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Original Article

Effect of race and ethnicity on surgical outcomes for rhegmatogenous retinal detachments

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Objective: To evaluate the effect of socioeconomic and demographic factors on outcomes in rhegmatogenous retinal detachments (RRDs).

Design: Retrospective cohort study.

Methods: A total of 71 white and 124 black and/or Hispanic patients who had surgical repair of RRDs between October 2013 and September 2021 at a single-centre safety net hospital. Main outcomes were single surgery success rates (SSSR) and postoperative visual acuity at 6-month and final follow-up.

Results: Black and (or) Hispanic patients were significantly younger (black and [or] Hispanic, 50.7 years vs white, 57.6 years; $p = 0.003$), had lower mean household incomes (black and [or] Hispanic, $80,932 vs white, $92,911; $p = 0.007$), were more likely to have more than 1 retinal break (black and [or] Hispanic, 65% vs white, 49%; $p = 0.04$), and had higher rates of proliferative vitreoretinopathy (PVR) at presentation (black and [or] Hispanic, 35% vs white, 18%; $p = 0.02$). SSSR was similar (black and [or] Hispanic, 73.4% vs white, 73.2%; $p = 0.98$), but black and (or) Hispanic patients had worse visual acuity postoperatively (black and [or] Hispanic, 20/63 vs white, 20/40 at final follow-up; $p = 0.03$). While race was linked to visual outcome in univariate testing; multivariate analysis revealed only macula status ($p = 0.007$ at 6 months; $p = 0.01$ at final follow-up), presence of PVR ($p < 0.001$ at both time points), and SSSR ($p = 0.003$ at final follow-up) as predictors of worse visual outcomes.

Conclusions: Preoperative factors such as higher rates of PVR may contribute to worse vision outcomes in black and (or) Hispanic patients undergoing surgical repair for RRD.

Objectif: Évaluer l'effet de facteurs socioéconomiques et démographiques sur le devenir de patients qui ont subi un décollement de rétine rhegmatogène (DRR).

Nature: Étude de cohorte rétrospective.

Méthodes: Au total, 71 patients caucasiens et 124 patients noirs et/ou hispaniques ont subi une réparation chirurgicale de DRR entre octobre 2013 et septembre 2021 dans un hôpital servant de filet de sécurité (*safety net hospital*). Le taux de réussite d'une intervention chirurgicale unique (SSSR) et l'acuité visuelle 6 mois après l'intervention et lors du suivi final constituaient les principaux paramètres de mesure.

Résultats: Les patients noirs et/ou hispaniques étaient significativement plus jeunes que les patients caucasiens (50,7 ans vs 57,6 ans; p = 0,003), avaient un revenu familial moyen plus faible (80 932 $ vs 92 911 $; p = 0,007), étaient plus susceptibles de présenter plus d'une déchirure de la rétine (65 % vs 49 %; p = 0,04) et étaient plus nombreux à présenter une vitréorétinopathie proliférante (VRP) au moment de l'examen initial (35 % vs 18 %; p = 0,02). Le SSSR était semblable (73,4 % vs 73,2 %; p = 0,98); en revanche, l'acuité visuelle des patients noirs et/ou hispaniques était inférieure à celle des patients caucasiens après l'intervention (20/63 vs 20/40 lors de la dernière visite de suivi; p = 0,03). Si l'analyse univariée a permis d'établir un lien entre la race et les résultats visuels, l'analyse multivariée n'a fait ressortir que 3 facteurs prédictifs de piètres résultats visuels : état de la macula (p = 0,007 à 6 mois; p = 0,01 lors de la dernière visite de suivi), présence d'une VRP (p < 0,001 aux 2 visites) et SSSR (p = 0,003 lors de la dernière visite de suivi).

Conclusions: Des facteurs préopératoires, comme un taux plus élevé de VRP, pourraient contribuer à l'obtention de résultats visuels de moins bonne qualité chez les patients noirs et/ou hispaniques qui subissent une réparation chirurgicale de DRR.

