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CASE REPORT

Prone Positioning Covid-19 Patients: A Double-Edged Sword—A Case Report of a Devastating Ocular Complication

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ABSTRACT

In the late 1970s, prone positioning was established as an efficient treatment for acute respiratory distress syndrome (ARDS). Currently, with the world facing a global health crisis due to the COVID-19 pandemic, it has become an accepted routine practice in intensive care units dealing with critically ill COVID-19 patients. Ophthalmic complications associated with the prone position are not a novelty in clinical practice. Indeed, it is estimated that in patients undergoing spine surgery, prone positioning carries a tenfold increased risk of eye injury when compared to supine and lateral positioning. The majority of these complications are treatable ocular surface disorders, but irreversible sight-threatening conditions also occur. We report a unique and dramatic case of a ruptured globe in a COVID-19 patient placed in prolonged prone position, emphasizing its difficult diagnosis and management while focusing on life-saving support.

Keywords: COVID-19; Intraocular pressure; Prone position; Ruptured globe; Scleral degenerations

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Key Summary Points

The Covid-19 pandemic has led to a surge of patients with ARDS requiring mechanical ventilation in prone position.

The benefits of prone position in respiratory outcomes are undeniable, but multiple ophthalmic complications can result from such a treatment strategy, the majority of them being benign and treatable.

To the best of our knowledge, this is the first report of a devastating globe rupture resulting from mechanical ventilation in prolonged prone position.

This case highlights the need for strong cooperation between ophthalmologists and intensivists to promote regular eye evaluations in ICU admitted patients, especially those presenting with ocular red flags, to identify more vulnerable patients, and to adopt protective preventive measures to minimize irreversible sight-threatening ocular complications.

DIGITAL FEATURES

This article is published with digital features, including a summary slide, to facilitate understanding of the article. To view digital features for this article go to https://doi.org/10.6084/m9.figshare.14725407.

INTRODUCTION

Since its first description in December 2019, coronavirus disease 2019 (COVID-19) has progressed to a pandemic and a global health emergency [1]. Patients with COVID-19 can develop acute respiratory distress syndrome (ARDS), requiring mechanical ventilation and critical care treatment, which leads to an unparalleled rise in intensive care admissions [1, 2]. The mortality rate among patients with severe ARDS can reach 60%, even with the best medical management [3].

In COVID-19-related ARDS, this value can be even higher, especially among older patients [4]. Therefore, the use of prolonged prone positioning (at least 16 h a day) in patients who fail to respond to fully optimized ventilatory support is currently a well-established treatment approach to improve oxygenation and survival rates [3]. While its benefits clearly surpass its risks, positioning patients into prone for prolonged periods may give rise to various complications, namely pressure ulcers, displaced intravenous accesses, endotracheal tube obstruction, peripheral nerve injuries, and facial and ocular disorders [5].

Numerous ophthalmic complications resulting from prone positioning have been reported in the literature. Ocular surface disorders are by far the most common, but other sight-threatening conditions including ischemic optic neuropathy, retinal vascular occlusions, elevated intraocular pressure and orbital compartment syndrome have also been described [1, 6]. Such complications have already been reported in prone-positioned patients for spine surgeries [7], but the COVID-19 pandemic has raised this concern to a new level due to the extended duration of prone positioning and the extraordinary need to adopt this practice.

Herein, we describe a case of a ruptured globe in a COVID-19 patient placed in prolonged prone position. To our knowledge, this is the first clinical case reporting such a devastating complication.

This case report complies with the guidelines for human studies and was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. The patient was informed of the delicate nature of her ocular condition and gave her consent to publish this report and accompanying images.

CASE REPORT

A 78-year-old Caucasian woman, with a past medical history of non-insulin-dependent type

