with enhanced scan: without wall, thin ($< 2\text{cm}$), thick ($\geq 2\text{cm}$). Typically Rathke's cyst demonstrated as round or oval thin-walled cystic lesions. In our study, most of the Rathke's cyst have no wall (46.7%) or thinned wall (33.3%). Large log-likelihood study is a kind of probabilistic estimation method. This study attempts to apply this method for the MRI diagnosis of sellar cystic lesions. The optimized index was chosen from various signs of 84 cases of sellar cystic lesions and the frequency of each indicator was converted into scores. The type of disease was identified depended on the total scores.

SUMMARY AND CONCLUSION

The present study of MRI for quantitative diagnosis of sellar cystic lesion, various types of cyst were visualized and analyzed. Cysts located at Rathkes pouch was higher among all observed lesions. Pathologically lesion were classified as micro adenoma and craniopharyngioma. This MRI study will be quite useful to Neuro-surgeon to have safer and easy approach for surgical interruptions. This study demands further patho-physiological, micro-cellular, genetic, nutritional, hormonal, embryological studies because exact pathogenesis of quantitative and qualitative cyst is still un-clear. This Research paper was approved by ethical committee of Dr. Ulhas Patil, Medical College, Jalgon-425001, Maharashtra.

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