Original Article

Rhegmatogenous retinal detachment: an analysis of 2315 eyes over a six-year period

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ABSTRACT

Background: Rhegmatogenous retinal detachment (RRD) is a form of retinal detachment caused by passage of fluid from the vitreous cavity into the space between the neurosensory retina and the retinal pigment epithelium via a retinal break or full-thickness defect. At our tertiary referral center, we evaluated the clinical and epidemiological features of RRD, and we herein report the frequency of related risk factors.

Methods: In this retrospective study, we reviewed the records of patients with a final diagnosis of RRD at an academic ophthalmological referral center in Isfahan, Iran, over a six-year period. We retrieved and reviewed data from the medical records of all eligible participants, including sex, age, laterality, lens status, macular status, type of RRD, location and number of breaks, type of surgery, rate of re-operation during the first year after initial surgery, and documented clinical risk factors for RRD. Clinical risk factors were categorized as the presence of myopic refractive error, ocular trauma, history of cataract surgery, history of other ocular surgeries, history of uveitis, or undetermined.

Results: We included 2315 eyes of 2229 patients with a mean (standard deviation [SD]) age of 51.1 (16.9) years and a male-to-female ratio of 1.8:1. The most common quadrants containing retinal breaks were the superotemporal quadrant (34.1%), inferotemporal quadrant (23.4%), and superonasal quadrant (10.7%). Macula-involved RRD was seen in 90% of eyes (n = 2083 eyes). The most frequently identified risk factors were cataract surgery (32.9%) and myopia (22.3%) in adults, and myopia (35.0%) and ocular trauma (27.4%) in the pediatric group. Most eyes underwent pars plana vitrectomy (51.3%), whereas pneumatic retinopexy (0.7%) was the least commonly selected.

Conclusions: Our results indicate that cataract surgery and myopia are the most common risk factors for RRD in adults. Myopia and ocular trauma are the most common risk factors in pediatric patients. As observed in many studies, the characteristics of the study population, including middle age, male sex, myopia, and ocular trauma, may be associated with RRD at different rates. Further population-based longitudinal studies with larger sample sizes are required to verify these preliminary observations.

KEYWORDS

retinal detachments, rhegmatogenous retinal detachment, retinal break, retinal hole, retinal tear, myopias, trauma, macula luteas

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INTRODUCTION

Retinal detachment (RD), caused by the loss of adherence of the neurosensory retina (NSR) and retinal pigment epithelium (RPE), is an important cause of blindness worldwide. There are three categories of RD: rhegmatogenous RD (RRD), tractional RD, and exudative RD [1]. RRD is the most common form and is caused by passage of fluid from the vitreous cavity into the space between the NSR and RPE via a retinal break or full-thickness defect [2, 3].

Because there are no retinal blood vessels within the fovea and the retinal tissue within this area depends entirely on the choroid for its oxygen supply, macular detachment can lead to permanent vision damage. If the macula detaches, vision may remain poor despite surgical intervention [4, 5]. Risk factors for breaks or tears in the NSR include a family history of RRD, previous RRD in the opposite eye, male sex, ocular trauma, myopia, congenital anomalies, and cataract extraction [6-9].

Knowledge of the epidemiological features of RRD would enhance our understanding of how other factors behave and interact in different populations and would help promote awareness of this potentially blinding disorder [10-12]. The etiology, anatomical characteristics, and prognosis of RRD in the developing world differ from those in the developed world. These differences may arise because of genetic, geographic, and socioeconomic factors [10-12].

Although limited research has been published on the epidemiological and other factors related to RRD, to the best of our knowledge, studies in Iran, particularly involving considerable numbers of cases, are scarce [13, 14]. We evaluated the various epidemiological features of RRD to detect the frequency of related risk factors and to identify modifiable factors for RRD prevention.

METHODS

This retrospective study included patients with a final diagnosis of RRD at the ophthalmological referral center of Feiz Hospital, affiliated with Isfahan University of Medical Sciences, Isfahan, Iran, spanning a six-year period between 2012 and 2017. This study adhered to the Helsinki Declaration of Ethical Standards and was approved by the Institutional Review Board of Isfahan University of Medical Sciences, Isfahan, Iran (approval code: IR.MUI.MED.REC.1397.219; approval date: 2019-02-12).

