1. Introduction

Hypertensive retinopathy (HR) is a critical retinal vasculature finding in patients with elevated blood pressure (BP). Based on the Joint National Committee (JNC) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure declaration, HR should be considered as an end-organ damage in hypertensive patients. Therefore, HR often needs therapeutic management initiation even in patients who have mild hypertension (HTN) without any other organ-involvement. It is estimated that one out of three American adults have HTN. Previous studies reported the prevalence of 30.6–51% for HR among hypertensive patients. Unlike other blood vessels, retinal vessels do not have sympathetic nerve supply and utilize autoregulation for adjusting the blood flow. Increasing BP causes the vasoconstriction of retinal vessels (first phase). If this situation lasts long, intima thickening and media hyperplasia will happen. Arteriolar narrowing and sclerosis of the vessels are the characteristics of this stage (second phase). If the BP increases severely, the blood-retina barrier will disrupt, erythrocyte and plasma will leak out of the vessels (third phase). Retinal hemorrhage (dot, blot, or flame-shaped), microaneurysms, cottonwool spots, hard

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* Corresponding author. Eye Research Center (ERC), Farabi Eye Hospital, Tehran University of Medical Sciences, Qazvin Square, South Kargar Street, Tehran, PO Box: 14155-7146, Iran.

E-mail address: khojasteh63@gmail.com (H. Khojasteh).

The two authors (HK and AA) have contributed equally in the preparation of this manuscript, and therefore both serve as co-first authors.

https://doi.org/10.1016/j.ajoc.2021.101217

Received 12 April 2021; Received in revised form 3 July 2021; Accepted 4 October 2021

Available online 5 October 2021

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exudates, necrosis of smooth muscle cells, and retinal ischemia occurs in this stage. Papilledema and optic nerve ischemia are results of malignant HTN (fourth phase).2,8-10

Managing the different HR stages and their complications is limited to controlling BP by non-surgical treatments [e.g., BP-lowering and intravitreal anti-vascular endothelial growth factor (VEGF) therapy when there is retinal neovascularization] and routine monitoring/follow-up.8,11,12 To the best of our knowledge, there has not been any reported surgical approach for managing HR-induced intra-retinal macular hemorrhage to date.

Herein, we present a novel surgical approach to remove the intra-retinal loculated foveal hemorrhage in an elderly man with HR.

2. Case report

A 67-year-old man presented to our clinic with the complaint of progressive diminution of vision in his left eye (OS) for the past six months. He had a history of uncontrolled HTN, which had led to HR. He did not have any other significant past medical history or background diseases.

Despite six months of metabolic control and medical therapy for the HTN, the patient’s vision was getting worse. Ophthalmic examination revealed best-corrected visual acuity (BCVA) of 20/20 in the right eye (OD) and 20/400 in the left eye (OS); intraocular pressure (IOP) was 17 mmHg in OD and 18 mmHg in OS. Anterior segment examination was unremarkable. Fundus examination of OS revealed arterial narrowing and multiple areas of small retinal hemorrhage. Old, organized hemorrhage with a yellow foveal centered lesion appearance was detected (Fig. 1A). Late phase of fluorescein angiography (FA) showed blocked fluorescence corresponding to the retinal hemorrhages. No abnormal leakage was detected at the site of foveal lesion appearance was detected (Fig. 1B). Macular optical coherence tomography (OCT) showed a dense hyper-reflective intra-retinal lesion at the fovea (Fig. 1C). Spectral-domain optical coherence tomography (SD-OCT) of the macula illustrates dense hyper-reflective intra-retinal lesion at the fovea (C). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Fig. 1. Fundus photograph of the left eye shows areas of retinal hemorrhage (red arrows) and yellow organized clot at the fovea (A). Late phase of fluorescein angiography (FA) demonstrates blocked hypofluorescent areas (yellow arrows) due to hemorrhage and no apparent leakage at the foveal lesion (B). Spectral-domain optical coherence tomography (SD-OCT) of the macula illustrates dense hyper-reflective intra-retinal lesion at the fovea (C). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

3. Discussion

Management of submacular hemorrhage is controversial. For large submacular hemorrhages secondary to choroidal neovascularization (CNV), there is no significant difference between surgical intervention with pars plana vitrectomy (PPV) and submacular surgery compared to observation regarding the visual acuity improvement.13 In a retrospective study, Lim et al. reported that submacular injection of tissue plasminogen activator (tPA) could improve the visual outcome of submacular hemorrhage.14 On the other hand, Ibanez et al., in a prospective randomized controlled trial, have shown that submacular tPA did not improve the results compared with mechanical clot extraction. Minimally invasive procedures such as intravitreal injection of anti-VEGF agents and pneumatic displacement have also been advocated to manage such cases with promising results.15,16

Our index case was unique and complex, not only because there was no CNV to justify intravitreal anti-VEGF therapy but also because the hemorrhage was intrafoveal in contrast to subfoveal. At the time of initial presentation, clinicians decided to observe and follow the patient closely. However, as visual acuity remained suboptimal (20/400) and the patient felt his vision was getting worse after six months, we employed a surgical approach to remove the clot. The surgical plan was to remove the clot from the retina’s inner side as the OCT had shown that it was near the ILM. To our knowledge, the described technique has not been reported previously.

