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Long-Term Results of Full Macular Translocation for Choroidal Neovascularization in Age-Related Macular Degeneration

Saskia H.M. van Romunde, MD,[1] *Antonio Polito, MD,*[1] *Laura Bertazzi, MD,*[1] *Massimo Guerriero, PhD,*[2] *Grazia Pertile, MD*[1]

Purpose: To investigate the long-term outcome of full macular translocation (FMT) for neovascular age-related macular degeneration (AMD) and to identify predictive factors.

Design: Retrospective, uncontrolled case series.

Participants: Patients were considered for FMT if they had low vision in the fellow eye and choroidal neovascularization (CNV) along with (1) no response to vascular endothelial growth factor (VEGF) inhibitors, (2) retinal pigment epithelium (RPE) tear, (3) subretinal hemorrhage, (4) foveal scar tissue of recent onset, or (5) CNV before the availability of VEGF inhibitors. From 2004 through 2012, a total of 255 patients underwent FMT. Exclusion criteria were patients younger than 60 years, FMT for disease other than AMD, and a follow-up of less than 12 months.

Methods: Preoperative, annual, and last distance best-corrected visual acuity (BCVA) were obtained retrospectively from patient files. Complications were recorded using funduscopy, optical coherence tomography, autofluorescence, and angiography.

Main Outcome Measures: Distance BCVA at 1 year and 5 years after surgery and at last visit compared with preoperative BCVA.

Results: One hundred fifty-eight patients (mean follow-up, 45 months) were included. Median BCVA improved from 0.90 logarithm of the minimum angle of resolution (logMAR) before surgery to 0.70 logMAR 1 year after FMT (2 lines gained; $P = 0.000$). In a subgroup of 56 patients followed up for 5 years or more, median BCVA improved from 0.95 logMAR before surgery to 0.70 logMAR 1 year after surgery, and remained improved 5 years after FMT with a median BCVA of 0.80 logMAR (1.5 lines gained compared with preoperative BCVA; $P = 0.000$). The main complications were foveal RPE atrophy (n = 73; 47%) and CNV recurrence (n = 47; 30%). Foveal RPE atrophy (odds ratio [OR], 7.0), CNV recurrence (OR, 2.6), and proliferative vitreoretinopathy (PVR; OR, 17.6) were statistically significant predictors ($P < 0.05$) for losing 1 line or more at last visit.

Conclusions: In this study, BCVA was improved up to 5 years after FMT. Foveal RPE atrophy, CNV recurrence, and PVR carried a worse prognosis. In patients who are unlikely to benefit from VEGF inhibitors, FMT can be considered for second eyes with neovascular AMD. *Ophthalmology 2015;■:1–9 © 2015 by the American Academy of Ophthalmology.*

Supplemental video is available at www.aaojournal.org.

Age-related macular degeneration (AMD) is the leading cause of blindness in elderly white people.[1] Although the neovascular type of AMD is less prevalent than the nonexudative (dry) type of AMD, it is associated with a worse prognosis if left untreated.[2] The introduction of vascular endothelial growth factor (VEGF) inhibitors has improved the prognosis of neovascular AMD significantly.[3–5] However, some patients do not respond to VEGF inhibitor treatment. Furthermore, some patients are unlikely to benefit from VEGF inhibitors because of massive submacular hemorrhage or retinal pigment epithelium (RPE) tear. In these cases, surgical treatment is an option to rescue the vision.

Full macular translocation (FMT) is a surgical treatment in which the macular area is rotated to a healthy RPE and choroid. The technique was first performed by Machemer and Steinhorst[6] and was developed further by Eckhardt et al.[7] The effect of FMT has been studied previously,[7–17] but only a few studies have investigated the long-term outcome.[18–22] The results differ substantially among the various articles, and accordingly, there is a lack of conclusive evidence.

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Our aim was to investigate the long-term outcome of FMT for neovascular AMD in the group of patients who underwent surgery in our institution. Furthermore, we investigated whether we could identify predictive factors for the outcome of FMT.

Methods

This was a single-center retrospective study that was performed in the Hospital Sacro Cuore − Don Calabria (Negrar, Italy). The institutional review board ruled that approval was not required for this study.

Patients

From 2004 through 2012, a total of 255 patients with choroidal neovascularization (CNV) underwent FMT. This surgery was offered to patients with advanced disease in the fellow eye and progressive visual loss in the study eye and (1) no response to VEGF inhibitors treatment, (2) an RPE tear, (3) a massive subretinal hemorrhage, (4) fibrotic scar tissue of recent onset, or (5) CNV before VEGF inhibitors were available in our institution (in 2007). Patients were considered nonresponsive to VEGF inhibitors when vision continued to decrease despite at least 3 injections. When spectral-domain optical coherence tomography (SD OCT) became available (November 2008), the status of outer retinal layers in the fovea were taken into consideration when offering FMT to AMD patients. Using multimodal imaging, patients with absent external limiting membrane and ellipsoid zone or marked thinning of outer nuclear layer tended to be excluded from surgery. After informing patients about the procedure and risks of complications, patients gave informed consent. Visual function, fundus examination, SD OCT, autofluorescence, fluorescein angiography, and indocyanine green angiography (Spectralis HRA+OCT, Heidelberg Engineering GmbH, Heidelberg, Germany) were obtained before surgery. Exclusion criteria for this study were (1) FMT for diseases other than neovascular AMD, (2) age younger than 60 years, and (3) a follow-up of less than 12 months.

