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Clinical, histopathological and immunohistochemical features of glomus tumor of the nail bed

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Abstract

Purpose: Glomus tumors account for 1–4% of benign hand tumors. In 65% of cases, it is located in the nail bed. Its rarity makes misdiagnosis problems relatively common. Symptomatology is characterized by the hallmark symptomatic triad. Imaging investigations may guide the diagnosis, but the diagnosis is made by pathological examination doubled by immunohistochemical (IHC) markers. *Patients, Materials and Methods*: We studied a group of seven female patients, aged 28 to 56 years. Clinical examination revealed the presence of the characteristic symptomatic triad. Ultrasound imaging tests were performed. *Results*: Anatomopathological examination made a diagnosis of glomus tumor in all seven cases. IHC staining showed that tumor cells were positive for alpha-smooth muscle actin (α-SMA) and h-caldesmon in all seven cases and negative for cluster of differentiation 34 (CD34) in 72.14%. IHC stainings for p63, S100, cytokeratin (CK) AE1/AE3 were negative in all cases. The clinical diagnosis completed by ultrasonography was histopathologically confirmed in all cases. *Conclusions*: Although the glomus tumor is a rare lesion, we need to be familiar with it because a diagnostic delay also implies a treatment delay which will lead to amplified suffering and even real disability due to the high-intensity pain in these cases.

Keywords: glomus tumor, nail bed, surgery, immunohistochemical staining.

Introduction

Originating from glomus bodies, the glomus tumor is described as a rare benign tumor with low malignant potential, accounting for 1–4% of all hand tumors [1]. Seventy-five percent of glomus tumors are located in the hand, with 65% of these in the subungual region [2]. Being a rare tumor, the misdiagnosis rate is high [3]. They can be solitary or multiple tumors, the latter being associated with chromosome 1p21-22 [4, 5]. Localization in the hand is more common in women aged 30–50 years [6]. Extradigital locations (lung, liver, stomach, colon, kidneys) are more often reported in men [7, 8]. A volar pulp location is reported in only 10% of glomus tumors. Because it originates from the glomus bodies, which are contractile neuromyoarterial receptors that control blood pressure and temperature by regulating flow in the cutaneous microvasculature, the clinical expression of this type of tumor can be characterized as being relatively severe, represented by the hallmark symptomatic triad identified by specific tests Love's pin test, Hildreth's test, and cold sensitivity test [6]. Transillumination test can help determine the size of the tumor [2]. Imaging investigations that can help establish the diagnosis include plain radiography, ultrasonography (US), Doppler US in positron emission tomography/computed tomography (PET/CT) and magnetic resonance imaging (MRI). MRI alone can be a radiological adjunct to clinical examination and is especially indicated in small tumors [9, 10]. As to dermoscopic examination, it is reported in very few cases [11, 12]. Histopathologically, there are three forms of glomus tumor: solid tumor is the most common variant (75%) followed by glomangioma (20%) and glomangiomyoma (5%) [13, 14]. Immunohistochemically, glomus tumors are positive for alpha-smooth muscle actin (α-SMA), muscle-specific actin (MSA) and h-caldesmon [15, 16]. Surgical treatment with complete tumor removal is the curative solution for the treatment of glomus tumors of the nail bed [17]. Recurrence rate of 4–50% is found only in case of incomplete excision or missed diagnosis of coexisting small glomus tumor at the time of surgery [18].

Aim

We studied a group of seven patients, all female, with clinical features of the glomus tumor. The diagnosis was made based on the symptomatic triad completed by US. Surgical treatment consisted of tumor excision with transungual approach using local anesthesia with 1% Lidocaine in five cases and the wide-awake local anesthesia with no tourniquet (WALANT) technique in two cases. For the

histopathological (HP) diagnosis, the usual stainings but also immunohistochemical (IHC) tests were used. Two years after surgery no recurrence was recorded. Patient satisfaction with the aesthetic outcome was maximum.