Studies on the presentation and outcomes of rhegmatogenous retinal detachments (RRDs) in patients from black and Hispanic minority groups in the United States are limited.[1–4] A recent study from Xu et al.[5] found that both nonwhite race and lower mean household income (MHI) were associated with fovea-off presentation in RRD. Nonwhite race (but not MHI) was additionally associated with lower single-surgery success rate (SSSR) and worse visual acuity outcomes. As a result of its large number of subjects, this database review was not able to perform individual chart auditing and thus could not analyze some potentially relevant ophthalmic characteristics. Racial disparities have been implicated in visual impairments in ocular pathologies other than RRDs after controlling for socioeconomic factors.[6] In light of these findings, the purpose of our study is to evaluate RRD patients in our safety net hospital and to determine whether differences in preoperative characteristics other than sociodemographic factors may account for these variations in outcomes.

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Methods

A retrospective single-centre cohort study was conducted with patients who had been diagnosed with RRD from October 2013 to September 2021. This study was approved by the Institutional Review Board of Boston University School of Medicine and adhered to the tenets of the Declaration of Helsinki. Potential subjects were identified through an electronic medical record search for *International Classification of Diseases*, Ninth Revision (ICD-9) code 361.x and ICD-10 code H33.0x to identify patients with RRD. Inclusion criteria included patients who had surgical interventions for RRD with pneumatic retinopexy, scleral buckle (SB), pars plana vitrectomy (PPV), or combined SB/PPV. Exclusion criteria included patients with a previous history of ipsilateral RRD repair, patients refusing to self-identify race or ethnicity, patients not undergoing surgical repair, and patients treated for nonrhegmatogenous retinal detachments such as tractional or exudative retinal detachments. In patients with bilateral RRD, only the first operated eye was included in the data analysis. Clinical notes and operative reports were reviewed individually for data collection including patient demographics, preoperative characteristics, and surgical outcomes.

Baseline demographic data were collected, including patient age, sex, self-reported race and ethnicity with categories including white, Hispanic, black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander.[7] Because the largest portions of our patient population self-identified as non-Hispanic white, black or African American, or Hispanic, chart review was limited to these three race or ethnic categories. Patients self-identifying as black or Hispanic were grouped as "black and (or) Hispanic race or ethnicity" for data analysis. Mean household income (MHI) was obtained from the U.S. Census Bureau Small Area Income and Poverty Estimates 2019 data based on patient's ZIP code.[8]

Ophthalmic baseline factors collected included presenting visual acuity (VA), prior history of trauma or cataract surgery, location and number of retinal breaks, number of quadrants detached, status of the fovea, and presence of proliferative vitreoretinopathy (PVR), vitreous hemorrhage, and lattice degeneration. The location of breaks was categorized into superior and inferior hemispheres. Subjects with breaks in both the superior and inferior hemispheres were included in the inferior hemisphere category. Number of breaks was categorized into single break or >1 break. The number of quadrants detached was categorized as 1 or >1 quadrant. Fovea-splitting detachments were considered macula-on. Duration of symptoms including the patient's subjective history of flashes, floaters, or visual field cuts and time from diagnosis to surgical intervention were both recorded in number of days. Snellen VA measurements were converted to the logMAR scale. For VA worse than 20/400, logMAR equivalencies were assigned as followed: counting fingers, 1.98; hand motions, 2.28; and light perception, 2.80.[9] Postoperative findings including primary and final surgical repair success and VA at 6 months and final follow-up, as documented at the most recent visit within the study period, were collected.

Statistical analysis was performed with IBM SPSS version 26 (IBM Corporation, Armonk, NY). The primary outcome was single-surgery success rate (SSSR), defined as anatomic reattachment of the retina after a single procedure without tamponade agents, between white and black and (or) Hispanic patients with secondary outcomes comparing preoperative factors and VA results between groups. For comparison of categorical variables between the white and black and (or) Hispanic subject groups, χ^2 and Fisher's exact tests were used. For comparison of means and medians of normally and nonnormally distributed continuous variables, *t* tests and Mann−Whitney *U* tests were used, respectively. Linear regression analysis, controlling for sex and race or ethnicity and including variables with p values <0.05 on univariate analysis, as well as previously identified predictors of vision outcomes in RRD repair, was performed to identify factors predictive of 6-month and final VA results. p values <0.05 were considered statistically significant.

