

1 **Paracentral acute middle maculopathy after uneventful ocular surgery with**  
2 **local anaesthetic blocks**

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25 **Running title:**

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27 Paracentral middle maculopathy after local anaesthesia.

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34 **Abstract**

35 **Objective:** To describe the role of local anaesthetic blocks as a potential cause of  
36 paracentral acute middle maculopathy (PAMM) after uneventful ocular surgery.

37 **Methods:** Retrospective, observational, international, multicentre case series. Nine  
38 cases of PAMM with associated visual loss following uneventful ocular surgery with  
39 local anaesthetic blocks were observed in a 9-year period (2011-2020).

40 Demographic, ocular and systemic data, anaesthetic data and surgical details were  
41 collected. Visual acuity (VA), fundus photography, fluorescein angiography, optical  
42 coherence tomography (OCT) and optical coherence tomography angiography  
43 (OCTA) images were reviewed.

44 **Results:** All nine cases were associated with decreased VA at 24h postoperative  
45 check (ranging from hand movement to 20/200). A hyperreflective band within the  
46 middle retinal layers was observed in the structural OCT in the acute phase,  
47 evolving to thinning and atrophy of the inner retinal layers in sequential follow-up  
48 scans performed. Fluorescein angiography showed delayed perfusion in early  
49 arterial phase with normal perfusion in late venous phases. OCTA showed  
50 decreased perfusion in the deep capillary plexus. Visual recovery was variable  
51 between cases during follow-up (ranging from count fingers to 20/20).

52 **Conclusions:** A combination of a vasoconstrictive effect of the anaesthetic agent,  
53 an intraocular pressure spike and a mechanical effect of the volume of anaesthetic  
54 injected may result in decreased retinal artery perfusion and be evidenced as  
55 PAMM in OCT scans. PAMM may present as a potential complication of local  
56 anaesthetic blocks in cases of unexpected visual loss after uneventful ocular  
57 surgery.

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59 **Keywords:**

60 Anaesthetic block; Paracentral Acute Middle Maculopathy; peribulbar; retrobulbar;  
61 sub-Tenon; optical coherence tomography.

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63

64 **Introduction**

65 Paracentral acute middle maculopathy (PAMM) is an optical coherence  
66 tomography (OCT) finding defined as a band-like hyperreflective lesion mostly  
67 confined to the inner nuclear layer (INL) owing to ischaemia or infarction of the  
68 intermediate and deep retinal capillary plexus.<sup>1-3</sup> Several retinal diseases have  
69 been associated with this finding, including retinal vascular occlusive disorders  
70 such as branch or central retinal arterial occlusions (RAO), cilioretinal artery  
71 occlusion, central retinal vein occlusion (RVO), and systemic diseases such as  
72 diabetic retinopathy, hypertensive retinopathy, Purtscher retinopathy or sickle cell  
73 retinopathy.<sup>4,5</sup> PAMM may be seen as an isolated finding or associated with  
74 other OCT features, including hyperreflectivity of the superficial retinal layers  
75 (retinal nerve fiber layer -RNFL-, ganglion cell layer -GCL- and Inner plexiform  
76 layer -IPL-) in RAO or diffuse thickening and macular edema in RVO.  
77 Local anaesthetics (sub-Tenon, peribulbar and retrobulbar) have been employed in  
78 ocular procedures for decades, and although these techniques are widely used,  
79 they are not free of complications. Well-known risks include intraorbital  
80 haemorrhage, local toxicity and, in worst case-scenarios, ocular perforation. The  
81 presence of impaired blood flow in the optic nerve head and therefore the retina  
82 has also been reported. Small case series and case reports describing retinal  
83 artery occlusions following cataract or pterygium surgery under local anaesthesia  
84 have been reported, using retrobulbar, peribulbar or sub-Tenon's techniques.<sup>6-12</sup>  
85 Whereas in some clinical presentations these features are obvious, sometimes the  
86 fundus phenotype is more subtle and alterations can easily be overlooked in  
87 fundoscopy, and in certain cases, even in OCT images.  
88 With this aim, we hereby describe the clinical phenotypes of a series of cases of  
89 PAMM and unexpected postoperative visual loss after uneventful ocular surgery  
90 with local anaesthetic blocks. The detailed ocular and systemic clinical  
91 characteristics of these cases are described as an attempt to share this data with  
92 the ophthalmic community, in order to identify future potential relationships  
93 between these preoperative features and PAMM which could help predict this  
94 postoperative complication.