Patients, Materials and Methods

We studied a group of seven patients, admitted to the Clinic of Plastic Surgery, Sf. Spiridon Emergency County Hospital, Iaşi, Romania, between 2013 and 2019. For the current study, the approval of the Hospital's Ethics Committee was obtained. Informed consent was obtained from all study patients. All study patients were female, aged between 28 and 56 years, and a history of disease progression of one to seven years. All patients had painful symptoms for one to five years. Clinical examination consisted of performing the following tests: Love's pin test, cold sensitivity test, and Hildreth's test. None of the cases had a history of trauma to the nail complex. In two cases, dermoscopy was recommended. In none of the cases was the transillumination test performed. Regarding the imaging examinations, in all cases plain face and profile X-rays and US were performed. MRI examination was not performed in any of the cases. Surgery was performed under local anesthesia, in three of the nine cases using the WALANT technique (1% Lidocaine with 1:100 000 Adrenaline), and in the other six cases 1% Lidocaine and placement of a tourniquet at the base of the finger to provide effective exsanguination of the surgical field, thus enabling a good visualization of the tumor. The surgical technique for tumor ablation used the trans-nailbed approach, followed by curettage of the tumor at the level of the phalanx and its complete removal, followed by reconstruction of the nail bed with 7-0 absorbable wire and protection with the nail plate previously detached (Figure 1, A–D). A few holes were made in the nail plate to allow drainage and prevent hematoma formation.

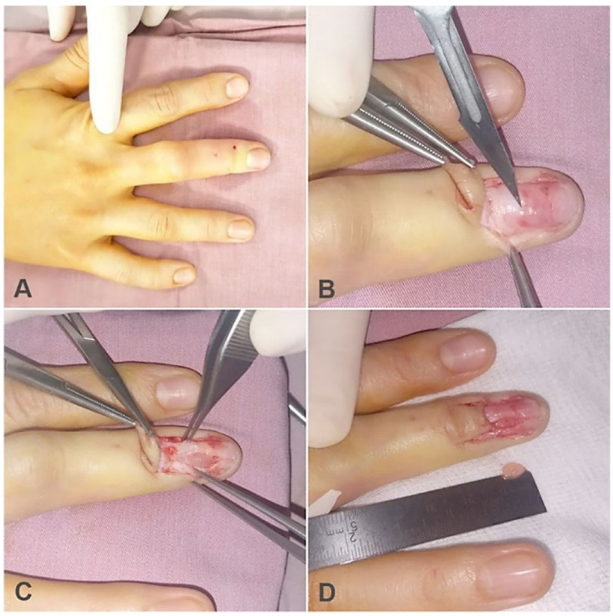

Figure 1 – ***(A) Left middle finger glomus tumor that is not obvious to the naked eye; (B) Left middle finger glomus tumor is obvious intraoperatively; (C) Glomus tumor – intraoperatively aspect; (D) Glomus tumor, surgical specimen, well-defined, fibrous, elastic, yellowish-white nodular mass.***

The surgical specimen was histopathologically examined using the usual Hematoxylin–Eosin (HE) staining. For phenotyping, additional IHC tests were performed for α-SMA (clone 1A4 – mouse, Cell Marque), h-caldesmon (clone E94 – rabbit, Ventana), p63 (clone 4A4 – mouse, Ventana), cluster of differentiation 34 (CD34) (clone QBEnd/10, Ventana), cytokeratin (CK) AE1/AE3 (clone PCK-26, Ventana), S100 (polyclonal, Cell Marque). No dilutions were used, the antibodies being ready to use. The device used was the Ventana XT type and the Leica DM working microscope.

None of the seven study patients developed recurrence within two years. Patient satisfaction with the postoperative aesthetic outcome was assessed.

Results

The fingers of the dominant right hand were affected in five (71.4%) of the seven study cases, in the remaining two cases the non-dominant hand (left hand) being affected. All fingers were affected by in various proportions: the thumb in one case (14.28%), the index finger in two (28.57%) cases, middle finger in two (28.57%) cases, ring finger in one case (14.28%), and little finger also in one case (14.28%). Age distribution of the study cases showed: one patient (14.28%) in the 20–30 years, three (42.85%) patients in the 30–40 years, one (14.85%) patient in the 40–50 years, and one (14.85%) patient in the 50–60 years age group. The tests used in the clinical diagnosis were positive in all study patients. Love's pin test, which consists of applying pressure over the suspected area with a pinhead, was certainly positive in all cases, causing tears to come out of two women's eyes. In the cold sensitivity test, cold water or an ice cube is applied to the affected area. If the patient experiences increased pain, it would indicate a positive result, which was the case with all the seven study cases. The application of a tourniquet proximal to the lesion produced a reduction of pain and tenderness (Hildreth's test) in all but two patients (Table 1).