The main risks of the proposed surgical technique, other than standard PPV complications, include the induction of a traumatic macular hole (which happened in our case), retinal pigmented epithelium (RPE) damage, subretinal hemorrhage from Bruch’s membrane trauma, and sacrificing parts of the inner retinal layer overlying the lesion. Induced
macular hole was successfully managed by an inverted rotational ILM flap and intraocular gas. We attempted to stabilize the ILM flap in the fovea using the vacuum “drying method” and SF6 gas. However, due to the invisibility of ILM flap on the post-op OCT, it is hard to prove the beneficial effects of the flap on the successful outcome of the surgery; the macular hole might be closed due to ILM peeling and SF6 gas. The visual outcome at two months follow-up was favorable (20/50) and OCT showed significant structural improvement. It should be mentioned that our procedure was very delicate. Given the current limitation of capacity and quality of surgical instruments and intra-operative imaging devices, we do not recommend our procedures in the management of benign regular/mild intraretinal hemorrhage/lesions, which do not affect the quality of life or daily routines of the patients, or which may spontaneously resolve. Unlike the aforementioned situation, the BCVA for our patient deteriorated over the 6-month period, which affected his quality of life and work efficiency significantly. Based on our evaluation, loculated nature of the blood clot, and the patient’s desire, we concluded that spontaneous improvement of his BCVA would not be probable and an intervention was needed.

Although selecting the proper therapeutic approach to remove the retinal lesions could vary based on their location, extension, speed/grade of progression/aggression, and their effects on RPE, photoreceptors, and visual field of the patients, the proposed surgical technique may shed light on the promising potential future of this method, particularly with the advancement of surgical instruments and imaging modalities including refined intra-operative 3D-OCT.

In summary, we do not want to advocate or propose that our surgical technique is to be employed routinely in the management of foveal hemorrhage secondary to hypertensive retinopathy. Rather, we would like to share a potential option when there are no other alternatives to attempt to preserve or improve vision for the affected patients.

4. Conclusion

In cases of organized intrafoveal hemorrhage that are not related to CNV, gentle manual dissection may yield good visual outcomes even if an iatrogenic macula hole is induced. Given the potential adverse events, the described technique should be employed only in cases with non-resolving or organized hemorrhage associated with poor visual acuity after a sufficient period of monitoring and medical therapy. Advancements in imaging modalities such as intraoperative 3D-OCT may pave the way for performing similar surgeries with a higher level of precision and minimal complications.

Patient consent

Written informed consent was obtained from the patient for the publication of this manuscript.

Funding

No funding or grant support.

Authorship

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

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

Research ethics

We further confirm that any aspect of the work covered in this manuscript that has involved human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

IRB approval was obtained (required for studies and series of 3 or more cases).

Written consent to publish potentially identifying information, such as details or the case and photographs, was obtained from the patient(s) or their legal guardian(s).

Declaration of competing interest

None of the authors has any relevant conflict of interests pertaining to the index manuscript.

Acknowledgments

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajoc.2021.101217.

References

1. Wong TY, Mitchell P. Hypertensive retinopathy. N Engl J Med. 2004;351:2310–2317.
2. Harjasaoliha A, Raji V, Garcia GJ. Review of hypertensive retinopathy. Disease-a-Month. 2017;63:63.
3. Erdem S, Bicakci E. Hypertensive retinopathy: incidence, risk factors, and comorbidities. Clin Exp Hypertens. 2012;34:397–401.
4. Polatini P, Penzo M, Bongiovi S, Canni C, Pesina A. Role of ophthalmoscopy in arterial hypertension: a problem revisited. Cardiologia. 1991;36:713–722.
5. Caspide C, Macca G, Sampieri L, et al. High prevalence of cardiac and extracardiac target organ damage in refractory hypertension. J Hypertens. 2001;19:2063–2070.
6. Besharati MR, Kastegar A, Shahi MR, Maybodi ME. Prevalence of retinopathy in hypertensive patients. Saudi Med J. 2006;27:1725.
7. Shanitha GPS, Srinivasan Y, Kumar AA, et al. Can retinal changes predict coronary artery disease in elderly hypertensive patients presenting with angina? Am J Emerg Med. 2010;28:617–621.
8. Modi P, Arsiwalla T. Hypertensive Retinopathy. StatPearls [Internet]; 2020.
9. Grosso A, Veglio F, Porta M, Grignolo F, Wong T. Hypertensive retinopathy revisited: some answers, more questions. Br J Ophthalmol. 2005;89:1646–1654.
10. Tso MO, Jampol LM. Pathophysiology of hypertensive retinopathy. Ophthalmology. 1982;89:1132–1145.
11. Al-Halafi AM. Tremendous result of bevacizumab in malignant hypertensive retinopathy. Oman J Ophthalmol. 2015;8:61.
12. Salman AG. Intravitreal bevacizumab in persistent retinopathy secondary to malignant hypertension. Saudi J Ophthalmol. 2013;27:25–29.
13. Bressler NM, Bressler SB, Chylack LT, et al. Surgery for hemorrhagic choroidal neovascular lesions of age-related macular degeneration: ophthalmic findings: SST report no. 13. Ophthalmology. 2004;111:1993–2006.
14. Lim JI, Drews-Botsch C, Sternberg Jr P, Capone Jr A, Asberg TM, Sr. Submacular hemorrhage removal. Ophthalmology. 1995;102:1393–1399.
15. Cho HJ, Koh KM, Kim BH, et al. Intravitreal ranibizumab injections with and without pneumatic displacement for treating submacular hemorrhage secondary to neovascular age-related macular degeneration. Retina. 2015;35:205–212.
16. Shin JY, Lee JM, Byeon SH. Anti-vascular endothelial growth factor with or without pneumatic displacement for submacular hemorrhage. Am J Ophthalmol. 2015;159:904–914 e1.