We identified eligible patients by searching the electronic hospital database using the International Classification of Diseases (ICD)-10 codes containing the phrases [15] "retinal detachment" and/or "RD". We excluded patients with lack of a definite RRD diagnosis in the discharge medical record, lack of ophthalmologist assessment in the medical record, proven non-rhegmatogenous etiology including serous or tractional RD, uncertain diagnosis, and insufficient available information.

All participants underwent a complete ophthalmological examination including best-corrected distance visual acuity measurement using a Snellen chart (Auto Chart Projector CP 670; Nidek Co., Ltd., Gamagori, Japan), intraocular pressure measurement using the Goldmann applanation tonometer (AT900; Haag-Streit, Koeniz, Switzerland), undilated and dilated slit-lamp biomicroscopy examination of the anterior and posterior segments (Photo-Slit Lamp BX 900; Haag-Streit), and dilated fundus examination using indirect ophthalmoscopy (Keeler Instruments, Inc., Philadelphia, PA, USA) and a +20 D auxiliary non-contact lens (Volk Optical, Inc., Mentor, OH, USA) using peripheral indentations. All patients were primarily attended by the associate ophthalmologist, and the final clinical diagnosis of RRD was confirmed by an expert vitreoretinal specialist (F.K.).

We retrieved and reviewed data from the medical records of all eligible participants, including sex, age, laterality (bilateral or unilateral), lens status (phakic, aphakic, or pseudophakic) [12], macular status (off or detached versus on or attached), type of RRD, location and number of breaks, need for re-operation within the first year after initial surgery, type of surgery, and documented clinical risk factors for RRD (Figure 1). Clinical risk factors [16-18] were categorized as myopic refractive error, ocular trauma, history of cataract surgery, history of other ocular surgeries, history of severe ocular inflammation (uveitis), and undetermined.

The type of RRD was categorized as [1, 2] (1) total, (2) subtotal, or (3) partial. The locations of breaks were categorized [19, 20] as (1) superotemporal quadrant, (2) inferotemporal quadrant, (3) superonasal quadrant, (4) inferonasal quadrant, (5) multi-quadrant, (6) macula and periphery, (7) macula only, and (8) undetermined. Patients were allocated to one of two subgroups according to age: (1) adults and (2) pediatric patients. Pediatric patients were defined as those aged less than 18 years [21]. We further distributed our participants among nine age subgroups at 10-year intervals [22]. The numbers of breaks were categorized [19] as (1) single, (2) multiple in one quadrant, (3) multiple in more than one quadrant, (4) macula only, or (5) undetermined. The types of surgery were categorized as (1) pars plana vitrectomy (PPV) [23], (2) scleral buckling [24], (3) combined [25], or (4) pneumatic retinopexy [26].

Statistical analyses were performed using IBM SPSS Statistics for Windows (version 26.0; IBM Corp., Armonk, NY, USA). Normally distributed numerical variables are reported as mean (standard deviation [SD]), whereas categorical variables are reported as frequency (percentage).

RESULTS

Of the 3526 medical records identified through the initial search of hospital electronic data, 2315 eyes of 2229 patients with RRD were enrolled in this study (Figure 1); 86 (3.9%) patients had bilateral RRD (Table 1). There were 1447 (64.9%) male patients, with a male-to-female ratio of 1.8:1 and a mean (SD) age of 51.1 (16.9) years (range: 2–89 years) (Table 1).

Table 1 summarizes the demographic and clinical characteristics of the included patients, along with the locations and numbers of breaks observed in eyes with RRD. Most eyes had partial RRD (n = 1687, 72.9%), while total and subtotal RRD were observed in 16.9% (n = 391) and 10.2% (n = 237) of eyes, respectively. Macula-involved RRD was documented in 90.0% of eyes (n = 2083). The most common sites of breaks were the superotemporal quadrant (n = 789 eyes, 34.1%), inferotemporal quadrant (n = 542 eyes, 23.4%), and superonasal quadrant (n = 247 eyes, 10.7%) (Table 1 and Figure 2). Multiple breaks in one quadrant and multiple breaks in more than one quadrant were observed in 317 (13.7%) and 383 (16.6%) eyes, respectively (Table 1).

