

ULTRASOUND: A COST EFFECTIVE AND ACCURATE IMAGING MODALITY FOR EVALUATION AND LOCALIZATION OF GANGLION CYSTS

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ABSTRACT

OBJECTIVE: To evaluate different features of ganglion cyst by using ultrasound and its exact localization in relation to adjacent tendons, ligaments, arteries and joints. **METHODOLOGY:** A cross sectional study was conducted in Department of Radiology, Dallah Hospital, Riyadh. Study duration was 1 year (1st August 2016 to 31st July 2017). A sample size of 89 patients was achieved using simple random sampling (Lottery Method). Patients diagnosed with ganglion cysts based on USG findings using MRI as gold standard, both genders and age greater than 18 years were included. Superficial ultrasound with high frequency transducer was performed in all patients, probe frequency ranging from 12 to 18 MHz. Ethical approval was taken from ethical review board of Dallah Hospital and consent was taken from patients. Data was analyzed using SPSS Software version 20. Chi-square test was applied for observing association between different variables. **RESULTS:** Total 89 patients were included in study. There were 25 (28%) males and 64 (72%) females. Mean age of patients was 43.6 ± 14.8 SD. Most common location of ganglion cyst in relation to joint, ligament, tendon & artery was anterior to scapholunate ligament 9 (10.1%) and around scapholunate joint dorsal aspect of wrist 18 (20.1%), volar surface 10 (11.2%) and medial to radial artery 2 (1.1%) respectively. A significant association was reported between limb & anatomical side ($p=0.03$), margins & echogenicity ($p=0.03$). **CONCLUSION:** Ultrasound is the primary imaging modality for evaluation and localization of ganglion cysts. Majority of ganglion cysts appear anechoic, have smooth margins and demonstrate clear internal content with no septation or echoes. Moreover, ganglion cysts occur most commonly adjacent to scapholunate ligament on dorsal surface of wrist. Although diagnosis of ganglion cysts is rarely a problem, we believe ultrasound allows accurate evaluation of ganglion cysts even as small as 2 mm, which are difficult to appreciate clinically or on MR imaging.

Key words: ganglion cysts, ultrasound, radial artery, scapholunate ligament, septation

Introduction

Ganglion cysts are most common soft tissue tumors affecting majority of population worldwide.¹ Males are three times more prone to develop ganglion cyst as compared to females.² Moreover, 60% of benign tumors represent themselves as ganglion cyst.³ Etiology of ganglia in 10% of patients is reported due to trauma.⁴ Most common sites for occurrence of

ganglia are hand, wrist, foot and ankle. Ganglion cysts are most common cause of palpable masses in hand and wrist.⁵ Approximately, 60-70% of ganglion cysts are located on dorsal aspect of wrist while 20% of ganglia arise from volar side of wrist.⁶ Dorsal ganglia origin is associated with dorsal scapholunate ligament.⁷

Globally, improved development in ultrasonography and high frequency probes makes ultrasound (US)

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first line diagnostic tool for superficial soft tissue lesion investigation.⁸ Ultrasound is one of the safest, cheap, easily repeatable and portable imaging technology. Ultrasound imaging is useful in determination of ganglion cysts and helps to understand their anatomical association with adjoining structures.⁹ Ganglia frequently appear anechoic on ultrasound and present with no vascularity on imaging.¹⁰⁻¹¹

Ganglion cysts appear as well circumscribed (thin walled) and anechoic masses with posterior acoustic enhancement on ultrasound examination.^{12,13} Evidence exists that on ultrasound examination it is difficult to differentiate between ganglion cysts and synovial cysts.¹⁴ Ganglion might appear as unilocular, multilocular, rounded or lobulated on US.¹⁵ On advance ultrasound imaging thin internal septations of ganglion cysts appear as fine linear echoes.^{16,17}

Artul & Habib reported that Doppler dimension of US is useful component in determination of vascularity of ganglion cysts. However, advancement in contrast enhanced ultrasound and 3D ultrasonography helps in enhancement of sensitivity, specificity and accuracy of diagnostic modality.¹⁸ A limited data is available on ultrasound as primary imaging modality for evaluation of ganglion cysts. This study is to evaluate different features of ganglion cyst by ultrasound and its exact localization in relation to adjacent tendons, ligaments, arteries and joints.

