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## EVALUATION OF TEMPORAL ARTERY DUPLEX ULTRASOUND FOR DIAGNOSIS OF TEMPORAL ARTERITIS

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## ABSTRACT

### OBJECTIVE

Temporal arteritis or giant cell arteritis is a form of systemic inflammatory vasculitis closely associated with polymyalgia rheumatica. It may have serious systemic, neurologic and ophthalmic consequences as it may lead to impaired vision and blindness. Definitive diagnosis is made after histopathologic analysis of a superficial temporal artery (TA) biopsy, which requires a small surgical procedure often under local anesthesia. We investigated whether a non-invasive technique such as duplex ultrasound of the TA could replace histopathological analysis.

### METHODS

Eighty-one patients referred to our department for TA biopsy were first screened with a duplex ultrasound for a surrounding halo and/or occlusion of the TA. Presence of visual disturbances and unilateral pain (headache and/or tongue/jaw claudication) was noted before TA biopsy. Pathological analysis was considered the golden standard. Correlation between duplex findings, symptoms and pathology was determined by Spearman's Rho test. The predictive value of a halo and TA occlusion on duplex were determined by ROC curve analysis.

### RESULTS

A halo or TA occlusion was found in 16.0% and 3.7% of patients, respectively. Unilateral pain was reported in 96% of cases while 82% complained of visual disturbances. Correlation coefficients for halo and occlusion were 0.471 and 0.404, respectively ( $p < 0.0001$ ), suggesting a moderate correlation between duplex and biopsy. There was no significant correlation between visual impairment or pain and histologic findings. The ROC curve analysis showed a sensitivity of 53.3% and 20.0%, and specificity of 91.9% and 100% for presence of a halo and occlusion of the TA on duplex, respectively.

### CONCLUSIONS

Arterial duplex is a moderately sensitive but highly specific test for exclusion of temporal arteritis. We observed a moderate correlation between these findings on duplex and histopathological analysis as a golden standard. Arterial duplex may serve as a valuable diagnostic addition to prevent unnecessary surgical procedures and can even substitute biopsy in patients where surgery is not an option.

## INTRODUCTION

Temporal arteritis, or giant cell arteritis, is a common form of vasculitis associated with significant morbidity and a broad spectrum of pathology<sup>(1)</sup>. This may range from isolated vasculitis without clear clinical significance to recurrent headaches, association with rheumatological diseases such as polymyalgia rheumatica<sup>(2)</sup>, and even blindness<sup>(3)</sup>. Not only the arteries of the head are often affected, but also branches from the proximal aorta. It is a disease of the elderly, almost exclusively confined to people older than 50 years<sup>(1)</sup>.

Suspicion is raised when an older patient describes recurrent headaches and recurrent pains at the temples, often one-sided. A quick diagnosis is paramount because not recognizing this disease may lead to vision loss when the ophthalmic arteries are involved in the inflammation. On the other hand, a false diagnosis may lead to exposure of patients who do not suffer from temporal arteritis to unnecessary high corticosteroid doses

Although a thorough anamnesis and clinical investigation may raise suspicion of TA, a temporal artery (TA) biopsy remains the golden standard. This is a procedure with low risk of morbidity and often performed under local anesthesia. However, surgery leads to a visual scar and all negative aspects and possible complications related to a surgical procedure such as discomfort and perioperative pain. In less than 0.5% of procedures, serious complications such as facial nerve damage<sup>(4)</sup>, stroke<sup>(5)</sup>, local skin necrosis, or infection occur<sup>(6)</sup>. Because of the typically segmental occurrence of temporal arteritis, there is a risk for false-negative results when only a small portion of the vessel is biopsied, resulting in up to 44% negative biopsy results in patient with clinical disease symptoms<sup>(6)</sup>.

Therefore, alternatives to surgery with equal specificity as this golden standard are welcome. Temporal artery ultrasonography or duplex ultrasound may be a good alternative: The procedure can be scheduled within a short term, it is cheaper than surgery, non-invasive, and free of pain<sup>(6),(7),(8)</sup>.

Typical signs of TA on duplex ultrasound are a hypo-echoic halo (from oedema of the arterial wall), perivascular edema, and less common a stenosed or occluded temporal artery.

A meta-analysis conducted by Karassa et al.<sup>(9)</sup> regarding duplex ultrasound described 68-77% of sensitivity and 83-96% specificity for a positive ultrasound (unilateral halo sign), with the conclusion that a negative ultrasound virtually excludes presence of temporal arteritis.