Among 2315 eyes with RRD, 1187 (51.3%) and 1073 (46.4%) eyes underwent PPV and scleral buckling, respectively. Pneumatic retinopexy was performed on less than 1% of eyes (n = 17). Among patients hospitalized because of RRD during the study period, 419 eyes (18.1%) required re-operation for RRD within the first year after initial surgery (Table 1).

Table 2 summarizes the risk factors associated with RRD based on sex, age, and macular involvement. Among the risk factors associated with RRD, myopia was the most common (n = 539 eyes, 23.3%). Of these, most patients were male (n = 338 eyes, 62.7%) and adults (n = 474 eyes, 87.9%), with the majority of eyes being macula-off (n = 485 eyes, 90.0%) at the time of diagnosis (Table 2). There were no cases of myopia-induced

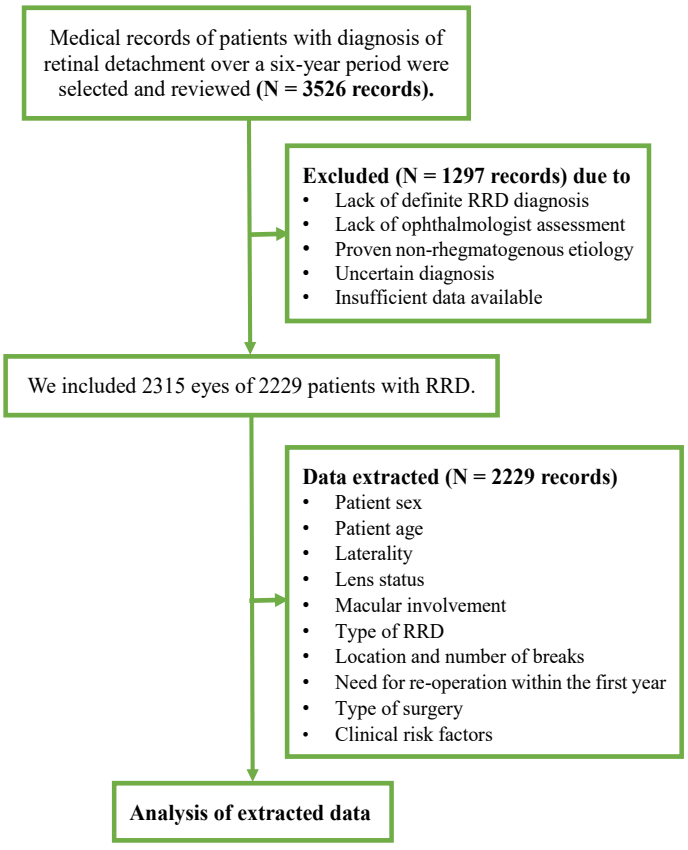

Figure 1. Flow diagram of the study process. Abbreviations: N, number; RRD, rhegmatogenous retinal detachment.

RRD in children less than nine years of age. Most eyes with myopia-induced RRD were observed in the subgroup aged 20–29 years (n = 98 eyes, 18.2%) (Table 3). Among risk factors associated with RRD, uveitis (n = 39 eyes, 1.7%) was the least common. Of these, most patients were adults (n = 38 eyes, 97.4%), and only one patient was aged less than 18 years (Table 2).

Table 1. Demographic and clinical characteristics of 2315 eyes of 2229 included patients with RRD

