American Journal of Ophthalmology Case Reports 25 (2022) 101278

Contents lists available at ScienceDirect

American Journal of Ophthalmology Case Reports

journal homepage: www.ajocasereports.com/

Total Neuro-retinal Tubulation (TNT), a novel imaging finding

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ARTICLE INFO

Keywords:
Medical retina
Imaging
Optical coherence tomography angiography
Retinal traction

ABSTRACT

A peculiar tubular structure was found in the left eye (LE) of a 71-year-old patient with diabetic retinopathy, who already had undergone panretinal-photocoagulation, detected by spectral-domain optical coherence tomography (SD-OCT) as an incidental finding. The reason for consultation was vitreous hemorrhage of the fellow-eye. Fundoscopic examination of LE revealed three oval retinal holes separated by small bridges of retinal tissue, which corresponded to tubular structures visible in SD-OCT, surrounded by photocoagulation scars. Optical coherence tomography B-scans of these structures revealed a tubular arrangement of tissue, composed of solid parts and hyporeflective cystoid spaces. Intermittent choroidal hypertransmission was detected deep to the tubular structures indicating impaired or absent retinal pigment epithelium (RPE). OCT-Angiography was performed using the Zeiss Plex Elite 9000 swept source device (Zeiss Meditec, Dublin, California, USA). Within the tubular structures, no flow signal was detected. Segmentation at the level of the outer retina choriocapillaris (ORCC) indicated partially intact choriocapillaris in the areas of tubular structures and retinal holes. We hypothesize that the tubular structures mainly consist of neuro-retinal tissue and propose the term total neuro-retinal tubulation (TNT). We postulate that the edge curling effect that leads to the tubular arrangement relates to focal retinal tears caused by tractional forces acting on the retina in this case by scarring in response to laser photocoagulation. Since the retinal periphery is more prone to retinal tears, widefield OCT imaging modalities are likely to offer further insights into this newly described finding and shed greater light on the biomechanical properties of the retina. Histopathological investigation is required to make a valid statement about the histology of TNT.

1. Case-report

A 71 year-old female presented with vitreous hemorrhage due to proliferative diabetic retinopathy in her right eye. Visual acuity was hand movements only in that eye. In the left eye which had previously undergone panretinal photocoagulation but no vitrectomy, visual acuity was 20/32. Incidental note was made of a tubular structure in the left eye, detected by spectral-domain optical coherence tomography (SD-OCT). Fundoscopic examination of the left eye revealed three oval retinal holes separated by small bridges of retinal tissue (Fig. 1 **A**). These corresponded to tubular structures visible in SD-OCT (Fig. 2 **A-D**), surrounded by photocoagulation scars. There was no notable difference in blue auto-fluorescence emission (Fig. 1 **B**) between the retinal holes and the tubular structures. OCT B-scans of these structures revealed a tubular arrangement composed of solid parts and hyporeflective cystoid spaces (Fig. 2 **A-D**). Homogenous choroidal hyper-transmission was noted in the area corresponding to the clinically observed retinal holes, while intermittent choroidal hypertransmission was detected deep to the tubular structures indicating impaired or absent retinal pigment epithelium (RPE). OCT-Angiography was performed using the Zeiss Plex Elite 9000 swept source device (Zeiss Meditec, Dublin, California, USA). Within the tubular structures, no flow signal was detected (Fig. 3, **B**). Segmentation at the level of the outer retina choriocapillaris indicated at least partially intact choriocapillaris in the areas of tubular structures and retinal holes (Fig. 3, **A**).

2. Discussion

We hypothesize that the tubular structures mainly consist of neuro-retinal tissue and propose the term total neuro-retinal tubulation (TNT). Retinal tears due to traction have been described in patients with diabetic retinopathy.[1] Since the retinal holes were surrounded by laser coagulation scars, we postulate that the edge curling effect that leads to the tubular arrangement relates to focal retinal tears caused by tractional forces acting on the retina. These in turn are induced by scarring in response to laser photocoagulation.

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https://doi.org/10.1016/j.ajoc.2022.101278
Received 1 May 2020; Received in revised form 30 July 2021; Accepted 13 January 2022
Available online 20 January 2022