In this paper, we present a prospective study of 81 patients who were referred to our center for temporal artery biopsy who were screened previous to surgery for duplex abnormalities of the temporal artery. The aim of our study was to assess sensitivity and specificity of duplex ultrasound at our center and to benchmark our results against other institutions.

## METHODS

Eighty-one patients who were referred to our department at the Antwerp University Hospital between February 2015 and January 2020 for unilateral temporal artery biopsy were included in this prospective study.

Each patient was first screened with duplex ultrasound for a surrounding halo and/or occlusion of the TA by an experienced ultrasound technician. Symptoms(10) such as pain at the temples, fever, masticatory claudication, and visual disturbances were noted, as was earlier corticoid use and increased sedimentation rates on routine blood test. Duplex findings were classified as a halo when a hypoechoic zone around the lumen of the TA was found of more than 0.5 mm in its sagittal diameter (Figure 1). Following the ultrasound investigation, unilateral TA biopsy was performed under local anesthesia in day care.

Pathological analysis of the TA after biopsy under local anesthesia was considered the golden standard for definitive diagnosis. Normality was assessed using Kolmogorov-Smirnov test for normality. Correlation between duplex findings, clinical symptoms and pathological diagnosis was determined by Spearman's Rho test. The predictive value of a halo and TA occlusion on duplex were determined by ROC curve analysis. Statistical analysis was performed using SPSS for Windows, Version 25.0 (IBM).

## RESULTS

Eighty-one patients were included in this study, with a mean age of 71 years (range: 28 – 98 years) with a normal distribution. Of these, 36 patients (44.4%) were female. Unilateral pain was reported by 52 patients (64.2%) while 28 (34.6%) complained of visual disturbances. Other symptoms were less common: 10 patients (12.3%) reported masticatory claudication, and 2 (2.5%) complained of fever. Erythrocyte sedimentation rate was elevated in 15 patients (18.5%). High doses of corticosteroids were administered to 13 patients (16.0%) before the examination and biopsy. On duplex examination, a halo or TA occlusion was found in 13 patients (16.0%) and 3 patients (3.7%), respectively. These findings are summarized in table 1.

Pearson correlation coefficients for presence of a halo surrounding the TA and TA occlusion were 0.471 and 0.404, respectively ( $p < 0.0001$ ), suggesting a moderate correlation between duplex and biopsy. There was no significant correlation between visual impairment or pain and histologic findings. We found a weak association between the prescription of high doses of corticosteroids and clinical symptoms (masticatory claudication  $p = 0.294$ ,  $p = 0.008$ ; visual disturbances  $p = 0.282$ ,  $p = 0.011$ ) or elevated sedimentation ( $p = 0.257$ ,  $P = 0.02$ ). Masticatory claudication was moderately associated with elevated sedimentation rates ( $p = 0.397$ ,  $p = 0.0001$ ), unilateral pain ( $p = 0.225$ ,  $p = 0.044$ ), and visual disturbances ( $p = 0.396$ ,  $p = 0.0001$ ). When patients complained of fever, there was also a moderate correlation with elevated sedimentation rates on routine blood examination ( $p = 0.427$ ,  $p = 0.0001$ ).

ROC curve analysis (Figure 2) showed a sensitivity of 53.3% and 20.0%, and specificity of 91.9% and 100% for presence of a halo and occlusion of the TA on duplex, respectively (table 2).

## DISCUSSION

Temporal arteritis can be a symptom of a number of severe pathologies that require urgent medical treatment<sup>(1)</sup>. Examples are polymyalgia rheumatica<sup>(11)</sup>, giant cell arteritis<sup>(12)</sup>, and ophthalmic artery arteritis<sup>(2)</sup>. Early recognition of the problem and adequate treatment, mostly with corticosteroids or other immune suppressants, is essential. Giant cell arteritis may even lead to permanent blindness in 7 to 14% of untreated patients<sup>(13)</sup>.

Therefore, the diagnosis should be made with high validity, as treatment with high doses of immunosuppressants may result in serious side-effects<sup>(14)</sup>.

TA biopsy is considered the gold standard to make the definitive diagnosis of temporal arteritis. This procedure is invasive, may cause discomfort to the patient, and has a risk of postoperative bleeding, pain, and infection. In this study, we investigated whether temporal artery duplex ultrasound may be a sound alternative for TA biopsy.