Results

A total of 249 patients who were diagnosed with RRD were reviewed initially. Nineteen patients who declined to report race and 35 patients who received nonsurgical treatment for RRD including laser retinopexy were excluded. The 195 remaining patients with RRD were then categorized as white (n = 71) or black and (or) Hispanic (n = 124) based on self-reported race. The black and (or) Hispanic minority patient group consisted of black (n = 75) and Hispanic (n = 49) patients. The primary outcome of SSSR (black and [or] Hispanic, 73.4% vs white, 73.2%; $p = 0.98$) was similar between the 2 groups. While the final surgery success rate showed a trend toward better results in the white patient group, this finding failed to meet statistical significance (black and [or] Hispanic, 86% vs white, 94%; $p = 0.08$).

Demographic data (Table 1) showed that black and (or) Hispanic patients were significantly younger (black and [or] Hispanic, mean age 50.7 years vs white, mean age 57.6 years; $p = 0.003$) and had a lower MHI (black and [or] Hispanic, mean $80,932 vs. white, mean $92,911; $p = 0.007$) but had a similar sex breakdown (black and [or] Hispanic, 65% male vs white, 68% male; $p = 0.66$). While presenting VA, duration of symptoms, and macula status were similar between groups, time to intervention after diagnosis was significantly longer in the black and (or) Hispanic group (black and [or] Hispanic, median 4 days vs white, 2 days; $p = 0.005$). This discrepancy was accounted for primarily by longer time to intervention in the macula-off presentation group (black and [or] Hispanic, median 5 days vs white, 2 days; $p = 0.008$). There was no significant difference in time to intervention between white and black and (or) Hispanic patients presenting with macula-on RRDs.

Table 1—Characteristics and outcomes of rhegmatogenous retinal detachments

Characteristic	Black and (or) Hispanic patients (n = 124)	White patients (n = 71)	*p* Value
Demographics			
Age, y, mean ± SD	50.7 ± 15.5	57.6 ± 14.7	0.003
Male sex, n (%)	80 (65%)	48 (68%)	0.66
Mean household income, US$	80,932 ± 24,235	92,911 ± 36,305	0.007
Preoperative characteristics			
Median presenting visual acuity	1.30 (Snellen 20/400)	1.30 (Snellen 20/400)	0.27
Median duration of symptoms, days	9.5	8	0.55
Median time to intervention, days	4	2	0.005
Macula-on	2	1	0.36
Macula-off	5	2	0.008
Macula-on, n (%)	39 (31%)	26 (37%)	0.46
History of trauma, n (%)	20 (16%)	8 (11%)	0.36
Pseudophakia, n (%)	40 (32%)	19 (28%)	0.42
>1 Retinal break, n (%)	80 (65%)	35 (49%)	0.04
Break in inferior hemisphere, n (%)	44 (35%)	18 (25%)	0.14
>1 Quadrant detached, n (%)	86 (69%)	42 (59%)	0.14
Preoperative proliferative vitreoretinopathy, n (%)	43 (35%)	13 (18%)	0.02
Lattice degeneration, n (%)	32 (26%)	16 (23%)	0.61
Vitreous hemorrhage, n (%)	15 (12%)	9 (13%)	0.98
Surgical procedure			
Combined scleral buckle–pars plana vitrectomy, n (%)	35 (28%)	11 (15%)	0.04
Silicone oil tamponade, n (%)	44 (35%)	5 (7%)	<0.001
SF_6	28 (23%)	33 (46%)	<0.001
C_3F_8	45 (36%)	28 (39%)	0.19
No tamponade agent	7 (6%)	5 (7%)	0.15
Outcomes			
Single-surgery success rate, n (%)	91 (73%)	52 (73%)	0.98
Median visual acuity 6 months	0.70 (Snellen 20/100)	0.40 (Snellen 20/50)	0.02
Final surgery success rate, n (%)	107 (86%)	67 (94%)	0.08
Median final visual acuity	0.50 (Snellen 20/63)	0.30 (Snellen 20/40)	0.03