95

## 96 **Methods**

97 Nine cases of PAMM following local anaesthetic blocks were observed in four  
98 medical centres, three in Spain (Hospital Clínic of Barcelona, Hospital la Arzuzafa  
99 of Córdoba and Hospital Povisa of Vigo) and one in the United Kingdom  
100 (Moorfields Eye Hospital, London). Data collection was systematically performed  
101 retrospectively from clinical records produced during routine clinical care.  
102 Demographics and systemic data, including cardiovascular data and medications  
103 used were collected from all study centres. Ocular data included axial length and  
104 refraction. Details of the anaesthetic procedures included type of local anaesthesia,  
105 (sub-Tenon's, peribulbar or retrobulbar), dose and volume of anaesthesia  
106 administered, and surgical details were collected from surgical logbooks. Visual  
107 acuity (VA), fundus photography, fluorescein angiography (FA), OCT, Spectral  
108 Domain OCT (SD-OCT) and optical coherence tomography angiography (OCTA)  
109 images, when possible, were reviewed. When appropriate, electrodiagnostic tests  
110 (EDDs) were performed at physician discretion. This study was approved by the  
111 institutional review board at Hospital Clínic (Comité Ético de Investigación Médica,  
112 CEIM) and was conducted in accordance with the Declaration of Helsinki.

113

## 114 **Results**

### 115 ***Baseline Characteristics***

116 Nine cases developed PAMM (seven men, two women, age range 40 to 83 years)  
117 with associated severe vision loss immediately after uneventful ocular surgery in a  
118 nine-year period (2011-2020). Indications for surgery were cataract (66.6%, 6/9) or  
119 pterygium surgery (33.3%, 3/9), performed under local anaesthesia of different  
120 types (peribulbar 66.6%, 6/9; retrobulbar, 22.2%, 2/9; Sub-Tenon's, 11.1%, 1/9).  
121 No optic nerve injury or globe perforation was derived from retrobulbar or  
122 peribulbar blocks in any of these cases. Five patients presented typical findings of  
123 CRAO (55.5%, 5/9), but in the rest of cases, ischemic damage to the retina was  
124 subtle in fundoscopy and diagnosis was made by structural OCT examination  
125 (44.4%, 4/9). In all cases, macular OCT images obtained 24-hours after surgery  
126 revealed a hyperreflective band at the level of the inner retinal layers (from inner  
127 nuclear layer -INL- to outer plexiform layer -OPL-) sparing the outer retina,

128 consistent with the diagnosis of PAMM. Optic nerve head OCT images were also  
129 obtained and showed no additional findings. Sequential SD-OCT (Cirrus HD-OCT,  
130 Carl Zeiss Meditec Inc, Dublin, CA, USA) images captured during follow-up  
131 showed progressive thinning of the inner retinal layers. In two cases, VA improved  
132 after presentation (22.2%, 2/9), whereas in 7 out of 9 cases vision alteration was  
133 permanent (77.7%, 7/9). The details of each individual case are described below.  
134 Demographics and clinical characteristics of cases included in the series are  
135 summarized in Table 1.

### 136 **Case 1**

137 A 40-year-old man underwent uneventful pterygium surgery in his right eye (OD)  
138 under sub-Tenon's block (2% lidocaine). No significant past medical history (PMH)  
139 was described. Twenty-four hours after the procedure, the patient complained of a  
140 central scotoma and VA was 20/200. Fundoscopy revealed a subtle perifoveal  
141 yellowish halo with thinning of the retinal vessels in the macular region (Fig. 1). FA  
142 showed a delayed arterial filling in the macular bundle, with normal perfusion in the  
143 late phase. SD-OCT images (Spectralis, Heidelberg Engineering, Heidelberg,  
144 Germany) revealed a hyperreflective band at the level of INL, consistent with the  
145 diagnosis of PAMM. EDDs tests showed OD marked macular dysfunction without  
146 generalized retinal dysfunction. Conservative management was indicated, and six  
147 weeks after the procedure OD VA improved to 20/32, with persistence of the  
148 hyperreflective band, thinning of the inner retinal layers and moderate macular  
149 atrophy in the SD-OCT scan.