Although a careful clinical examination and patient history is essential for evaluating any pathology, the clinical symptoms we proposed (jaw claudication, pain upon mastication, fever, temporal headache, and increased sedimentation rate) were not sensitive or specific enough to rule out the diagnosis of an arteritis temporalis<sup>(9)</sup>. The aspecificity of these symptoms, together with an urge to start treatment urgently to prevent further serious injury, causes the diagnosis of giant cell arteritis to be quite a challenge to any clinician. **(15)**

The outcome of our study suggests that duplex has a high specificity and therefore equal to a negative result after temporal artery biopsy. In other words, when a duplex is negative, it is quite sure that no arteritis temporalis is present. Because of the segmental nature of temporal arteritis ("skip lesions"), even surgical biopsies may produce false negative results in up to 7%<sup>11</sup>. With ultrasound, the entire TA can be examined, and any skip lesions may be identified. Furthermore, because the procedure is non-invasive, a wait-and-see strategy<sup>(11)</sup> can be followed before starting immunosuppressant therapy with duplex ultrasound on regular time intervals<sup>10</sup>. In addition, duplex ultrasound is also a fair examination to determine whether temporal arteritis is present, with a sensitivity of 53.3% and a specificity of 91.9% when a halo sign was observed compared to TA biopsy.

History of corticosteroid use does not seem to influence this diagnosis, as can be deduced from our data. It is possible that both biopsy and ultrasound are equally confounded by high doses of corticosteroids administered previous to the procedure.

We advocate therefore routine use of arterial duplex by an experienced sonographer to determine whether or not signs of temporal arteritis are indeed present.

We observed a high specificity of duplex ultrasound findings, indicating that duplex findings such as a halo surrounding the TA (91.1% specificity) and a TA occlusion (100% specificity) are very predictive of a positive pathological result after TA biopsy. The lower sensitivity in our data demonstrate that in case of a negative duplex ultrasound but clinical suspicion of temporal arteritis, a biopsy should definitely be performed before long-term steroid treatment is initiated.

If there is both clinically and on ultrasound a strong suspicion of temporal arteritis, there is no need for a biopsy and treatment should be started right away to prevent any complications resulting from treatment delay<sup>(5)</sup>.

Duplex ultrasound may be of equal benefit for further follow-up after starting corticosteroid treatment and document regression of temporal arteritis.

Our study has some limitations, as we were not able to document how long patients were receiving corticosteroid therapy before undergoing investigations, or to register the interval between clinical suspicion and definitive diagnosis of temporal arteritis. Because our center does not have any waiting lists, this time interval is always relatively short (3 days at most). <sup>(16)</sup>**(1)**

We conclude that arterial duplex ultrasound is a moderately sensitive but highly specific test for exclusion of temporal arteritis. In this study, we found a moderate correlation between findings on duplex ultrasound that are typical of temporal arteritis and surgical biopsy results. A positive ultrasound should be followed by a surgical biopsy to confirm the diagnosis. . A negative ultrasound minimizes the need to conduct an invasive procedure and can be followed by a wait-and-see strategy. Duplex ultrasound is a valuable diagnostic addition to prevent unnecessary surgical procedures, follow up on treatment and can even substitute biopsy in patients where surgery is not an option.