Methodology

A cross sectional study was conducted in Department of Radiology, Dallah Hospital, Riyadh. Study duration was 1 year (1st August 2016 to 31st July 2017). A sample size of 89 patients was calculated with 95% confidence interval (z), 13% prevalence (p) and 7% margin of Error (d) using WHO calculator. All patients who were diagnosed with ganglion cysts based on USG findings using MRI as gold standard, both genders and age greater than 18 years were included. Selection of patients was done by using list (sampling frame) of ganglion cysts patients from outdoor OPD and simple random sampling (lottery method) was used for final sample size achievement. Superficial ultrasound with high frequency transducer was performed in all patients, probe frequency ranging from 12 to 18 MHz. MRI images were also acquired

in all patients included in this study. Some patients underwent MRI for other indications and ganglion cyst was subsequently identified as an incidental finding. While few patients were advised MRI for primary evaluation of ganglion cyst, its exact location and relationship. In our study only those patients were included who underwent USG and MRI within a span of maximum one month, with the diagnosis of ganglion cyst on both modalities. Ethical approval was taken from ethical review board of Dallah Hospital and consent was taken from patients. Data was collected through pre tested questionnaire. Reliability of questionnaire was assessed after a pretest exercise of 10 questionnaires. Data was analyzed using SPSS software version 20.0. A chi-square test was applied for observing association and P-value ≤ 0.05 was considered significant.

Results

Total 89 patients of ganglion cyst were recruited. There were 25 (28%) males and 64 (72%) females. Mean age of patients was 43.6 ± 14.8 SD. Among all the patients with ganglion cysts 89 (100%), 64 (71.9%) had ganglion cysts in upper limb while 25 (28.1%) had ganglion cysts in lower limb. However, 48 (53.9%) ganglion cysts were located on left side while 41 (46.1%) were located on right side. Moreover, ganglion cysts were located on wrist 40 (44.9%), finger 18 (20.2%), foot 23(25.8%), distal forearm 2 (2.2%), ankle 3 (3.4%), shoulder 1 (1.1%), thumb 2 (2.2%). Among all patients diagnosed with ganglion cysts 89 (100%), 54 (60.7%) had smooth margins, 34 (38.2%) had lobulated margins while 1 (1.1%) had ill-defined margins. Anechoic appearance was reported in 80 (89.9%) patients on ultrasound while hypoechogenicity was reported in 9 (10.1%) patients. Internal content was clear in 50 (56.2%) patients, echoes in 8 (9%) patients, septations in 24 (27%), echogenic foci 1 (1.1%), sepatation & echoes in 6 (6.7%) patients. Ganglion cyst size (mm) was 3x3x2 in 11 (12.4%), 4x4x2 in 5 (5.6%), 5x4x2 in 8 (9%), 6x5x5 in 4 (4.5%), 6x6x4 in 2 (2.2%), 7x5x4 in 8 (9%), 8x8x4 in 8 (9%), 10x9x5 in 5 (5.6%) and others in 38 (42.7%). Ganglion cysts localization with respect to joints, tendons and arteries is shown in (Tab. 1).

Ganglion cysts exact localization adjacent to joints	Number (N=89)	Frequency (100%)
Anterior to scapholunate ligament	9	10.1%
Around scapholunate joint (dorsal aspect of wrist)	18	20.1%
A1 Pulley	3	3.3%
Distal Phalanx index finger	1	1.1%
Deep to flexor carpi radialis	2	2.2%
Over radio-carpal joint	2	2.2%
Over distal radio-ulnar joint	1	1.1%
2 nd carpo metacarpal joint	1	1.1%
Over interphalangeal joint	1	1.1%
Localization adjacent to tendon		
2 nd flexor tendon sheath	3	3.3%
3 rd flexor tendon sheath	4	4.5%
4 th flexor tendon sheath	5	5.6%
5 th flexor tendon sheath	2	2.2%
1 st and 2 nd extensor compartments of wrist	4	4.5%
Lateral to extensor digitorum longus tendon in foot	6	6.7%
Anterior to peroneal tendon in foot	4	4.5%
Volar wrist	10	11.2%
Deep to extensor digitorum longus tendon in foot	5	5.6%
Localization adjacent to arteries		
Medial to radial artery	2	2.2%
b/w 1 st extensor compartment and radial artery	1	1.1%
Encasing radial artery	1	1.1%
Close to radial artery	1	1.1%
Superficial to radial artery	1	1.1%
Others	4	4.5%

Table 1: Ganglion cyst localization with respect to joints, tendons & arteries

Among all the male patients 25 (28.1%), 12 (13.5%) had smooth margin ganglion cysts, 13 (14.6%) had lobulated margins and 0 (0%) had ill-defined margins. Among all the female patients 64 (71.9%), 42 (47.2%) had smooth margins, 21 (23.6%) had lobulated margins and 1 (1.1%) had ill-defined margins ($\chi^2=3.044$, $p=0.218$, $df=2$). Among all the male patients 25 (28.1%), 21 (23.6%) were anechoic while 4 (4.5%) were hypoechoic. Among all female patients 64 (71.9%), 59 (66.3%) were anechoic while 5 (5.6%) were hypoechoic ($\chi^2=1.326$, $p=0.250$, $df=1$). Association between gender, side and limb is shown in (Tab. 2)

