Macular edema is the most important cause of central visual loss in branch retinal vein occlusion (BRVO) and central retinal vein occlusion (CRVO). The causes of visual loss in eyes with BRVO other than macular edema are retinal capillary nonperfusion and intraretinal hemorrhage. Currently, the only proven treatment modality for macular edema secondary to BRVO is grid laser photocoagulation, as described in the Branch Vein Occlusion Study (BVOS). Although it has not been evaluated in any multicenter randomized controlled study, the efficacy of intravitreal triamcinolone acetonide (IVTA) injection in eyes with BRVO has been suggested in several uncontrolled studies.

My colleagues and I recently performed a study that explored the best treatment approach in eyes with macular edema due to BRVO. We proposed a stepwise approach. We first applied grid laser if the eye met the BVOS guidelines, as this is the only proven treatment strategy. IVTA injection was performed in eyes that did not improve after laser or were considered not eligible for grid laser. Eyes with capillary nonperfusion and extensive hemorrhages were excluded. Central macular thickness (CMT) was quantitatively measured by optical coherence tomography (OCT) and the gain in best-corrected visual acuity (BCVA) was analyzed. This article summarizes our findings in the study.

STUDY DESIGN
We evaluated the efficacy of primary and secondary (following grid laser photocoagulation) IVTA injection for the treatment of macular edema associated with BRVO. All eyes had a BCVA worse than 20/40. Eyes eligible for the BVOS guidelines received grid laser treatment prior to treatment in our study. Patients who did not experience at least two lines of visual acuity improvement following grid laser or who did not meet the guidelines set forth by the BVOS received an initial 4 mg IVTA injection.

The efficacy of IVTA treatment was assessed by analyzing the change in BCVA and reduction in CMT as measured by OCT. Spikes in IOP and other complications were recorded. Surgeons used IVTA as the primary treatment in 25 eyes and as a secondary treatment in 12 eyes. Mean follow-up was 9.6 months. BCVA was 0.06 ±0.30 and 0.17 ±0.50 in the primary and secondary IVTA injection groups, respectively.

STUDY TREATMENT
Diagnosis of BRVO was made by clinical examination. Macular edema was confirmed, and eyes with macular ischemia were excluded by fluorescein angiography.
Edema was quantitatively measured using OCT. In order to be eligible for the study, history of BRVO had to be at least 2 months but no more than 12 months. BCVA was measured using the standard Early Treatment of Diabetic Retinopathy Study (ETDRS) chart and it had to be 20/40 or less for inclusion in the study. Eyes with glaucoma or other retinal pathology were excluded.

Twenty-five eyes received IVTA injection (primary injection group) as the initial treatment. The remaining 12 eyes of patients who did not improve significantly (the same amount) following grid laser received IVTA injection as a second line of therapy (secondary injection group).

The mean age of the study patients was 66.4 years (range 43-81). There were 23 males (62.2%) and 14 females (37.8%). On average, there were 6.6 months between the onset of BRVO and IVTA treatment and 5.5 months between the onset of BRVO and initial laser treatment. Time to treatment was statistically shorter in eyes in the primary IVTA group (5.2 months) than those in the secondary injection group (8.6 months). Eyes were followed for an average of 9.6 months after the IVTA injection.

Pre-IVTA BCVA was 0.06 ±0.30 in the primary and 0.17 ±0.50 in the secondary IVTA groups (P=.002). In the primary IVTA injection group, BCVA increased following IVTA at 1 month and remained statistically better than preinjection values at all time points during follow-up. In the secondary IVTA injection group, a small increase in BCVA was noted. This gain was statistically significant only at the 3 month visit (P=.041).

Pre-IVTA CMT was not statistically different in the primary and secondary injection groups (P=.17). In the primary IVTA injection group, CMT decreased at 1 month following IVTA injection. This reduction continued to be statistically significant until the 6 month visit. In the secondary IVTA injection group, a slight reduction in CMT was noted. This reduction was statistically significant only at the 1 month visit (P=.02).