## References

1. Ness, T., C. Auw-Hädrich, and D. Schmidt. "Temporal arteritis (giant cell arteritis). Clinical picture, histology, and treatment." *Der Ophthalmologe: Zeitschrift der Deutschen Ophthalmologischen Gesellschaft* 103.4 (2006): 296.
2. Liu, Grant T., et al. "Visual morbidity in giant cell arteritis: clinical characteristics and prognosis for vision." *Ophthalmology* 101.11 (1994): 1779-1785.
3. Alberts, M S, and D M Mosen. "Diagnosing temporal arteritis: duplex vs. biopsy." *QJM : monthly journal of the Association of Physicians* vol. 100,12 (2007): 785-9.
4. Bhatti, M. Tariq, and Michael H. Goldstein. "Facial nerve injury following superficial temporal artery biopsy." *Dermatologic surgery* 27.1 (2001): 15-17.
5. Haist, Steven A. "Stroke after temporal artery biopsy." *Mayo Clinic Proceedings*. Vol. 60. No. 8. Elsevier, 1985.
6. LeSar, Christopher J., et al. "The utility of color duplex ultrasonography in the diagnosis of temporal arteritis." *Journal of vascular surgery* 36.6 (2002): 1154-1160.
7. Schmidt, Wolfgang A., et al. "Color duplex ultrasonography in the diagnosis of temporal arteritis." *New England Journal of Medicine* 337.19 (1997): 1336-1342.
8. Wojczal J, Kozera G, Luchowski P, Neubauer-Geryk J. Advantages in diagnosis of giant cell arteritis by ultrasound. *Postepy Dermatol Alergol*. 2019;36(1):25-28.
9. Karassa FB, Matsagas MI, Schmidt WA, Ioannidis JP. Meta-analysis: test performance of ultrasonography for giant-cell arteritis. *Ann Intern Med*. 2005;142(5):359-369.
10. Myklebust, G., and J. T. Gran. "A prospective study of 287 patients with polymyalgia rheumatica and temporal arteritis: clinical and laboratory manifestations at onset of disease and at the time of diagnosis." *Rheumatology* 35.11 (1995): 1161-1168.
11. Poller DN, van Wyk Q, Jeffrey MJ. The importance of skip lesions in temporal arteritis. *Journal of Clinical Pathology*. 2000;53:137–9.
12. González-Gay, Miguel A., et al. "Visual manifestations of giant cell arteritis: trends and clinical spectrum in 161 patients." *Medicine* 79.5 (2000): 283-292.
13. Nesher, G., M. Sonnenblick, and Y. Friedlander. "Analysis of steroid related complications and mortality in temporal arteritis: a 15-year survey of 43 patients." *The Journal of Rheumatology* 21.7 (1994): 1283-1286.

|                                 | <b>Yes</b> | <b>No</b>  | <b>Unknown</b> |
|---------------------------------|------------|------------|----------------|
| <b>TA Halo on duplex</b>        | 13 (16,0%) | 65 (80,2%) | 3 (3,7%)       |
| <b>TA Occlusion on duplex</b>   | 3 (3,7%)   | 75 (92,6%) | 3 (3,7%)       |
| <b>Positive biopsy</b>          | 17 (21,0%) | 63 (77,8%) | 1 (1,2%)       |
|                                 |            |            |                |
| <b>Fever</b>                    | 2 (2,5%)   | 2 (2,5%)   | 77 (95,1%)     |
| <b>Visual Disturbances</b>      | 28 (34,6%) | 6 (7,4%)   | 66 (81,5%)     |
| <b>Jaw claudication</b>         | 10 (12,3%) | 5 (6,2%)   | 66 (81,1%)     |
| <b>Temporal pain</b>            | 52 (64,2%) | 2 (2,5%)   | 27 (33,3%)     |
| <b>Increased sedimentation</b>  | 15 (18,5%) | 2 (2,5%)   | 64 (79%)       |
|                                 |            |            |                |
| <b>History of corticoid use</b> | 13 (16,0%) | 0 (0%)     | 68 (84,0%)     |

**Table 1. Summary of principal findings in the study. TA, temporal artery.**

|                      | Positive biopsy          | Negative Biopsy           |  |
|----------------------|--------------------------|---------------------------|--|
| <b>Halo on US</b>    | 8<br>(53,3% Sensitivity) | 5<br>(8,1%)               |  |
| <b>No Halo on US</b> | 7<br>(46,7%)             | 57<br>(91,9% Specificity) |  |
| <b>Sum</b>           | 15 (100%)                | 62(100%)                  |  |

|                           | Positive biopsy          | Negative Biopsy          |  |
|---------------------------|--------------------------|--------------------------|--|
| <b>Occlusion on US</b>    | 3<br>(20,0% Sensitivity) | 0<br>(0%)                |  |
| <b>No Occlusion on US</b> | 12<br>(80%)              | 62<br>(100% Specificity) |  |
| <b>Sum</b>                | 15 (100%)                | 62(100%)                 |  |

**Table 2. Sensitivity and specificity of duplex findings compared to temporal artery biopsy results as golden standard.**