### 150 **Case 2**

151 An 82-year-old man with an OD preoperative VA of 20/50 underwent an uneventful  
152 phacoemulsification surgery under retrobulbar block (4mL of a mixture of  
153 bupivacaine 0.75%, lidocaine 5% and hyaluronidase 150 IU). Significant PMH  
154 included hypertension and atrial fibrillation on anticoagulant treatment. In the 24-  
155 hour postoperative check, he complained of central scotoma and VA was 20/200.  
156 Funduscopy showed a cherry red spot with whitening of the perifoveal region  
157 consistent with the diagnosis of CRAO. OCT scans revealed a hyperreflective band  
158 in the inner retinal layers. After 6 months of follow-up, VA was light perception (LP)  
159 and OCT scans confirmed a progressive retinal and optic nerve atrophy.

**Case 3**

160 **Case 3**  
161 An 80-year-old woman with an OD preoperative VA of 20/50 underwent an  
162 uneventful phacoemulsification surgery under peribulbar block in her OD (6mL of a  
163 mixture of lidocaine 1%, bupivacaine 0.5% and hyaluronidase 150 IU). Significant  
164 PMH included diabetes mellitus, HTA, hypercholesterolemia, hypothyroidism, a  
165 history of coronary bypass and peripheral vascular disease, on treatment with  
166 antiplatelet drugs which were discontinued 3 days prior to the surgery. The day  
167 after the surgery she presented with a VA of hand movement (HM). Fundoscopy  
168 revealed a cherry red spot with whitening of the perifoveal region (Fig. 2),  
169 compatible with diagnosis of CRAO. A hyperreflective band in INL was present in  
170 the SD-OCT scan, consistent with the finding of PAMM. FA performed after 48h  
171 confirmed delayed perfusion of the macular region. Sequential follow-up SD-OCT  
172 scans showed progressive thinning of middle retinal layers and macular atrophy.  
173 Final VA in the OD was count fingers (CF).

**Case 4**

174 **Case 4**  
175 A 49-year-old man with preoperative VA of 20/20 in both eyes underwent an  
176 uneventful OD pterygium surgery under retrobulbar block (2.5mL of a mixture of  
177 lidocaine 2% and bupivacaine 0.75%). No significant PMH was described. On day  
178 1 he complained of decreased vision, VA was 20/200 and fundoscopy revealed  
179 whitening of the perifoveal region. SD-OCT images revealed an OD hyperreflective  
180 band in INL consistent with the diagnosis of PAMM. FA reported no ischaemia nor  
181 oedema. Carotid doppler ultrasonography and blood tests for prothrombotic factors  
182 were performed, resulting all within normal limits. Sequential follow-up SD-OCT  
183 scans showed progressive atrophy in INL and final VA was 20/200.

**Case 5**

184 **Case 5**  
185 An 83-year-old man with OD preoperative VA of 20/200 underwent an uneventful  
186 phacoemulsification surgery under peribulbar block (4mL of a mixture of  
187 bupivacaine 0.75% and lidocaine 2%). Significant PMH included hypertension,  
188 myocardial infarction and hypercholesterolemia. At the moment of the surgery, he  
189 was on antiplatelet, anticoagulant and on tamsulosin treatment. On the first  
190 postoperative review 24h after the surgery VA was HM. Fundoscopy revealed a  
191 cherry red spot with whitening of the perifoveal region. A diagnosis of CRAO was

192 made and SD-OCT revealed a hyperreflective band in INL consistent with PAMM.  
193 FA showed delayed arterial filling in the macular bundle in early phases with  
194 normal perfusion in late phases. Sequential follow-up SD-OCT scans showed  
195 progressive inner nuclear retinal atrophy layers and macular atrophy. Final VA was  
196 CF with residual permanent central scotoma.