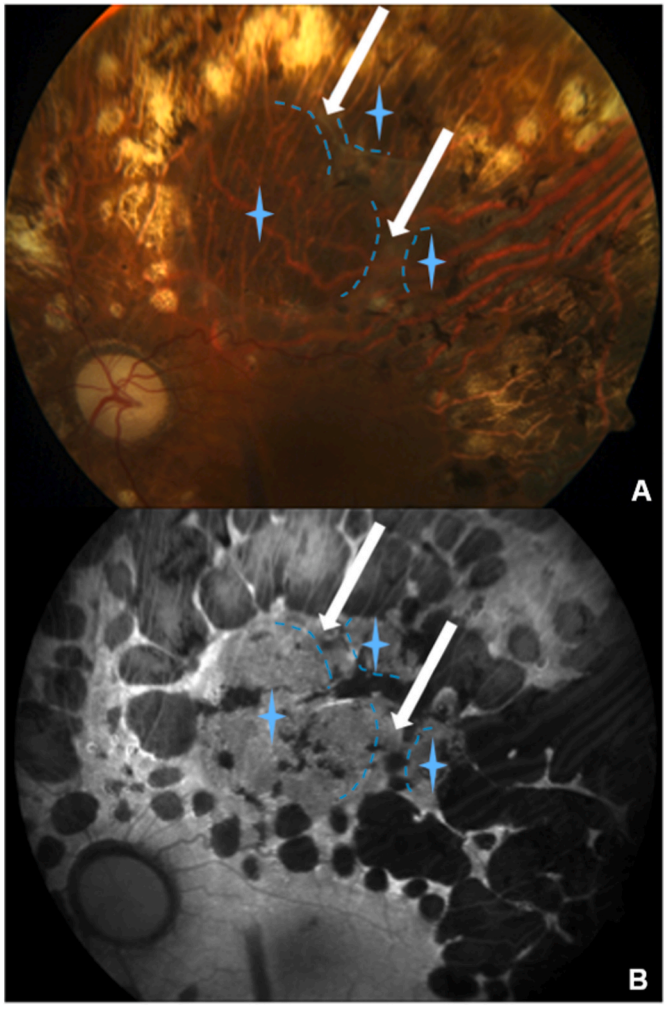

Fig. 1. A Zeiss fundus-photography of the left eye of a 71 year-old female with diabetic retinopathy. Note the photocoagulation scars due to panretinal laser-retinopexy **B** Autofluorescence imaging demonstrating bridges of retinal tissue (white arrows, blue dotted lines) associated to oval retinal holes (blue stars), the corresponding structures are marked on the fundus-photography as well. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

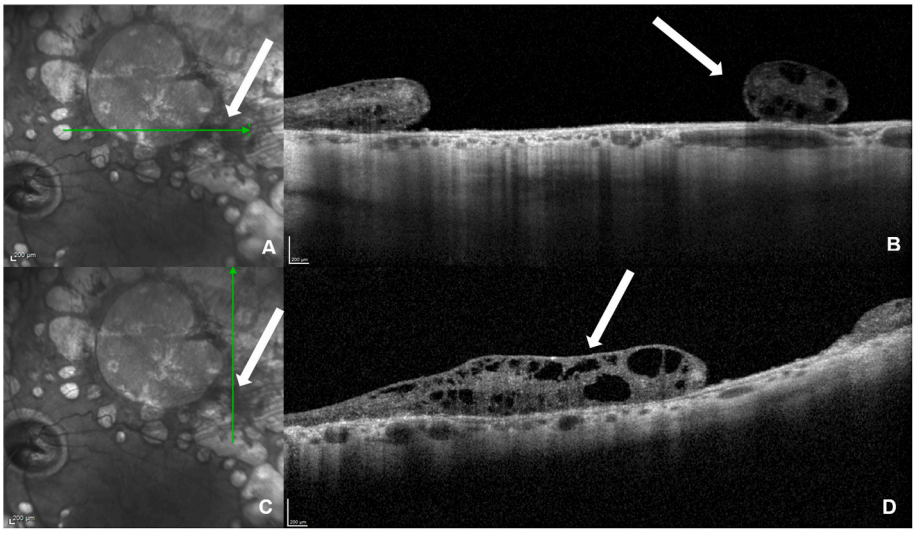

Fig. 2. SD-OCT en face scan (**A,C)** B-scans (**B,D)**; demonstrating tubular structures with overall heterogenous reflectivity and hyporeflective cystoid spaces (white arrow).