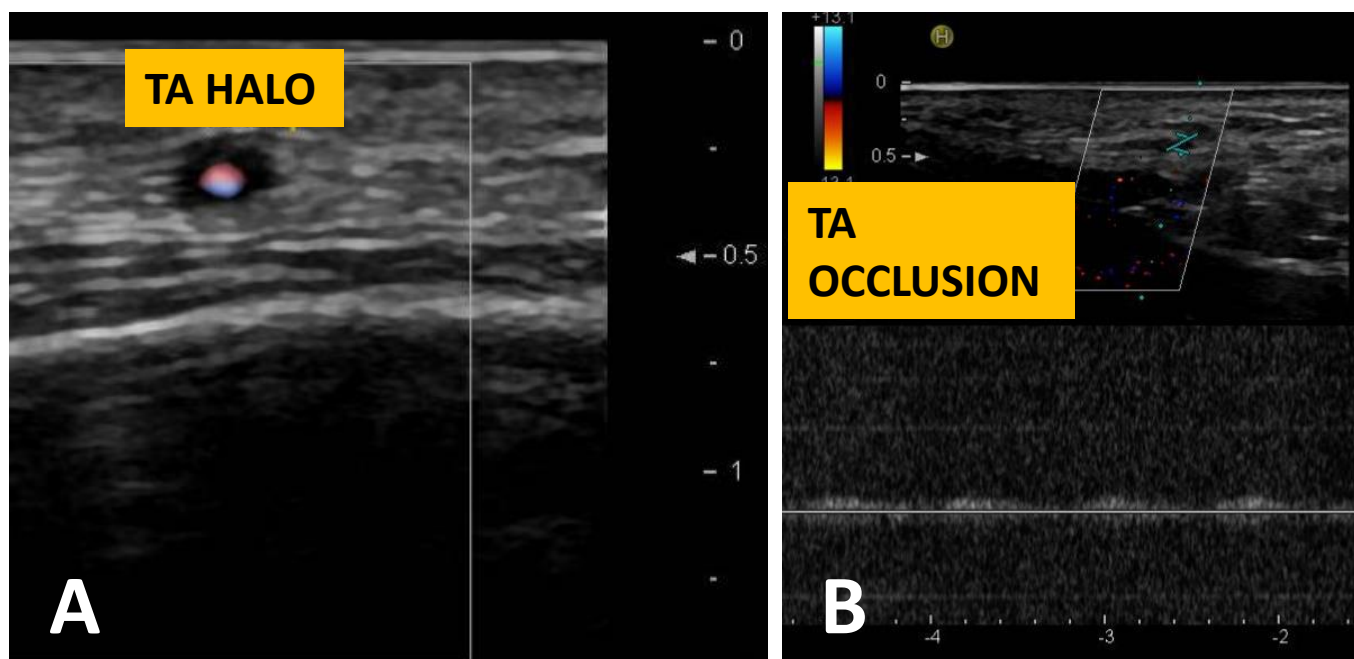


Figure 1. Duplex ultrasound images of a halo surrounding the temporal artery (A) and absence of flow in the temporal artery (B), both indicative of temporal arteritis. TA, Temporal artery.