Table 1 – ***Clinical tests of the study's cases***

Case No.	Love's test	Cold sensitivity test	Hildreth's test	Transillumination test
1.	+	+	+	Absent
2.	+	+	+	Absent
3.	+	+	+	Absent
4.	+	+	-	Absent
5.	+	+	-	Absent
6.	+	+	+	Absent
7.	+	+	+	Absent

Dermoscopic examination recommended only in two of the cases with very small tumors did not assist the diagnosis. No nail deformity was found at clinical examination in any of these cases. Plain face and profile radiography showed in only two (28.57%) cases a change in the contour of the distal phalanx, in the other cases the radiological appearance being normal. Ultrasound examination revealed in four of the seven study cases the presence of a hypoechoic nodule with intense vascularization located between the distal phalanx and the nail body (Table 2).

No intraoperative accidents or incidents have been recorded in any of the seven study cases. The surgical

specimen revealed a well-defined, firm, elastic, yellowish-white nodular mass with translucent areas. The degree of patient satisfaction in the immediate postoperative period was maximum, given the disappearance of the painful symptoms with a strong emotional impact on patients.

HP examination revealed that all seven case studies had a positive result of solid glomus tumor. The tumor process was well-defined by the presence of a fibrous capsule in the periphery. The tumor process had insular and trabecular architecture, islands and trabeculae of tumor cells arranged in a loose myxoid stroma. With the usual HE staining, small, uniform, often round glomus cells with small, round nucleus placed centrally in the cell, homogeneous chromatin, and weakly visible nucleoli were seen. The cytoplasm was amphophilic or pale eosinophilic. Rare mitoses were noted, each cell being well-delimited by a basement membrane (Figure 2, A–C).

Immunohistochemically, the tumor cells were consistently positive for α-SMA and h-caldesmon and in only five of the seven cases for CD34 (Figure 3, A–C). All seven cases showed negative immunostaining for CK AE1/AE3, S100, and p63 (Figure 4, A–C). Positive immunostaining for MSA was obtained in the two cases in which this IHC test was performed (Table 3).

Table 2 – ***Clinical and imagistic tests of the study's cases***

Case No.	Age [years]	Sex	Symptom's history [years]	Affected hand	Affected finger	Clinical test	Dimension of the GT [cm]	X-ray	US	MRI	Dermoscopy
1.	28	F	7	NDH	D3	+++	0.6/0.5/0.3	Bone distortion	+	-	-
2.	31	F	1	DH	D4	+++	0.5/0.4/0.2	Normal	+	-	-
3.	39	F	1.5	NDH	D2	+++	0.8/0.5/0.3	Bone distortion	+	-	-
4.	45	F	3	NDH	D2	+++	0.3/0.3/0.3	Normal	-	-	Irrelevant
5.	51	F	4	DH	D1	+++	0.4/0.3/0.2	Normal	-	-	Irrelevant
6.	37	F	2	NDH	D5	+++	0.5/0.3/0.2	Normal	-	-	-
7.	56	F	1	NDH	D3	+++	0.6/0.4/0.2	Normal	+	-	-

DH: Dominant hand; F: Female; GT: Glomus tumor; MRI: Magnetic resonance imaging; NDH: Non-dominant hand; US: Ultrasonography.