Variables	Value
Age (y), Mean ± SD	51.1 (16.9)
Sex (Male / Female), n (%)	1447 (64.9) / 782 (35.1)
Laterality (Unilateral/ Bilateral), n (%)	2143 (96.1) / 86 (3.9)
Eye (Right / Left), n (%)	1199 (51.8) / 1116 (48.2)
Lens status, n (%)	
Phakic	1597 (69.0)
Aphakic	56 (2.4)
Pseudophakic	662 (28.6)
Macula involving, n (%)	
Yes	2083 (90.0)
No	232 (10.0)
Type of RRD, n (%)	
Total	391 (16.9)
Sub-total	237 (10.2)
Partial	1687 (72.9)
Location of breaks, n (%)	
Superotemporal quadrant	789 (34.1)
Inferotemporal quadrant	542 (23.4)
Superonasal quadrant	247 (10.7)
Inferonasal quadrant	161 (7.0)
Multi-quadrant	347 (15.0)
Macula and periphery	36 (1.5)
Macula only	68 (2.9)
Undetermined	125 (5.4)
Number of breaks, n (%)	
Single	1431 (61.8)
Multiple in one quadrant	317 (13.7)
Multiple in more than one quadrant	383 (16.6)
Macula only	68 (2.9)
Undetermined	116 (5.0)
Reoperation in first year, n (%)	
Yes	419 (18.1)
No	1896 (81.9)
Type of surgery, n (%)	
Pars plana vitrectomy	1187 (51.3)
Scleral buckling	1073 (46.4)
Combined	38 (1.6)
Pneumatic retinopexy	17 (0.7)

Abbreviations: RRD, rhegmatogenous retinal detachment; y, years; SD, standard deviation; n, numbers; %, percentage.

Table 2. Clinical risk factors documented in patients with RRD according to sex, age, and macular status

Clinical risk factor	Total	Sex, n (%)		Age, n (%)		Macula involving, n (%)	
		Males	Females	Pediatric	Adult	Yes	No
Myopia	539 (23.3)	338 (22.5)	201 (24.8)	65 (35.0)	474 (22.3)	485 (23.3)	54 (23.3)
Ocular trauma	308 (13.3)	241 (16.0)	67 (8.3)	51 (27.4)	257 (12.1)	280 (13.5)	28 (12.1)
Cataract surgery	718 (31.0)	464 (30.9)	254 (31.3)	18 (9.7)	700 (32.9)	637 (30.6)	81 (35.0)
Ocular surgery *	47 (2.0)	29 (1.9)	18 (2.2)	2 (1.1)	45 (2.1)	40 (1.9)	7 (3.0)
Uveitis	39 (1.7)	15 (1.0)	24 (2.9)	1 (0.5)	38 (1.7)	34 (1.6)	5 (2.1)
Undetermined	664 (28.7)	416 (27.7)	248 (30.5)	49 (26.3)	615 (28.9)	607 (29.1)	57 (24.5)
Total	2315 (100.0)	1503 (100.0)	812 (100.0)	186 (100.0)	2129 (100.0)	2083 (100.0)	232 (100.0)

Abbreviations: RRD, rhegmatogenous retinal detachment; y, years; n, number of eyes; %, percentage. Note: *, a single asterisk indicates ocular surgeries except for cataract; Pediatric: pediatric patient was defined as a patient aged < 18 years.

Table 3. Age distribution of patients with RRD according to clinical risk factors

Clinical risk factor	Age subgroups (y), n (%)								
	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89
Myopia	0 (0.0)	65 (36.0)	98 (39.7)	87 (31.2)	82 (24.6)	79 (18.7)	75 (16.9)	51 (16.1)	2 (2.4)
Ocular trauma	2 (40.0)	49 (27.1)	64 (25.9)	61 (21.9)	53 (15.9)	30 (7.1)	26 (5.8)	18 (5.7)	5 (5.9)
Cataract surgery	0 (0.0)	18 (9.9)	24 (9.7)	43 (15.4)	98 (29.3)	164 (38.8)	189 (42.5)	139 (43.8)	43 (51.2)
Ocular surgery *	0 (0.0)	2 (1.1)	2 (0.8)	4 (1.4)	7 (2.1)	11 (2.6)	12 (2.7)	7 (2.2)	2 (2.4)
Uveitis	0 (0.0)	1 (0.5)	12 (4.9)	14 (5.0)	7 (2.1)	3 (0.7)	2 (0.4)	0 (0.0)	0 (0.0)
Undetermined	3 (60.0)	46 (25.4)	47 (19.0)	70 (25.1)	87 (26.0)	136 (32.1)	141 (31.7)	102 (32.2)	32 (38.1)
Total	5 (100.0)	181 (100.0)	247 (100.0)	279 (100.0)	334 (100.0)	423 (100.0)	445 (100.0)	317 (100.0)	84 (100.0)

Abbreviations: RRD, rhegmatogenous retinal detachment; y, years; n, number of eyes; %, percentage. Note: *, a single asterisk indicates ocular surgery except for cataract.