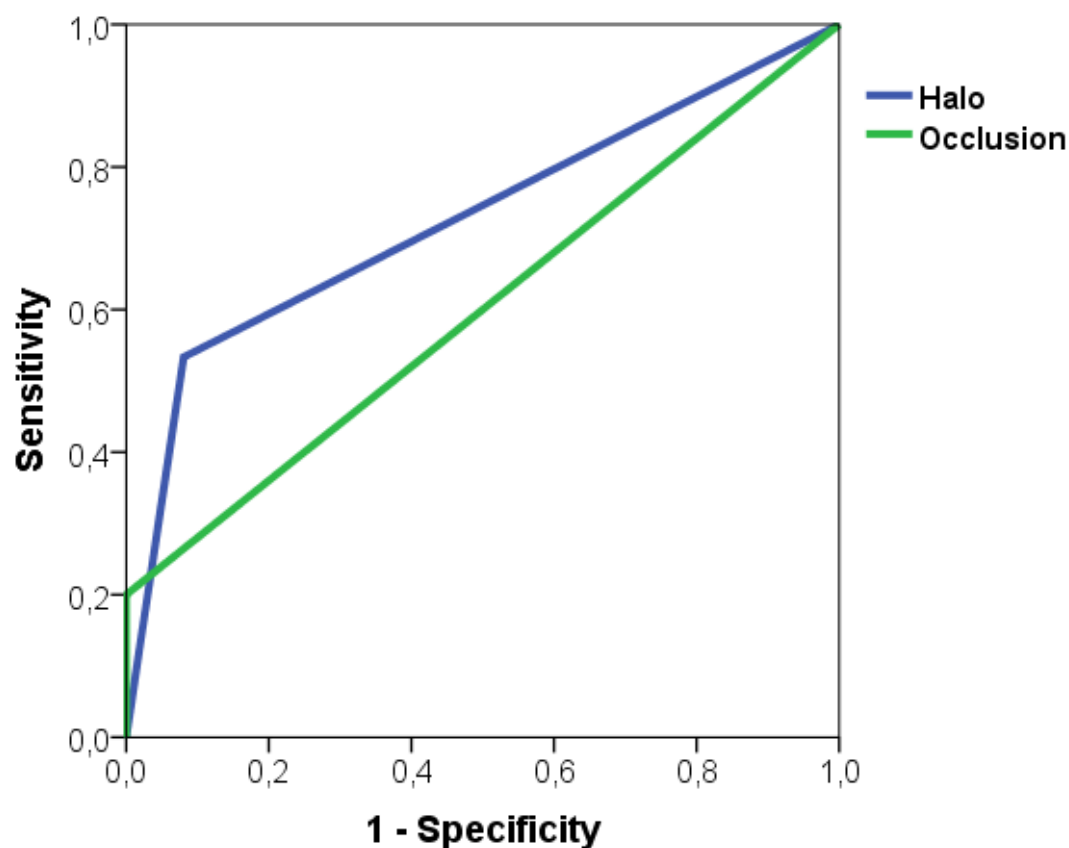


Figure 2. ROC Curve analysis of sensitivity and specificity of presence of a halo sign around the TA or TA occlusion with biopsy result as golden standard.

1. Ness T, Auw-Hadrich C, Schmidt D [Temporal arteritis (giant cell arteritis). Clinical picture, histology, and treatment]. *Ophthalmologie* 2006;103:296-301.
2. Liu GT, Glaser JS, Schatz NJ, Smith JL Visual morbidity in giant cell arteritis. Clinical characteristics and prognosis for vision. *Ophthalmology* 1994;101:1779-1785.
3. Alberts MS, Mosen DM Diagnosing temporal arteritis: duplex vs. biopsy. *QJM* 2007;100:785-789.
4. Bhatti MT, Goldstein MH Facial nerve injury following superficial temporal artery biopsy. *Dermatol Surg* 2001;27:15-17.
5. Haist SA Stroke after temporal artery biopsy. *Mayo Clin Proc* 1985;60:538.
6. LeSar CJ, Meier GH, DeMasi RJ, Sood J, Nelms CR, et al. The utility of color duplex ultrasonography in the diagnosis of temporal arteritis. *J Vasc Surg* 2002;36:1154-1160.
7. Schmidt WA, Kraft HE, Vorpahl K, Volker L, Gromnica-Ihle EJ Color duplex ultrasonography in the diagnosis of temporal arteritis. *N Engl J Med* 1997;337:1336-1342.
8. Wojczal J, Kozera G, Luchowski P, Neubauer-Geryk J Advantages in diagnosis of giant cell arteritis by ultrasound. *Postepy Dermatol Alergol* 2019;36:25-28.

9. Karassa FB, Matsagas MI, Schmidt WA, Ioannidis JP Meta-analysis: test performance of ultrasonography for giant-cell arteritis. *Ann Intern Med* 2005;142:359-369.
10. Hunder GG, Bloch DA, Michel BA, Stevens MB, Arend WP, et al. The American College of Rheumatology 1990 criteria for the classification of giant cell arteritis. *Arthritis Rheum* 1990;33:1122-1128.
11. Myklebust G, Gran JT A prospective study of 287 patients with polymyalgia rheumatica and temporal arteritis: clinical and laboratory manifestations at onset of disease and at the time of diagnosis. *Br J Rheumatol* 1996;35:1161-1168.
12. Poller DN, van Wyk Q, Jeffrey MJ The importance of skip lesions in temporal arteritis. *J Clin Pathol* 2000;53:137-139.
13. Gonzalez-Gay MA, Garcia-Porrua C, Llorca J, Hajeer AH, Branas F, et al. Visual manifestations of giant cell arteritis. Trends and clinical spectrum in 161 patients. *Medicine (Baltimore)* 2000;79:283-292.
14. Nesher G, Sonnenblick M, Friedlander Y Analysis of steroid related complications and mortality in temporal arteritis: a 15-year survey of 43 patients. *J Rheumatol* 1994;21:1283-1286.
15. van der Geest KSM, Borg F, Kayani A, Paap D, Gondo P, et al. Novel ultrasonographic Halo Score for giant cell arteritis: assessment of diagnostic accuracy and association with ocular ischaemia. *Ann Rheum Dis* 2020;79:393-399.
16. Sait MR, Lepore M, Kwasnicki R, Allington J, Srinivasaiah N Temporal artery biopsy: time matters! *Intern Med J* 2017;47:1465.