When IVTA injection was performed following grid laser treatment, it yielded only a small gain in BCVA, which was statistically significant only at the 3-month visit.

CONCLUSIONS/ANALYSIS
In our study, IVTA treatment produced a statistically significant BCVA gain when performed as initial treatment. When IVTA injection was performed following grid laser treatment, however, it yielded only a small gain in BCVA, which was statistically significant only at the 3 month visit.

Why did the results differ between groups? We think the main reason was our study design, and thus patient enrollment criteria for the different study arms. We purposely performed grid laser as the first line of treatment if the eye met BVOS guidelines at presentation. This led to the application of grid laser treatment in eyes presenting with better BCVA and enrollment into the secondary IVTA group if necessary. Primary IVTA injection was performed in eyes with worse BCVA at presentation and not eligible for grid laser. Because of these study enrollment criteria, pre-IVTA BCVA in the secondary IVTA group was statistically better than that in the primary IVTA injection group.

SIGNIFICANT GAINS IN PRIMARY INJECTION GROUP
Patients who received IVTA as their primary treatment showed significant improvement in BCVA throughout follow-up (P<.05). Only a small gain, however, in BCVA was observed at 3 months among patients in the secondary treatment group (P=.04).

At baseline, CMT averaged 434.8 µm in the primary treatment group and 389.0 µm in the secondary treatment group. Among patients in the primary treatment group, CMT decreased at 1 month postinjection and remained significantly decreased at 6 months follow-up (P<.05). A slight reduction, however, in CMT was observed only at 1 month follow-up in the secondary treatment group (P=.02).

Pre-IVTA BCVA was found to be the single statistically significant predictor of BCVA gain following IVTA injection. In univariate analysis, pre-IVTA BCVA and time duration between the BRVO and IVTA injection were found to be inversely correlated with final gain in BCVA. The remaining factors in the analysis did not have any correlation with final BCVA gain. In multivariate analysis, only pre-IVTA BCVA had a statistically significant (negative) correlation with final BCVA gain. There was no correlation between the remaining factors and final BCVA gain.

In eight patients (21.6%), IOP increased above 25 mm Hg 1 week following IVTA treatment and these patients were successfully managed with medical treatment. Four eyes underwent cataract surgery during the study period. Endophthalmitis did not develop in any of the study patients.
with relatively better visual function initially, but it yielded significant BCVA gain in eyes with relatively poor visual acuity. The thermal damage of the grid laser to the outer retinal and photoreceptor layers could be a possible reason for the absence of significant visual acuity gain in secondary IVTA injection group. Additionally, there was a longer time delay between the onset of symptoms and IVTA treatment in that group, which might theoretically increase the risk of permanent damage to the photoreceptor cells.

SUMMARY
IVTA injection produced a significant reduction of CMT in both groups. At 1 month, CMT decreased approximately 50% in the primary and 40% in the secondary injection groups. Similar to other studies in the literature, the edema-decreasing effect of IVTA was temporary and was completely lost after 6 months in the primary group and after 3 months in the secondary injection groups. There was not a strong correlation between BCVA and CMT at presentation or during follow-up in either group. Because of those findings, we suggest that macular edema is only a partial cause for visual acuity reduction in eyes with BRVO. IVTA treatment addresses only macular edema and thus in our study had a limited therapeutic effect.

In our study, eight patients (21.6%) had significant IOP increase, all of which were successfully controlled with topical antiglaucomatous medications.

In conclusion, we found that IVTA injection reduced CMT and thus macular edema due to BRVO in eyes both with and without prior grid laser treatment. The visual benefit, however, was significantly more limited in eyes with prior grid laser photocoagulation, as these eyes likely more refractory to any treatment because they were likely to be nonperfused. The edema-reducing effect was also transient and lost after 6 months in most cases. We recommend new, larger studies should be performed to evaluate the true therapeutic effect of IVTA injection in eyes with macular edema associated with BRVO.

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