#### 197 **Case 6**

198 A 55-year-old male underwent an uneventful OD refractive phacoemulsification  
199 surgery under peribulbar block (4mL of a mixture of bupivacaine 0.75% and  
200 lidocaine 2%). No significant PMH was described and preoperative VA was 20/20.  
201 On the first postoperative review 24h after the surgery the patient complained of  
202 central scotoma and VA was 20/50. Fundoscopy was apparently normal so an SD-  
203 OCT scan was performed revealing a hyperreflective band in the INL. Sequential  
204 follow-up SD-OCT showed persistence of the hyperreflective band, thinning of  
205 middle retinal layers and moderate macular atrophy. OCTA performed 1 month  
206 after surgery showed decreased small vessel branching of the deep capillary  
207 plexus in the OD compared to the fellow eye. After six weeks of follow-up, VA was  
208 20/20 but complained of mild decreased vision.

#### 209 **Case 7**

210 An 83-year-old woman with an OD preoperative VA of 20/100 underwent an  
211 uneventful phacoemulsification surgery under peribulbar block (6mL of a mixture of  
212 bupivacaine 0.75%, mepivacaine 2% and hyaluronidase 150 IU). Significant PMH  
213 included hypertension, acute myocardial infarction, chronic kidney failure, chronic  
214 myelocytic leukaemia, essential tremor and previous thyroidectomy and colostomy.  
215 At the moment of surgery, she was on antiplatelet treatment and bisoprolol. On the  
216 24-hour postoperative review, OD VA was 20/200 and fundoscopy revealed a  
217 subtle whitish perifoveal halo in the papillomacular bundle, with spared perfusion of  
218 the cilioretinal artery. OCT-A (SS-OCTA, Atlantis DRI, Topcon Corp, Japan) was  
219 performed revealing a markedly decreased small vessel branching of the deep  
220 capillary plexus in the OD compared to the normal left eye (OS) (Fig. 3). A  
221 hyperreflective band in the OD INL was observed in structural OCT scans. Five  
222 months after surgery, OD VA was 20/100 with a residual paracentral scotoma.

#### 223 **Case 8**

224 A 53-year-old male underwent an uneventful OD pterygium surgery under  
225 peribulbar block (4mL of a mixture of bupivacaine 0.75% + lidocaine 5% +  
226 hyaluronidase 150 IU). Preoperative OD VA was 20/20 with no remarkable PMH.  
227 The day after the surgery he complained of central scotoma and VA was reduced  
228 to 20/200. Fundoscopy revealed a cherry red spot in the OD. SD-OCT revealed a  
229 hyperreflective band in the INL consistent with the diagnosis of PAMM. Final VA  
230 was 20/200 with a residual permanent central scotoma. Sequential OCT scans  
231 showed progressive retinal atrophy over 3 months follow-up visits.

### 232 **Case 9**

233 A 68-year-old woman with an OS preoperative VA of 20/50 underwent an  
234 uneventful phacoemulsification surgery under peribulbar block (5mL of  
235 mepivacaine 2%). Significant PMH included hypertension, diabetes mellitus,  
236 hypercholesterolemia and arrhythmia (pacemaker carrier). At the moment of the  
237 surgery, she was on antiplatelet treatment with acetylsalicylic acid (100mg OD PO),  
238 atorvastatin, insulin and amiodarone. On the first postoperative review 24h after the  
239 surgery, OS VA was HM and the patient complained of no vision. Fundoscopy  
240 revealed a cherry red spot and OCT showed a hyperreflective band in the middle  
241 retinal layers. Moderate improvements in OS VA were observed during follow-up,  
242 resulting in a final VA of 20/200, a permanent central scotoma and macular atrophy  
243 on OCT scans.

244

### 245 **Discussion**

246 Unexpected postoperative severe visual loss after uneventful ocular surgery  
247 represents a rare but important concern for both the patient and the treating  
248 ophthalmologist. Postoperative retinal arterial occlusions after local anaesthesia  
249 may present with a broad spectrum of clinical patterns, from typical findings to very  
250 subtle alterations only apparent by structural OCT. This paper highlights the  
251 possible relationship between local anaesthetic blocks as a potential trigger for  
252 impaired foveal perfusion, resulting in a PAMM presentation pattern in structural  
253 OCT scans. A detailed description of preoperative clinical characteristics is  
254 presented to the ophthalmic community, as an attempt to identify predictive  
255 features in future studies to avoid this complication.