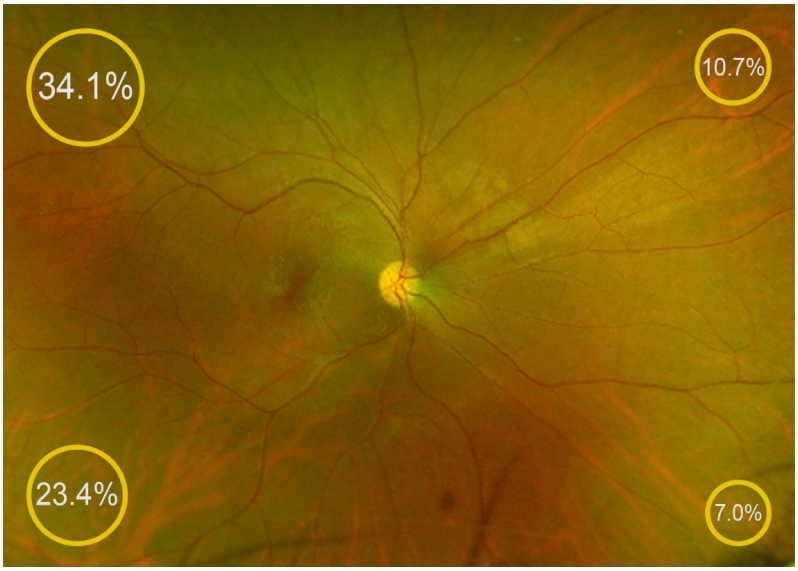

Figure 2. Break sites observed in eyes with rhegmatogenous retinal detachment upon initial fundus examination in study participants. The most common sites of breaks were the superotemporal quadrant (n = 789 eyes, 34.1%), inferotemporal quadrant (n = 542 eyes, 23.4%), superonasal quadrant (n = 247 eyes, 10.7%), and inferonasal quadrant (n = 161 eyes, 7.0%). Other locations were multi-quadrant, combined macula and periphery, macula only, and undetermined location in 15.0% (n = 347), 1.5% (n = 36), 2.9% (n = 68), and 5.4% (n = 125) of eyes, respectively. This figure has been reused with the permission of *Med Hypothesis Discov Innov Optom* [27].

According to age distribution, the 60–69-year subgroup had the highest number of affected eyes (n = 445 eyes, 19.2%), followed by the 50–59-year subgroup (n = 423 eyes, 18.3%). Patients aged less than 10 years or more than 80 years represented the least number of eyes: 5 (0.2%) and 84 (3.6%) eyes, respectively (Table 3). Overall, 308 (13.3%) eyes had a history of ocular trauma, with a male-to-female ratio of 3.6:1 (Table 2). Among eyes with a history of ocular trauma, most patients (n = 125 eyes, 40.6%) were within the age subgroups of 20–29 (n = 64 eyes, 20.8%) and 30–39 (n = 61 eyes, 19.8%) years. Among eyes with a history of cataract surgery (n = 718 eyes, 31.0%), most patients were within the age subgroup of 60–69 years (n = 189 eyes, 26.3%) (Table 3).

DISCUSSION

In the present study, cataract surgery, followed by myopia, was the most frequent risk factor for RRD in adults. Myopia and ocular trauma were the most common risk factors in pediatric patients. Male patients outnumbered female patients by nearly two-fold and were 3.6-fold more likely to have an ocular trauma history. In 90% of eyes with RRD, the macula was detached at the time of diagnosis. The most common retinal break sites were the superotemporal and inferotemporal quadrants, as observed in nearly 60% of eyes. More than half of the eyes underwent PPV surgery to repair RRD.

The risk of RRD varies according to sex and ethnicity. Caucasian and Asian populations have a relatively higher risk [28, 29]. In our study, the incidence of RRD in male patients was approximately two-fold greater than that of female patients, probably due to related risk factors such as trauma. Male individuals are more likely than female individuals to experience ocular trauma [30, 31]. In our study, ocular trauma was 3.6-fold more common in male participants, possibly due to occupational circumstances and longer periods spent outside the home. This sex-related imbalance in the rate of RRD may indicate a sex-related genetic susceptibility in male individuals [32]. Although some previous studies demonstrated a possible higher risk of RRD development in male than in female individuals, [2, 13, 29, 31, 33-36], another study of Indian, Malay, and Chinese individuals did not find sex to be a significant risk factor for development of RRD [37].