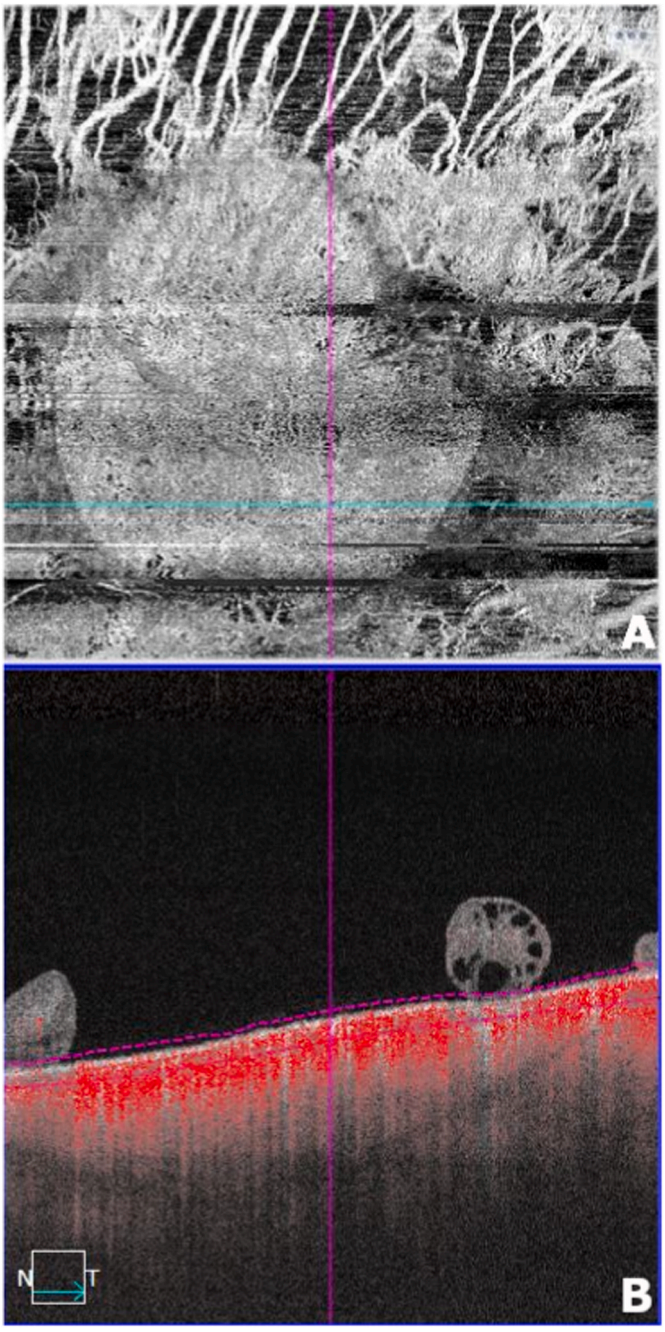

Fig. 3. OCTA **A** En face image with segmentation for outer retinal choriocapillaris layer (ORCC) layer indicating partly intact choriocapillaris in areas of tubular structures. **B** OCTA scan of tubular structure, note that there are no signs of flow within the tubular structures.

The free edges of giant retinal tears tend to curl inwards, that is towards the vitreous.[2] However in TNT, the free edges appear to roll outwards, resulting in the tubular appearance observed in SD-OCT imaging (Fig. 3 **B**).

We believe, that the neuro-retina in between two closely associated retinal tears/defects is capable of curling outwards due to loss of interdigitations with neighboring cells and RPE.[3] In contrast to outer retinal tubulations (ORT) which are largely comprised of cones, the histological composition of TNT is unknown.[4] We hypothesize that TNT, its outside wall is partially constituted by the basement membrane of Müller cells, as described in other forms of cystic degeneration of neuro-retinal tissue.[5]

3. Conclusions

We found TNT between retinal holes in the eye of a proliferative diabetic. Histopathological investigation is required to make a valid statement about the composition of TNT while SD-OCT imaging reveals cystic alterations that we interpret as degenerative in nature. Since the retinal periphery is more prone to retinal tears, wide-field OCT imaging modalities are likely to offer further insights into this newly described finding and shed greater light on the biomechanical properties of the retina.

Patient consent

Consent to publish this case report has been obtained from the patient in writing.

Funding

Novartis Pharma CH AG (unrestricted research grant).

Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

Declaration of competing interest

Timothy Hamann (TH): no relevant conflict of interest to declare.

Maximilian Robert Justus Wiest (MRJW): no relevant conflict of interest to declare.

Sandrine Anne Zweifel (SAZ): no relevant conflict of interest to declare.

The following authors have no financial disclosures: TH, MRJW, SAZ.

Acknowledgements

None.

References

1. Davis MD. Vitreous contraction in proliferative diabetic retinopathy. *Arch Ophthalmol.* 1965;74:741–751.
2. Adams GW, Enrique GV, Nanda SK. Retinotomies and retinectomies. In: Ryan S, Wikinson C, Schachat A, Hilton D, Wiedemann P, eds. *Retina*. fifth ed. Elsevier/Saunders; 2013:1826–1843.
3. Zweifel SA, Engelbert M, Laud K, Margolis R, Spaide RF, Freund KB. Outer retinal tubulation: a novel optical coherence tomography finding. *Arch Ophthalmol (Chicago, Ill.* 2009;127:1596–1602, 1960.
4. Litts KM, Zhang Y, Freund KB, Curcio CA. Optical coherence tomography and histology OF age-related macular degeneration support mitochondria as reflectivity sources. *Retina.* 2018;38:445–461.
5. Bringmann A, Unterlauft JD, Wiedemann R, Barth T, Rehak M, Wiedemann P. Two different populations of Müller cells stabilize the structure of the fovea: an optical coherence tomography study. *Int Ophthalmol.* 2020;40:2931–2948.