256 Different types of local anaesthesia (sub-Tenon's, peribulbar or retrobulbar) are  
257 routinely used to carry out ocular surgeries, albeit with some potential side  
258 effects.<sup>13</sup> From the local complications perspective, traditional needle blocks such  
259 as retrobulbar and peribulbar provide good analgesia and akinesia but can cause  
260 serious sight threatening complications including globe or optic nerve perforation.<sup>14</sup>  
261 Sub-Tenon's block appears as a safer anaesthetic technique for ocular  
262 procedures, providing good analgesia and akinesia without the risks derived from  
263 sharp needle use.<sup>15</sup> From the systemic complications perspective, peribulbar and  
264 retrobulbar blocks can cause major complications in cases of inadvertent injection  
265 through the optic nerve sheath such as brainstem anaesthesia, unconsciousness,  
266 severe cardiorespiratory collapse and even death.<sup>14,16</sup> Cardiovascular events have  
267 also been associated to sub-Tenon's block in some reports.<sup>15</sup>  
268 Retinal artery occlusions related to peribulbar and Sub-Tenon's blocks have been  
269 described in several publications.<sup>7-12</sup> Since the initial description of PAMM as a  
270 manifestation of retinal capillary ischaemia,<sup>2</sup> multiple series have associated this  
271 entity with several retinal vascular and systemic disorders.<sup>4</sup> The lack of adequate  
272 perfusion in the deep capillary plexus (DCP) seems to be the main cause of  
273 PAMM, as assessed by OCTA findings.<sup>3,17,18</sup> The deep capillary system is  
274 composed of an intermediate capillary plexus (ICP) and a deep capillary plexus  
275 (DCP). Anatomically, it is conceivable that the INL may receive its blood supply  
276 predominantly from the proximal ICP, whereas the OPL may receive its blood  
277 supply predominantly from the DCP.<sup>3</sup> The oxygen demand of the macula,  
278 especially at the level of the OPL and photoreceptor inner segments, is higher than  
279 any other region of the retina.<sup>19</sup> Furthermore, oxygen diffusion from the choroid to  
280 the retina is inherently limited by retinal thickness, which becomes greater  
281 parafoveally.<sup>3</sup> Taken together, the middle layers of the retina (INL and OPL) in the  
282 parafoveal region have a high-perfusion demand whose supply is limited by  
283 anatomical configuration, making these structures most vulnerable to ischaemia.<sup>3</sup>  
284 Recent reports have been directed to study the pathophysiology of retinal vascular  
285 occlusive disease.<sup>3</sup> Although retinal arterial occlusion can cause total inner retinal  
286 ischaemia involving all three plexuses, isolated PAMM lesions may appear as a  
287 result of preferential ICP and DCP ischaemia. In clinical practice, this means that

288 the transient occlusion of a large retinal arteriole with rapid restoration of normal  
289 flow could induce ischaemia in the deep stratus of the middle retina, while sparing  
290 the retinal nerve fibre and ganglion cell layers presenting as isolated PAMM. We  
291 believe that this theory may help to explain the subtle clinical pictures presented by  
292 four of our patients, with minimal clinical findings of arterial hypoperfusion on direct  
293 funduscopy examinations.

294 After a systematic literature review on potential causative mechanisms for CRAO  
295 or transient retinal artery occlusion (TRAO) after routine intraocular procedures, we  
296 suggest three hypotheses for this PAMM phenomenon observed in this series and  
297 other preliminary reports.<sup>9,10,12</sup> First, a vasoconstrictive effect of the anaesthetic  
298 agent on the central retinal artery, second, an intraocular pressure spike resulting  
299 in decreased retinal artery perfusion and, third, a mechanical effect of the volume  
300 of anaesthetic injected in the orbit compressing the optic nerve and the central  
301 retinal artery (a sort of transient acute orbital compartment syndrome-like process).  
302 Several publications addressing the effect of local anaesthesia on ocular  
303 haemodynamic have confirmed a decreased ocular blood flow during the  
304 procedure, even without vasoconstrictors.<sup>20-22</sup> These flow reductions were still  
305 present 5 minutes after peribulbar anaesthesia, when intraocular pressure returned  
306 to baseline values, supporting the theory of drug-induced vasoconstriction after  
307 peribulbar anaesthesia.<sup>22</sup> This vasoconstriction may relate to the anaesthetic drugs  
308 themselves, as bupivacaine or lidocaine have been reported to cause temporary  
309 reduction in the blood flow of the central retinal artery.<sup>22</sup> In our series, 8/9 cases  
310 received at least one of these two anaesthetic drugs, with a single case receiving  
311 only mepivacaine. None of the anaesthetic block mixtures included adrenalin or  
312 similar vasoconstrictive agents, commonly used in other local procedures  
313 elsewhere in the body. With regards to the possibility of an inadvertent  
314 intraoperative IOP spike, although it cannot be excluded, all surgeries were  
315 performed at normal infusion parameters in the phacoemulsification procedures, no  
316 particular findings were reported in pterygium surgical notes by any of the surgeons  
317 and IOP was normal at the 24h postoperative check in all nine cases. Finally, local  
318 anaesthetic blocks imply injecting a certain volume of fluid into a non-expandible  
319 compartment, and consequently, an increase of pressure in the orbit. Therefore,