Black and (or) Hispanic patients were more likely to have multiple retinal breaks (black and [or] Hispanic, 65% vs white, 49%; $p = 0.04$) and more likely to have PVR at presentation (black and [or] Hispanic, 35% vs white, 18%; $p = 0.02$). However, history of trauma, prior cataract surgery, presence of breaks in the inferior quadrant, size of the detachment, lattice degeneration, and vitreous hemorrhage rates were similar between the 2 groups (Table 1). Most patients underwent primary repair with PPV (n = 126; 65%), followed by combined PPV/SB (n = 46; 23%), SB alone (n = 13; 7%), and pneumatic retinopexy (n = 10; 5%). The success rates of each of these methods of repair were comparable between black and (or) Hispanic and white patients (Table 2). However, black and (or) Hispanic patients were more likely to receive combined SB/PPV (black and [or] Hispanic, 28% vs white, 15%; $p = 0.04$) and more likely to require silicone oil as a tamponade agent in their first surgery (black and [or] Hispanic, 35% vs. white, 7%; $p < 0.001$). White patients were more likely to receive SF_6 gas as a tamponade agent (black and [or]Hispanic, 23% vs white, 46%; $p < 0.001$), but the use of C_3F_8 gas as a tamponade agent did not differ between patient groups.

Visual outcomes were measured at both 6 months (mean, 186 days) and final follow-up (mean, 746 days). Despite similar presenting VAs, macula status, and surgical success rates, black and (or) Hispanic patients had worse postoperative VAs at 6 months (0.70 logMAR [Snellen equivalent, 20/100] for black and/or Hispanic patients vs 0.40 logMAR [Snellen equivalent, 20/50] for white patients; $p = 0.02$) and final follow-up (0.50 logMAR [Snellen equivalent 20/63] for black and/or Hispanic patients vs 0.30 logMAR [Snellen equivalent, 20/40] for white patients; $p = 0.03$). At final follow-up, the rates of pseudophakia (black and [or] Hispanic, 76% vs white, 70%; $p = 0.68$) and intraocular silicone oil (black and [or] Hispanic, 10% vs white, 7%; $p = 0.64$) were similar between groups, and multivariate analysis controlling for both race or ethnicity and MHI found only presenting macula status, presence of preoperative PVR, and SSSR as predictors of final VA outcomes (Table 3).

Discussion

Multiple studies have indicated the potential contribution of race or ethnicity to the variability in prevalence,

Table 2—Single-surgery success rates of surgical procedures for rhegmatogenous retinal detachment repair

Procedure	Black and (or) Hispanic patients (n = 124)	White patients (n = 71)	*p* Value
Combined scleral buckle–pars plana vitrectomy	63%(22/35)	55%(6/11)	0.89
Pars plana vitrectomy	79%(61/77)	84%(41/49)	0.70
Scleral buckle	75%(6/8)	40%(2/5)	0.50
Pneumatic retinopexy	50%(2/4)	50%(3/6)	0.52

Table 3—Linear regression analysis of factors influencing visual acuity outcomes after rhegmatogenous retinal detachment repair

Factor	Visual Acuity 6 Months		Visual Acuity Final	
	Beta	p Value	Beta	p Value
Age	0.01	0.91	0.02	0.83
Male sex	0.06	0.37	0.07	0.27
Nonwhite race or ethnicity	0.10	0.15	0.07	0.29
Mean household income	0.01	0.94	0.05	0.41
Time to intervention	0.12	0.09	0.12	0.09
Macula-off	0.19	0.007	0.17	0.01
Single retinal break	0.10	0.14	0.12	0.07
Preoperative proliferative vitreoretinopathy	0.33	<0.001	0.34	<0.001
Pseudophakic	0.01	0.94	0.06	0.38
Single-surgery success	0.13	0.06	0.20	0.003