Limb	Gender		Total	Chi-square	P value
	Male	Female			
Upper limb	17(19.1%)	47(52.8%)	64(71.9%)	0.263	0.608
Lower Limb	8(9%)	17(19.1%)	25(28.1%)		
Total Side	25(28.1%)	64(71.9%)	89(100%)		
Left	15(16.9%)	33(37.1%)	48(53.9%)	0.515	0.473
Right	33(37.1%)	31(34.8%)	41(46.1%)		
Total	25(28.1%)	64(71.9%)	89(100%)		
Limb	Anatomical side		Total	Chi-square	P value
	Left	Right			
Upper limb	39(43.8%)	25(28.1%)	64(71.9%)	4.5000	0.03
Lower Limb	9(10.1%)	16(18%)	25(28.1%)		
Total	48(53.9%)	41(46.1%)	89(100%)		

Table 2: Association between gender, limb, anatomical side and between anatomical side & limb

Among all the patients who had ganglion cysts in upper limb 64 (71.9%), 34 (38.2%) were clear, 18 (20.2%) had septations, 5 (5.6%) had internal echoes, 1 (1.1%) had echogenic foci, 6 (6.7%) with septations & internal echoes. While those who had ganglion cysts in lower limb 25 (28.1%), 16 (18%) were clear, 3 (3.4%) had echoes, 6 (6.7%) had septations, 0 (0%) with echogenic foci, 0(0%) had septations & echoes ($\chi^2=3.577$, $p=0.466$, $df=3$). A significant association between anatomical side and limb ($p=0.03$) was found as shown in (Tab. 3).

Margins	Side		Total	Chi-square	P value
	Left	Right			
Smooth	26(29.2%)	28(31.5%)	54(60.7%)	3.486	0.175
Lobulated	22(24.7%)	13(14.6%)	34(39.3%)		
Total	48(53.9%)	41(46.1%)	89(100%)		
Margins	Echogenicity		Total	Chi-square	P value
	Anechoic	Hypoechoic			
Smooth	45(50.6%)	9(10.1%)	54(60.7%)	6.490	0.03
Lobulated	35(39.3%)	0(0%)	35(39.3%)		
Total	80(89.9%)	9(10.1%)	89(100%)		

Table 3: Association between limb, echogenicity, exact location and margins, size & internal content

Discussion

Ultrasound is a common diagnostic tool used for evaluation and localization of ganglion cysts nowadays.¹⁹ High frequency transducer development and improvement in signal processing has improved acceptance of ultrasound for ganglion cysts evaluation

in last few decades²⁰ and is generally considered sufficient for assessment of typical cysts. MRI is usually reserved for atypical cysts, in case of compressive symptoms or in some pre-operative cases.

Total 89 patients of ganglion cyst were recruited. There were 25 (28%) males and 64 (72%) females. Nahra & Bucchieri reported that females are more likely to be affected by ganglion cysts as compared to males.²¹

Present study reported that most common location of ganglion cysts adjacent to joint, ligament, tendon & artery was anterior to scapholunate ligament 9 (10.1%) and around scapholunate joint dorsal aspect of wrist 18 (20.1%), volar surface of wrist 10 (11.2%) and medial to radial artery 2 (1.1%) respectively. Liu et al. reported that wrist is most common location for ganglion cysts with respect to scapholunate ligament of dorsal wrist. However in lower limb tibioperoneal joint is most common location for ganglion cysts.²²

Teefey et al. reported 91% of ganglion cysts were located on volar or dorsal surface of wrist.²³

In present study, anechoic appearance was reported in 80 (89.9%) patients on ultrasound while hypoechogenicity was reported in 9 (10.1%) patients. Teefey et al. reported that small ganglia are most likely to present with low level echoes.²³ However, Wang et al. contradicts and reported that ganglion cysts with such echoes are relatively complex and known as hypoechoic.²⁴

Among all the patients who had ganglion cysts in upper limb 64 (71.9%), 34 (38.2%) had clear, 18 (20.2%) had septations, 5(5.6%) had echoes, 1 (1.1%) had echogenic foci, 6 (6.7%) had septations with echoes. Hoglund et al reported that in terms of configurations, 5% of ganglion cysts were round or oval with sharply defined septations.

As ganglion cyst is a benign entity, close follow-up of the lesions is not recommended. Patient reassurance and observation is all that is needed as a conservative treatment plan because some cysts may spontaneously regress over time. However in case of atypical cysts, enlarging size or compression symptoms, patients can be followed-up, with again USG being the modality of choice as it is cost effective, easily available and time saving. We used the same follow-up protocol in all our patients.

Present study had limitations due to small sample

size and its generalization is limited because it was a single centered study.

Conclusion

Ultrasound is primary imaging modality for evaluation and localization of ganglion cysts. Majority of ganglion cysts appear anechoic, have smooth margins and demonstrate clear internal content with no septation or echoes. Moreover, ganglion cysts occur most commonly adjacent to scapholunate ligament on dorsal surface of wrist. Although diagnosis of ganglion cysts is rarely a problem, we believe ultrasound allows accurate evaluation of ganglion cysts even as small as 2 mm, which are difficult to appreciate clinically or on MR imaging. Being a completely benign entity, and no follow-up is recommended, unless the cyst is atypical, enlarging or causing compression effects.

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