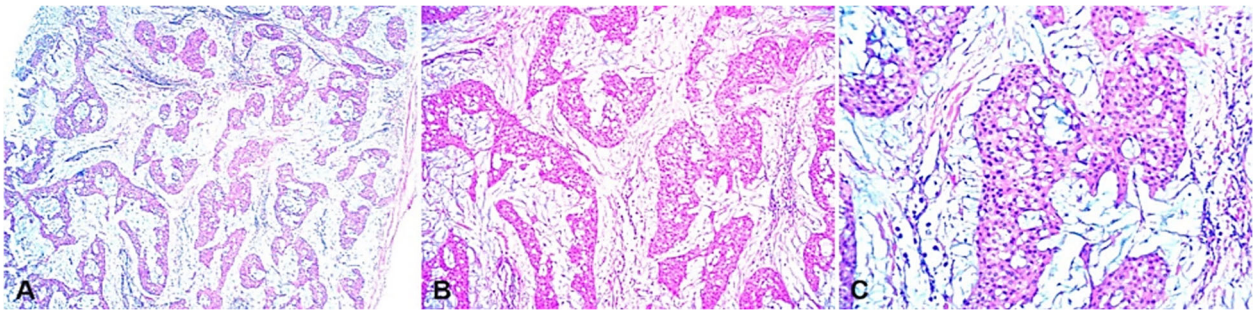

Figure 2 – ***(A–C) Glomus tumor: amphophilic cytoplasm, rare mitoses, each cell being well-delimited by a basal membrane. Hematoxylin–Eosin (HE) staining: (A) ×25; (B) ×100; (C) ×200.***

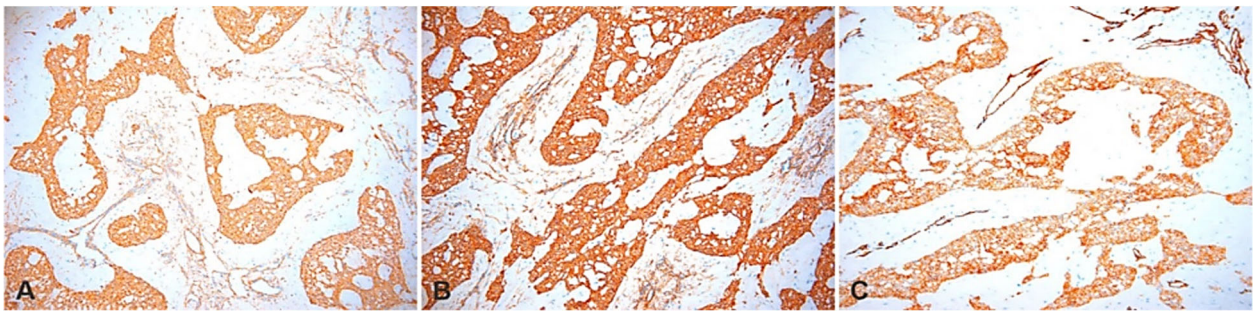

Figure 3 – ***Glomus tumor of the nail bed (×100): (A) α-SMA positive; (B) h-Caldesmon positive in tumor cells; (C) CD34 positive in tumor cells and vascular endothelium. α-SMA: Alpha-smooth muscle actin; CD34: Cluster of differentiation 34.***

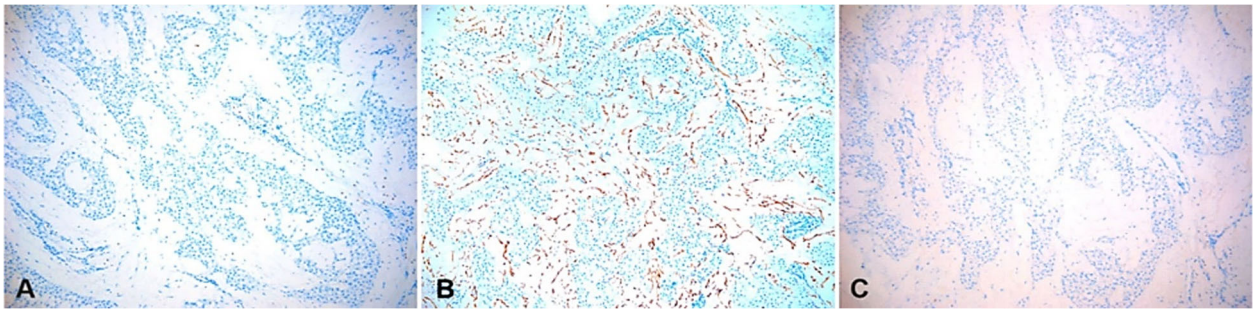

Figure 4 – ***Glomus tumor of the nail bed (×100): (A) CK AE1/AE3 negative; (B) S100 negative; (C) p63 negative. CK: Cytokeratin.***

Table 3 – *IHC tests of the study's cases*

IHC staining	Frequency	Percentage
α-SMA	7/7	100% positive
CD34	5/7	71.42% positive
CD31	–	–
p63	7/7	100% negative
S100	7/7	100% negative
Laminin	–	–
Desmin	–	–
h-Caldesmon	7/7	100% positive
CK AE1/AE3	7/7	100% negative
MSA	2/7	28.57% performed

α-SMA: Alpha-smooth muscle action; CD: Cluster of differentiation; CK: Cytokeratin; IHC: Immunohistochemical; MSA: Muscle-specific actin.