In our study, most patients were middle-aged, with a mean (SD) age of 51.1 (16.9) years. This distribution may be related to increases in the incidence of cataract formation and the need for cataract surgery after 40 years of age [33]. Those with previous cataract surgery have a higher incidence of RRD; approximately one in five patients with RRD in the study by Mitry et al. were pseudophakic [36]. In addition, the risk of tear formation is increased in individuals with areas of preexisting retinal thinning, such as lattice degeneration and other senile abnormalities [38]. Similarly, we found cataract surgery to be the most common risk factor for RRD development in adult participants.

As observed in previous studies, superotemporal and inferotemporal were the most common quadrants containing breaks [37], as we detected in nearly 60% of included eyes. The superotemporal quadrant was the most likely location of retinal breaks and demonstrated the highest proportion of detached breaks. By contrast, the inferonasal quadrant is the least likely location of a break and the most likely location of an attached break [19, 39].

In our analysis of three children with RRD, one featured high myopia. This finding is particularly important for school-aged children. In Asia, the prevalence of myopia is as high as 80% [40]. In our study, 86 (3.9%) patients had bilateral involvement. Bilateral RRD affects up to approximately 30% of individuals depending on case inclusion and study duration [7]. In all series, RRD has affected both eyes in certain proportions, indicating that fellow-eye involvement is an important consideration over time [2]. A previous study demonstrated a trauma-induced RRD rate of 6.3% to 12.2%, with most cases involving young men [41]. As observed in the previous study, we identified traumatic RRD primarily in young men.

In our study, uveitis was observed in 39 eyes (1.7%) as a clinical risk factor for RRD. Whether uveitis poses an additional risk of RRD development is poorly understood. However, some studies reported that patients with ocular toxoplasmosis have a higher frequency of RRD than the non-uveitic population [42, 43].

Currently, there are three main options for the management of RRD, including PPV [23], scleral buckling [24], and pneumatic retinopexy [26]. The choice of surgery depends on various factors, including patient characteristics, retinal findings, lens status, and the surgeon's experience and preference [44, 45]. However, at our center, we primarily perform PPV or scleral buckling. In our study, most patients underwent PPV, whereas pneumatic retinopexy was the least commonly selected, probably related to the selection of ocular surgeons and technical issues. Further studies may lead to novel treatment methods [46, 47].

Macular status at the presentation of ocular symptoms is important in the prediction of postoperative functional outcomes [48, 49]. In Western studies, macula-off status has a frequency of 40–60%, whereas the

rate is approximately 85% in developing countries [50, 51]. Similar to that of the previous study, the rate of macula-off status in our study was 90%. The high rate of macula-off status in developing countries, including the region of our study, could be attributed to delays in referral to the ocular center after the onset of clinical signs and symptoms.

Although the sample in our study was sizeable, the study had certain limitations. One important limitation of this hospital-based retrospective study was the quality of hospital records. Therefore, some data may have been overlooked. Further population-based longitudinal studies with larger sample sizes are recommended to verify our preliminary observations.

CONCLUSIONS

In this study, cataract surgery, followed by myopia, was the risk factor most commonly associated with the development of RRD in adults. Myopia and ocular trauma were the most common risk factors in pediatric patients. The most common locations of breaks were the superotemporal and inferotemporal quadrants, as observed in nearly 60% of eyes. There are some differences between the epidemiological features of RRD and the related factors in our study. As observed in many studies, the characteristics of the study population, including middle age, male sex, myopia, and ocular trauma, may be associated with RRD at different rates.

ETHICAL DECLARATIONS

Ethical approval: This study adhered to the Helsinki Declaration of Ethical Standards and was approved by the Institutional Review Board of Isfahan University of Medical Sciences, Isfahan, Iran (approval code: IR.MUI.MED.REC.1397.219; approval date: 2019-02-12).
Conflict of interests: None.

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