presentation, and outcomes in ophthalmologic conditions.[1–4,6] Previous studies on RRD repair in black patients are limited in that many of them were conducted in continental Africa,[10–18] where differences in access to health care may prevent accurate comparison with U.S. -based patient populations. Studies from the United Kingdom, however, have implicated race as a risk factor for failure of vitreoretinal surgical repairs, with Afro-Caribbean patients experiencing lower success rates than whites after primary repair for any vitreoretinal surgical indication,[19] for macular holes,[20,21] and for diabetic tractional retinopathy.[22,23] Studies on RRD in Hispanic patients in the United States are limited. While a recent large database review revealed that Hispanic patients were more likely to face delays prior to receiving surgery for RRD, the study did not evaluate ocular characteristics or surgical success rates.[24]

Our study found that RRDs in black and (or) Hispanic patients occur at a younger age and in patients with lower MHIs and are more likely to be associated with multiple retinal tears and PVR at initial presentation. Differences in time to intervention were powered primarily by delays in repair of macula-off RRDs; black and (or) Hispanic patients had surgery within 5 days, whereas white patients had surgery within 2 days. While both groups fall within an acceptable timeframe for surgical intervention of macula-off RRD, this discrepancy may reflect the barriers to surgical care associated with disparities in sociodemographic status.[25,25]

Black and (or) Hispanic patients were more likely to require combined SB/PPV and silicone oil tamponade than white patients. Despite these factors indicative of more complex RRDs in the black and (or) Hispanic group, SSSRs were essentially identical between the white and black and (or) Hispanic patient groups. In contrast to the recent study by Xu et al.,[5] we found no independent relationship between race or ethnicity or MHI and visual acuity outcomes. Our multivariate analysis including a more extensive selection of patient characteristics (most of which have been reported previously as potential predictors of RRD outcomes) revealed only macula status, presence of preoperative PVR, and SSSR as predictors of final visual acuity. Given that preoperative PVR was the only of these characteristics that differed significantly between patient groups, we suspect that this factor is the primary driving force behind the inferior visual acuity outcomes found in black and (or) Hispanic patients.

The most common cause of failed RRD repair is PVR, in which dispersion of the retinal pigment epithelial cells leads to scarring and formation of fibrotic membranes.[27] Even in cases of successful surgical repair, PVR is a known risk factor for poor visual outcomes because it can lead to changes in the macular anatomy, including epiretinal membranes, cystoid macular edema, and subretinal fibrosis, as well as retinal ischemia and inflammation that may result in photoreceptor death despite anatomic reattachment.[25,26,28–30] Both fovea-off RRD at presentation and the presence of PVR are more common in chronic detachments, and prolonged duration of RRDs is a risk factor for the development of PVR.[31] Preoperative PVR is a risk factor for postoperative PVR and worse RRD repair outcomes as well.[32] Younger patient age and higher numbers of retinal breaks (as seen in our black and [or] Hispanic patient group) have been identified previously as risk factors for PVR.[33,34] Previous studies of primary RRD repair including cases with PVR have reported SSSRs of 80.8%–87.3%,[35,36] higher than our rate of 73.3%. PVR rates in these studies were 9.5%–10.3%, consistent with the previously reported overall incidence rate of PVR in primary RRD of 5.1%–11.7%.[37] The rate of PVR in our patient population (28%) was significantly higher than that seen in previous studies, and while formal grading of PVR was inconsistent in preoperative clinical notes in this retrospective study, review of operative notes and the significant need for long-term tamponade agents in these patients suggest high-grade disease. We believe that the high rate and severity of PVR in our patient population account for the lower overall SSSR.

Preoperative PVR was significantly more prevalent in black and (or) Hispanic patients despite a similar duration of symptoms, a proxy for duration of detachment. This finding suggests the possibility that PVR may develop more rapidly in black and (or) Hispanic patients. Studies in other organ systems have demonstrated race-related variability in serum inflammatory markers.[38–40] Stepanikova et al.,[40] for instance, found higher serum levels of interleukin 6, a recognized mediator of PVR,[41] in blacks than whites. Because PVR is an inflammatory state in which cytokine levels are elevated,[28,42,43] black and (or) Hispanic patients may be more likely to have PVR because of higher circulating cytokine levels.