In all case studies, the clinical diagnosis of glomus tumor of the nail bed was confirmed by the anatomopathological diagnosis correlated with IHC staining. No recurrence was detected after two years of follow-up.

As to the aesthetic appearance of the operated nail, in the case with the largest tumor of the seven studied, there was a slight nail deformity, but this did not negatively impact the degree of patient satisfaction. Patient satisfaction was assessed with the help of the *Michigan Hand Outcomes Questionnaire* (MHQ) that contains six specific scales: (*1*) overall hand function, (*2*) activities of daily living, (*3*) pain, (*4*) work performance, (*5*) aesthetics, and (*6*) patient satisfaction with hand function, all of these being rated maximum in all cases.

Discussions

Wood was the first to describe a glomus tumor, in 1812, as a "painful subcutaneous tubercle" [19]. In 1924, Barré & Masson were the first to describe the histology of this entity as a rare benign vascular hamartoma consisting of neuromyoarterial cells of the glomus body [20]. Glomus body is a contractile neuromyoarterial receptor that controls blood pressure and temperature by regulating flow in the cutaneous microvasculature. As in previous reports, in the present study the digital localization of glomus tumor was recorded in female patients, most commonly aged 30–50 years, the solitary variant being the most common [21]. The etiology of this type of benign tumor is unknown and may be related to sex, age, heredity. The pattern of transmission is autosomal dominant [22]. It has been reported that it may also exist in children [23]. Malignant transformation of the glomus tumor is rare [15]. In more than half of the reported glomus tumors, and regardless of their location, an association with a novel micro-ribonucleic acid (RNA) 143 (*MIR143*)–*NOTCH* fusion gene has been uncovered through RNA sequencing [24]. The association between the glomus tumor and neurofibromatosis type 1 (NF1) was first reported in 1938 [5].

The diagnosis of a glomus tumor is clinical, based on the presence of the symptomatic triad (hallmark): Love's pin test (if pressure applied to the suspected area with a pinhead elicits intense pain), Hildreth's test (reduced pain and sensitivity after applying a tourniquet proximal to the lesion) and cold sensitivity test (pain amplification in case of cold exposure to cold) [25]. Regarding the accuracy and efficiency of these tests, several studies reported that the cold sensitivity test has a sensitivity, specificity, and accuracy of 100%, Love's pin test a sensitivity of 100% and 78% accuracy, while Hildreth's test has a sensitivity of 71.4%, specificity of 100%, and accuracy of 78% [26]. In our seven case studies, the Hildreth's test was negative in two cases. In the remaining cases, the symptomatic triad was present. Pain being the most important symptom of this type of tumor, the differential diagnosis should include, first of all, other painful skin lesions: leiomyoma, angiolipoma, dermatofibroma, neurofibroma, giant cell tumor, lymph node cyst, epidermal inclusion cyst, blue nevus, eccrine spiradenoma, squamous cell carcinoma, etc. [25, 27]. A new "pink glow" sign in ultraviolet dermoscopy has been described for the diagnosis of glomus tumor [28]. The transillumination test involves shining light through the finger in a dark room to assess the tumor size [2]. It is reported to have a sensitivity of 23% to 38% and a specificity of 90% [9]. The mechanism of pain seems to be associated with the contraction of myofilaments in response to temperature changes, due to increased intracapsular pressure [29].

Nail deformity is reported in 3.3% of cases [9]. When the diagnosis cannot be confirmed by clinical examination, imaging explorations are made. Face and profile radiography can detect changes in the contour of the distal phalanx with its imprint by the tumor mass. In our study, this imaging element was found in two of the cases in which the glomus tumor was larger (28.57%).