320 the injection of anaesthetics into the connective tissue surrounding the optic nerve  
321 might cause a temporary compression of the central retinal artery, resulting in a  
322 transient hypoperfusion to the retinal vasculature. In our series, the anaesthetic  
323 volume injected was similar in all cases (ranging from 2.5 to 6 mL), as was the  
324 axial length of study eyes (ranging from 23.02 to 23.76 mm). We believe that all  
325 these three situations may not have been exclusive, and a combination of them  
326 may have played a role in our patients resulting in retinal ischaemia presenting as  
327 PAMM.

328 We should bear in mind that PAMM is an OCT abnormality that may herald the  
329 presence of an underlying systemic condition, as it has been associated to several  
330 retinal vascular occlusive disorders.<sup>3,4</sup> It is possible that patients with underlying  
331 cardiovascular pathologies could be more susceptible to transient compression or  
332 spasm on the retinal arterial circulation. Five of the patients included in our series  
333 had previously diagnosed cardiovascular diseases, but the rest had no previous  
334 relevant medical history which may indicate that these disorders might be a  
335 predisposing factor, but not a necessary condition for developing PAMM.

336

337 As in other surgical complication report studies, our series has limitations, as the  
338 relatively small number of cases and the retrospective design. Unfortunately, most  
339 of the cases were observed prior to the advent of OCTA. OCTA is the only image  
340 modality that can address the loss and extension of capillary perfusion specifically  
341 in the deep capillary plexus, the main stratus affected in this condition. Given its  
342 non-invasive nature, we would recommend performing OCTA imaging in all  
343 patients with unexplained visual loss in the early postoperative period after cataract  
344 surgery.

345 In conclusion, PAMM may appear secondary to local anaesthetic blocks in a broad  
346 spectrum of retinal hypoperfusion presentations, associating unexpected  
347 postoperative vision loss after uneventful ocular surgery. Increasing the awareness  
348 of this complication would lead physicians to perform OCT investigations in such  
349 cases, as no robust data are present in the literature about the incidence or  
350 prevalence of this OCT finding at the present time, and this condition may be  
351 underreported due to the absence of fundoscopic findings in the more subtle

352 cases. Until potential risk factors for this complication are identified, an empiric  
353 alternative would be to recommend topical or intracameral anaesthesia when  
354 possible in patients with known underlying vasculopathy. Future studies with larger  
355 study populations will provide new insights to identify such predictive features and  
356 inform us for better counselling in patient-doctor discussions.

357

## 358 **Acknowledgments / Disclosure**

### 359 ***Funding / Support***

360 Javier Zarranz-Ventura is a grant recipient of the Spanish Retina & Vitreous  
361 Society (Sociedad Española de Retina y Vítreo). This work was partly supported by  
362 the National Institute for Health Research Biomedical Research Centre based at  
363 Moorfields Eye Hospital National Health Service Foundation Trust and University  
364 College London Institute of Ophthalmology. The views expressed are those of the  
365 authors (Pearse A. Keane, Dawn A. Sim, Adnan Tufail) and not necessarily those  
366 of the National Health Service, the National Institutes for Health Research or the  
367 Department of Health.