Studies outside the United States have indicated that socioeconomic status influences RRD repair outcomes and suggest that economic barriers to receiving timely care also may contribute to the development of PVR.[44–47] In the United States, there is an undeniable correlation between race or ethnicity and socioeconomic status. While MHI cannot be considered a complete reflection of socioeconomic status, it is at least 1 quantifiable measure. The 2019 Census Bureau Report on Income and Poverty in the United States revealed notable differences in MHI by race, with MHI in non-Hispanic white

households ($76,057) exceeding that in both black ($45,438) and Hispanic ($56,113) households.[48] Additionally, non-Hispanic whites in the United States are more likely to have health insurance coverage (5.2% uninsured rate) than blacks (9.6% uninsured rate) and Hispanics (16.7%).[49] Massachusetts, however, offers universal health care, potentially mitigating one socioeconomic contributor to delayed presentation in our patient group. In 2021, 97% of Massachusetts residents had health care coverage (compared with 90.8% of the overall U.S. population).[50] Despite the availability of universal health care, even in Massachusetts, socioeconomic factors contribute to discrepancies in coverage because both low income and minority race are linked to lower insured rates in the state.[51] The PVR rate in our black and (or) Hispanic group was significantly higher despite similar times to presentation based on symptom duration, suggesting that possible factors beyond detachment chronicity contribute to the differing PVR rates. Certainly further studies are required before drawing any firm conclusions regarding the rate and severity of PVR formation in different patient populations.

Our study has several strengths. First, based on the patient population cared for at Boston Medical Center, we were able to include a high percentage of black and (or) Hispanic patients in an environment of universal health care that may at least partially eliminate the confounding factor of access to health care afflicting minority patients.[52] We also performed individual chart reviews as opposed to a database review, which allowed for more detailed analysis of a wider variety of preoperative ocular factors. Finally, the fact that our patient groups had similar rates of pseudophakia and long-term silicone oil tamponade at final follow-up indicates that these factors, which are recognized contributors to VA results after RRD repair, were unlikely contributors to the vision differences found in our study.

Our study also has limitations. Our patient numbers are relatively limited in comparison with some of the previously published database reviews, but this smaller sample size allowed us the opportunity to perform individual chart reviews on multiple variables. The retrospective, chart review nature of this study limits our ability to obtain certain desired data such as the preoperative grading of PVR. We use MHI as the sole proxy for socioeconomic status. In an urban northeastern location, there can be a large variation of income within one ZIP code such that MHI may not capture more subtle socioeconomic challenges that would delay presentation, such as transportation or language barriers. We use patient reporting of symptom duration as a proxy for duration of detachment. Although the greater rate of PVR in black and (or) Hispanic patients despite similar detachment duration may suggest factors other than chronicity contributing to PVR formation, symptom duration is limited by its dependence on patient history and thus likely inaccurate in some cases. However, we think that it is the most quantifiable measure to determine detachment chronicity in a retrospective study. Finally, the single-centre nature of our study represents a potential limitation, especially because Boston Medical Center's status as a safety net hospital, defined by the Institute of Medicine as an organization that delivers comprehensive medical care to uninsured or otherwise vulnerable patients,[53] may make our results less generalizable to patient populations cared for at other locations. Future work would benefit from prospective multicentre studies with a larger sample size of patients and multiple vitreoretinal surgeons to increase the generalizability of their conclusions.

In conclusion, white patients and black and (or) Hispanic patients had similar SSSRs for RRDs. However, despite similar presenting macula status, duration of detachment, and SSSR, vision outcomes were significantly worse in black and (or) Hispanic patients, primarily driven by higher rates of PVR at presentation. We postulate that black and (or) Hispanic patients may be at a higher risk for PVR, potentially related to factors beyond chronicity of the detachment alone, a finding that, if verified in future studies, could affect clinical management of RRD in this patient population.

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