A useful imaging examination in the diagnosis of glomus tumor is US, especially high-frequency US, which can locate the tumor [30]. Chen in 2003, Matsunaga in 2007 and Park in 2011 reported typical US features for the ultrasound diagnosis of glomus tumor. Even so, in the case of subungual localization and small tumor size, US may not be conclusive [30]. MRI examination may be helpful, although classical MRI examination does not give specific images of the glomus tumor [31]. The symptomatic triad being present in all seven study cases, the diagnosis was clinical and completed with US in four of the seven cases. Dermoscopy performed in two cases did not help in preoperative diagnosis. The treatment in all cases of glomus tumor of the nail bed is surgical and consists of complete tumor excision. Misdiagnosis has been reported, and as a result, definite diagnosis and treatment are often delayed [3]. Surgery is performed under local anesthesia, and the approach can be transungual, as in our study patients. There is also an alternative technique, in which the incision is made laterally, along the dorsal side of the distal phalanx with minimal nail bed injuries [24].

Glomus tumors are typically composed of three components: glomus cells, smooth muscle cells, and vasculature. Glomus cells are small, uniform in perivascular distribution [24]. Tumor cells have eosinophilic to amphophilic cytoplasm and well-defined margins [24]. All our seven case studies presented the solid form of the glomus tumor, which has been reported in the literature as being present in 75% of cases.

The IHC profile of different studies on glomus tumors shows that the percentage of CD34-positive cells ranges from 32% to 53%, while immunopositivity for α-SMA and

MSA was 99% and 95%, respectively. h-Caldesmon is positive in 87% of cases, and collagen type IV and laminin are positive in 91% of cases, while vimentin and calponin are positive in 100% and 80% of cases, respectively [32]. Glomus tumors are negative for S100 in most cases. The immunostainings for CK AE1/AE3, CD31, p63, S100, CD117, desmin, chromogranin and synaptophysin, Wilms tumor protein 1 (WT1), are negative. p63 is used in the differential diagnosis with a mixed tumor [15, 16]. In this study, α-SMA and h-caldesmon were positive in all cases and CD34 in 71.42% of the cases. The differential diagnosis of glomus tumor includes other painful tumors, such as angioleiomyoma, when agglomerations of smooth muscle cells lacking the round cell component and frequently desmin-positive are found. The IHC phenotype of the glomus tumor, although relatively nonspecific, still supports a pericytic phenotype [15, 16]. In the case of dermal nevus, there are nests of melanocytes, without blood vessels, and by immunohistochemistry S100 is positive, while α-SMA and h-caldesmon negative. Paraganglioma is characterized by growth in zellballen nests, positivity on synaptophysin and chromogranin and S100-positive sustentacular cells. Neuroendocrine tumors are negative for α-SMA and positive for synaptophysin and chromogranin, while hidradenoma/eccrine spiradenoma have epithelial or sebaceous differentiation and is positive for keratin and negative for α-SMA [32]. For a broad and correct differential diagnosis, hemangioma, neuroma, even gouty arthritis, vascular diseases, cysts, exostoses, nail bed neurofibroma, arteriovenous malformations should be considered [3, 21]. HP examination will always make a definite diagnosis.

Conclusions

The glomus tumor, a rare benign tumor, most commonly located in the nail bed, despite a well-represented symptomatic triad is often misdiagnosed. Good knowledge of the symptoms, imaging diagnostic features, and HP characteristics doubled by IHC stainings specific to this type of tumor will lead to a definite diagnosis. This will avoid the delay in making the diagnosis and implicitly of surgery because most of these patients have a long history of excruciating pain resulting in a true disability.

Conflict of interests

The authors have no conflict of interests to declare.

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References

[1] Rahbari K, Farzan M, Saffar H, Farhoud AR. Glomus tumor of uncertain malignant potential in thumb: a case report and review of literature. Arch Bone Jt Surg, 2020, 8(1):117–120. https://doi.org/10.22038/abjs.2019.35225.1928 PMID: 32090155 PMCID: PMC7007706

[2] Samaniego E, Crespo A, Sanz A. Claves del diagnóstico y tratamiento del tumor glómico subungueal [Key diagnostic features and treatment of subungual glomus tumor]. Actas Dermosifiliogr, 2009, 100(10):875–882. PMID: 20038364

[3] Santoshi JA, Kori VK, Khurana U. Glomus tumor of the fingertips: a frequently missed diagnosis. J Family Med Prim Care, 2019, 8(3):904–908. https://doi.org/10.4103/jfmpc.jfmpc_88_19 PMID: 31041222 PMCID: PMC6482761