### 368 ***Financial disclosures***

369 Carolina Bernal-Morales, none; Daniel Velazquez-Villoria, none; Juan Manuel  
370 Cubero-Parra has been in advisory boards, has given lectures and has received  
371 travel grants from Alcon, Allergan, Bausch & Lomb, Bayer, DORC and Novartis  
372 and has been a lecturer for Novartis and Bausch & Lomb; Pearse A. Keane acts as  
373 a consultant for Novartis, Roche, Apellis, and DeepMind, he has received speaker  
374 fees from Allergan, Bayer, Topcon, and Heidelberg Engineering and has stocks in  
375 Big Picture Eye Health. ; Dawn A. Sim no disclosures; Alfredo Adan has been in  
376 advisory boards for Abbvie and Novartis; Adnan Tufail has been in advisory boards  
377 and has given lectures for Allergan, Alimera Science, Bayer, Novartis and Roche,  
378 and has received grants from Medisoft Ltd, Notal Vision and Novartis; Javier  
379 Zarranz-Ventura has been in advisory boards, is a consultant, lecturer and has  
380 received travel grants from Alcon, Alimera Science, Allergan, Bausch & Lomb,  
381 Bayer, Brill Pharma, DORC, Novartis and Roche, is a grant holder from Allergan  
382 and Novartis, and has been a lecturer for Topcon and Zeiss.

383

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**Figure Legends:**

**Fig. 1.** Case 1. Paracentral Acute Middle Maculopathy (PAMM) is seen in the OD of a 40-year-old man 24 hours after uneventful pterygium surgery with sub-Tenon's block of lignocaine 2%, presenting with central scotoma and decreased visual acuity (3/60). Colour fundus photographs of both eyes. In the OD, a subtle perifoveal yellowish halo with a very subtle thinning of the retinal vessels is seen in the macular region, whereas OS fundoscopy is unremarkable (**a,b**). Fundus fluorescein angiography revealed a delayed arterial filling in the macular bundle of the OD in the early arterial phase (**c**), with normal perfusion in the late phase (**d**). Spectral Domain Optical Coherence Tomography (SD-OCT) shows normal reflectivity of inner retinal layers in the OS (**e**). A hyperreflective band in the inner retinal layers is observed in the OD, consistent with the diagnosis of PAMM (**f**). Six weeks after the surgery, SD-OCT reveals thinning of the inner retinal layers, with persistence of the hyperreflective band and moderate macular atrophy in the SD-OCT retinal scan (**g**).



**Fig. 2.** Case 3. Paracentral Acute Middle Maculopathy (PAMM) associated to Central Retinal Artery Occlusion (CRAO) in the OD of an 80-year-old woman with pre-existing cardiovascular disease after uneventful phacoemulsification. Colour fundus photographs of the OD (**a**) and the OS (**b**) of the patient 24 hours after the surgery in the OD. The presence of a cherry red spot with whitening of the perifoveal region and a perfused optic disc is seen in the OD (**a**). Spectral domain optical coherence tomography (SD-OCT) 24 hours post-surgery (**c,d**). A hyperreflective band is seen in the inner retinal layers of the OD (**c**), in contrast with the normal reflectivity observed in the OS (**d**). Sequential follow up SD-OCT scans were performed in the next 2-8 weeks (**e**: 2 weeks, **g**: 4 weeks, **f**: 6 weeks, **h**: 8 weeks), which showed progressive thinning of the inner retinal layers and macular atrophy 2 months after the surgery.

**Fig. 3.** Case 7. Paracentral Acute Middle Maculopathy (PAMM) in the OD of an 83-year-old woman 24 hours after routine phacoemulsification under peribulbar anaesthesia. Colour fundus photographs of the OD 24 hours after the surgery (**a**). A subtle whitish perifoveal halo is seen in the OD papillomacular bundle, with spared perfusion of the cilioretinal artery. Swept source optical coherence tomography angiography (SS-OCTA, Atlantis DRI, Topcon Corp, Japan) of the deep capillary plexus of the right eye (**b**) and the left eye (**c**) 24 hours post-surgery, with the corresponding segmentation slabs inferiorly. Note a marked decrease in the small vessel branching of the PAMM-affected right eye compared to the unaffected left eye. Swept source optical coherence tomography (SS-OCT, Atlantis DRI, Topcon Corp, Japan) of the OD revealing a hyperreflective band in the inner retinal layers (**d**) in contrast with the normal reflectivity observed in the OS (**e**).