Surgical Procedure

Full macular translocation was carried out under general anesthesia in all patients. The surgical procedure was performed as described previously[9,20] (Videos available at www.aaojournal.org). Briefly, compensatory muscle surgery was performed first. Only when the angle of rotation could not be predicted, that is, in case of massive subretinal hemorrhage, were muscles adjusted after the retinal rotation. In phakic eyes, phacoemulsification with intraocular lens implantation was carried out. After a pars plana vitrectomy, the posterior hyaloid was detached and the vitreous base was shaved carefully with a vitreous cutter. Retinal detachment was induced by injecting balanced salt solution with a 41-gauge cannula into the subretinal space, and complete detachment was accomplished by fluid−air exchange. After the retina was detached, a 340° retinotomy was performed at the ora serrata. While lifting the retina, the CNV was removed and the afferent vessel was cauterized. Thereafter, the 360° retinotomy was completed and the retina was stabilized with perfluorocarbon liquid (PFCL). The retina was rotated carefully approximately 45°, preferably in the upward direction to maximize the translocation. After the translocation was completed, PFCL was injected up to the ora serrata to reattach the retina, and laser photocoagulation was performed at the edge of the retinotomy. Finally, PFCL was exchanged with silicon oil. After a mean of 4.0 months (standard deviation, 2.8 months), the silicone was removed from the eye. Postoperative patients made routine visits to the hospital, first weekly, then monthly, and after 6 months, at least once per year.

Outcome Measures

Demographics and clinical data were reviewed from patient files between January and March 2014. Preoperative imaging was retrieved and analyzed by an experienced observer to categorize preoperative lesions into CNV only, RPE tear, hemorrhage, or fibrosis, based on the predominant lesion component. Early and late complications were reported as detected during regular outpatient clinic visits by clinical examination, funduscopy, intraocular pressure measurements, and multimodal imaging using autofluorescence, fluorescein angiography, indocyanine green angiography, and when available, SD OCT.

The primary outcome measure was the Snellen distance best-corrected visual acuity (BCVA), which was converted into logarithm of minimum angle of resolution units (logMAR) for analysis. Secondary outcome measures were the intraoperative and postoperative complication rates. Because RPE atrophy was not reported consistently in patient files, we reviewed all images and defined it as present when it involved the fovea on autofluorescence and, if available, on SD OCT.

Statistical Analysis

SPSS software version 19 for Windows (IBM Corp, Armonk, NY) was used for analyzing the data. Differences in baseline BCVA and BCVA at 1 year were analyzed with the Wilcoxon signed-rank test. In a subanalysis of patients with a follow-up of at least 5 years, the Friedman test was used to assess the difference in baseline BCVA, BCVA at 1 year, and BCVA at 5 years after surgery. The Pearson chi-square test was used to compare the distribution of legally blind patients (Snellen $\leq$20/200 vs. Snellen $>$20/200) at baseline with the distribution of patients 1 year and 5 years after surgery. Predictive factors for the risk of losing 1 line or more at last visit were identified with the use of backward logistic regression controlling for confounding factors including baseline BCVA and duration of follow-up. A P value of less than 0.05 was considered statistically significant.

Results

Of the 255 patients who underwent FMT, 97 patients (38%) were excluded because of having less than 12 months of follow-up (n = 65), disease other than AMD (n = 25), or age younger than 60 years (n = 6). A short follow-up of less than 1 year occurred mostly in cases of long-distance referrals or because patients did not return at the scheduled visits (n = 30). Demographics and baseline characteristics of the 158 patients who were included are presented in Table 1. In all patients, the CNV was removed completely and the retina was translocated successfully. In 9 cases, the retina was translocated downward because of RPE damage in the superior part of the posterior pole. The mean duration of follow-up was 45 months (range, 12−109 months). Eighty-seven patients (55%), 56 patients (35%), and 3 patients (2%) were followed up for at least 3, 5, and 9 years, respectively.

Best-Corrected Visual Acuity

The distribution of BCVA 1 year after FMT and at last visit compared with baseline BCVA is shown in Figure 1. The median distance BCVA values were 0.90 at baseline and 0.70 at 1 year (P = 0.000; Table 2). Patients followed up for at least 5 years had a median BCVA of 0.95 at baseline, 0.70 at 1 year, and 0.80 at 5 years after surgery (P = 0.000). The number of patients who were legally blind