[4] Stewart DR, Sloan JL, Yao L, Mannes AJ, Moshyedi A, Lee CC, Sciot R, De Smet L, Mautner VF, Legius E. Diagnosis, management, and complications of glomus tumours of the digits in neurofibromatosis type 1. J Med Genet, 2010, 47(8):525–532. https://doi.org/10.1136/jmg.2009.073965 PMID: 20530151 PMCID: PMC3412429

[5] Boon LM, Brouillard P, Irrthum A, Karttunen L, Warman ML, Rudolph R, Mulliken JB, Olsen BR, Vikkula M. A gene for inherited cutaneous venous anomalies ("glomangiomas") localizes to chromosome 1p21-22. Am J Hum Genet, 1999, 65(1):125–133. https://doi.org/10.1086/302450 PMID: 10364524 PMCID: PMC1378082

[6] Netscher DT, Aburto J, Koepplinger M. Subungual glomus tumor. J Hand Surg Am, 2012, 37(4):821–823; quiz 824. https://doi.org/10.1016/j.jhsa.2011.10.026 PMID: 22192165

[7] De Cocker J, Messaoudi N, Waelput W, Van Schil PEY. Intrapulmonary glomus tumor in a young woman. Interact Cardiovasc Thorac Surg, 2008, 7(6):1191–1193. https://doi.org/10.1510/icvts.2007.172957 PMID: 18682431

[8] Rathi KR, Jena J, Dash BM, Mitra D, Patnaik PK, Basu AR. Extradigital glomus tumor as a cause of chronic perianal pain. Indian J Pathol Microbiol, 2009, 52(3):414–416. https://doi.org/10.4103/0377-4929.55012 PMID: 19679979

[9] Matsunaga A, Ochiai T, Abe I, Kawamura A, Muto R, Tomita Y, Ogawa M. Subungual glomus tumour: evaluation of ultrasound imaging in preoperative assessment. Eur J Dermatol, 2007, 17(1):67–69. https://doi.org/10.1684/ejd.2007.00190 PMID: 17324831

[10] Kim DH. Glomus tumor of the finger tip and MRI appearance. Iowa Orthop J, 1999, 19:136–138. PMID: 10847529 PMCID: PMC1888624

[11] Kumar P, Das A. Dermoscopy of glomus tumor. Indian Dermatol Online J, 2019, 10(2):206–207. https://doi.org/10.4103/idoj.IDOJ_88_18 PMID: 30984607 PMCID: PMC6434744

[12] Sethu C, Sethu AU. Glomus tumour. Ann R Coll Surg Engl, 2016, 98(1):e1–e2. https://doi.org/10.1308/rcsann.2016.0005 PMID: 26688416 PMCID: PMC5234378

[13] Morey VM, Garg B, Kotwal PP. Glomus tumours of the hand: review of literature. J Clin Orthop Trauma, 2016, 7(4):286–291. https://doi.org/10.1016/j.jcot.2016.04.006 PMID: 27857505 PMCID: PMC5106475

[14] Rodríguez JM, Idoate MA, Pardo-Mindán FJ. The role of mast cells in glomus tumours: report of a case of an intramuscular glomus tumour with a prominent mastocytic component. Histopathology, 2003, 42(3):307–308. https://doi.org/10.1046/j.1365-2559.2003.15355.x PMID: 12605654

[15] Folpe AL, Fanburg-Smith JC, Miettinen M, Weiss SW. Atypical and malignant glomus tumors: analysis of 52 cases, with a proposal for the reclassification of glomus tumors. Am J Surg Pathol, 2001, 25(1):1–12. https://doi.org/10.1097/00000478-200101000-00001 PMID: 11145243

[16] Nuovo M, Grimes M, Knowles D. Glomus tumors: a clinicopathologic and immunohistochemical analysis of forty cases. Surg Pathol, 1990, 3:31–45. https://ci.nii.ac.jp/naid/10016263947/

[17] Tang CYK, Tipoe T, Fung B. Where is the lesion? Glomus tumours of the hand. Arch Plast Surg, 2013, 40(5):492–495. https://doi.org/10.5999/aps.2013.40.5.492 PMID: 24086799 PMCID: PMC3785579

[18] Rosner IA, Argenta AE, Washington KM. Unusual volar pulp location of glomus tumor. Plast Reconstr Surg Glob Open, 2017, 5(1):e1215. https://doi.org/10.1097/GOX.0000000000001215 PMID: 28203512 PMCID: PMC5293310

[19] Wood W. On painful subcutaneous tubercle. Edinb Med Surg J, 1812, 8(31):283–291. PMID: 30329513 PMCID: PMC5744552

[20] Barré JA, Masson P. Etude anatomoclinique de certaines tumeurs sous-unguéales douloureuses (tumeurs du glomus neuro-myo-artériel des extrémités) [Anatomy-clinical study of certain painful subungual tumors (tumors of neuro-myo-arterial glomus of the extremities)]. Réunion Dermatologique de Strasbourg, Séance du 20 juillet 1924, Bull Soc Fr Dermatol Syphiligr, 1924, 31:148–159. https://www.abebooks.com/first-edition/Etude-anatomo-clinique-tumeurs-sous-ungu%C3%A9ales-douloureuses-glomus/30549899805/bd

[21] Wang PJ, Zhang Y, Zhao JJ. Treatment of subungual glomus tumors using the nail bed margin approach. Dermatol Surg, 2013, 39(11):1689–1694. https://doi.org/10.1111/dsu.12342 PMID: 24118542

[22] Hazani R, Houle JM, Kasdan ML, Wilhelmi BJ. Glomus tumors of the hand. Eplasty, 2008, 8:e48. PMID: 18997858 PMCID: PMC2567120
[23] Colon F, Upton J. Pediatric hand tumors. A review of 349 cases. Hand Clin, 1995, 11(2):223–243. PMID: 7635884
[24] Mravic M, LaChaud G, Nguyen A, Scott MA, Dry SM, James AW. Clinical and histopathological diagnosis of glomus tumor: an institutional experience of 138 cases. Int J Surg Pathol, 2015, 23(3):181–188. https://doi.org/10.1177/1066896914567330 PMID: 25614464 PMCID: PMC4498398
[25] Kitidumrongsook P, Luangjarmekorn P, Patradul A, Honsawek S. Painful subungual glomus tumour of the left thumb. BMJ Case Rep, 2013, 2013:bcr2013200942. https://doi.org/10.1136/bcr-2013-200942 PMID: 24336582 PMCID: PMC3863032
[26] Bhaskaranand K, Navadgi BC. Glomus tumour of the hand. J Hand Surg Br, 2002, 27(3):229–231. https://doi.org/10.1054/jhsb.2001.0746 PMID: 12074607
[27] Pertea M, Grosu OM, Terinte C, Poroch V, Velenciuc N, Lunca S. Nail bed solitary neurofibroma: a case report and literature review. Medicine (Baltimore), 2019, 98(3):e14111. https://doi.org/10.1097/MD.0000000000014111 PMID: 30653135 PMCID: PMC6370057
[28] Thatte SS, Chikhalkar SB, Khopkar US. "Pink glow": a new sign for the diagnosis of glomus tumor on ultraviolet light dermoscopy. Indian Dermatol Online J, 2015, 6(Suppl 1):S21–S23. https://doi.org/10.4103/2229-5178.171041 PMID: 26904443 PMCID: PMC4738509
[29] Carlstedt T, Lugnegård H. Glomus tumor in the hand. A clinical and morphological study. Acta Orthop Scand, 1983, 54(2):296–302. https://doi.org/10.3109/17453678308996573 PMID: 6303040
[30] Gómez-Sánchez ME, Alfageme-Roldán F, Roustán-Gullón G, Segurado-Rodríguez MA. The usefulness of ultrasound imaging in digital and extradigital glomus tumors. Actas Dermosifiliogr, 2014, 105(7):e45–e49. https://doi.org/10.1016/j.ad.2014.02.011 PMID: 24780369
[31] Al-Qattan MM, Al-Namla A, Al-Thunayan A, Al-Subhi F, El-Shayeb AF. Magnetic resonance imaging in the diagnosis of glomus tumours of the hand. J Hand Surg Br, 2005, 30(5):535–540. https://doi.org/10.1016/j.jhsb.2005.06.009 PMID: 16085343
[32] Miettinen M, Paal E, Lasota J, Sobin LH. Gastrointestinal glomus tumors: a clinicopathologic, immunohistochemical, and molecular genetic study of 32 cases. Am J Surg Pathol, 2002, 26(3):301–311. https://doi.org/10.1097/00000478-200203000-00003 PMID: 11859201

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