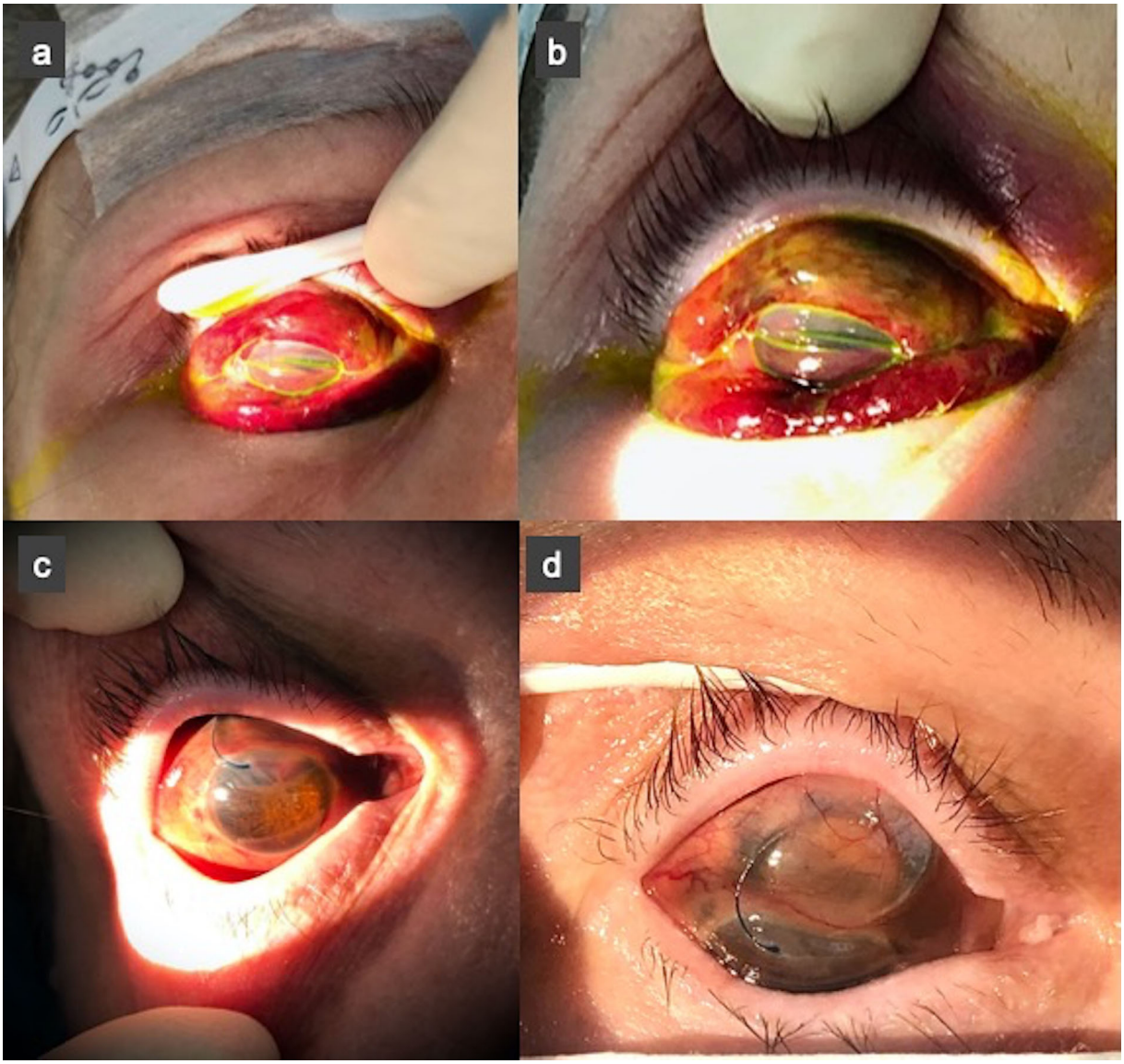

Fig. 1 Macroscopic photographs of the patient's right eye at presentation (**a**, **b**) revealing total disorganization of the anterior segment, with an extensive hemorrhagic chemosis and the presence of multiple corneal folds, suggesting globe hypotony. In the shallow anterior chamber, a superiorly deviated pupil and hyphema can be presumed. **c**, **d** After 2 weeks of treatment with lubricant drops and chloramphenicol-dexamethasone eye ointment and mechanical eyelid closure. **c** Hemorrhagic chemosis resolved, showing the presence of an exteriorized intraocular lens (IOL) haptic, over the superior bulbar conjunctiva and cornea. **d** The remainder of the IOL body is obvious in the superior subconjunctival space

2 diabetes, arterial hypertension, dyslipidemia and obesity, was admitted to the intensive care unit (ICU) of our tertiary hospital with ARDS related to COVID-19 disease, with severe hypoxemic respiratory failure, requiring mechanical ventilation in prone position.

Relevant ophthalmic antecedents included bilateral senile corticonuclear cataracts extracted by large-incision extracapsular cataract surgery 13 years before, with a remaining area of scleral thinning at the incision site, in the right eye. The patient had completed a total of three

sessions of 18-h prone-position mechanical ventilation over 4 days, by the time ophthalmological evaluation was requested because a thick subconjunctival hemorrhage was observed. There was no record of major eye trauma.

Bedside eye examination in the ICU revealed a considerable right peri-orbital edema and an extensive hemorrhagic chemosis, preventing complete eyelid closure (Fig. 1a and b). Intraocular pressure was impossible to assess, but globe hypotony was obvious by gentle digital palpation, and indirectly by the presence of multiple corneal folds. Anterior chamber structures were difficult to distinguish, but a superiorly deviated pupil and hyphema could be presumed. There was no red reflex. Left eye findings, in both the anterior and posterior segment, were unremarkable.

Upon suspicion of right globe rupture, an orbital computed tomography (CT) scan was performed. It showed a hazy and thickened eyeball outline, with internal structural disorganization, suggesting the presence of vitreous hemorrhage, and choroidal and retinal detachment (Fig. 2a). Contact B-scan ultrasonography was avoided at this time due to concern regarding iatrogenic damage.

A clinical diagnosis of occult right globe rupture was assumed.

Given the patient's severe respiratory failure even with maximum ventilatory support, disqualifying her for eye surgery under general anesthesia, an interdisciplinary decision between intensivists and ophthalmologists favored a focus on life-saving measures. Attempts to reduce the frequency of prone were hindered by worsening of the oxygen saturation levels.

Lubricant drops and chloramphenicol-dexamethasone eye ointment were prescribed along with mechanical eyelid closure with hypoallergenic tape, and eye protection with a fox shield. Simultaneously, preventive protective cushioning around the fellow left eye was adopted to minimize the risk of ocular injury.

With the resolution of conjunctival edema and hemorrhage, subsequent ophthalmological evaluations showed the presence of an exteriorized intraocular lens (IOL) haptic, over the superior bulbar conjunctiva and cornea (Fig. 1c). The remainder of the IOL body was in the superior subconjunctival space (Fig. 1d). The diagnosis of a ruptured globe became unequivocal. There was no corneal staining with fluorescein dye, or signs of infection. By this time, B-scan ultrasonography corroborated the suspicion of vitreous hemorrhage, and choroidal and total retinal detachment (Fig. 2b).

The patient's systemic condition progressively improved, and she was successfully extubated after 31 days in the ICU. Communication became possible, allowing visual acuity

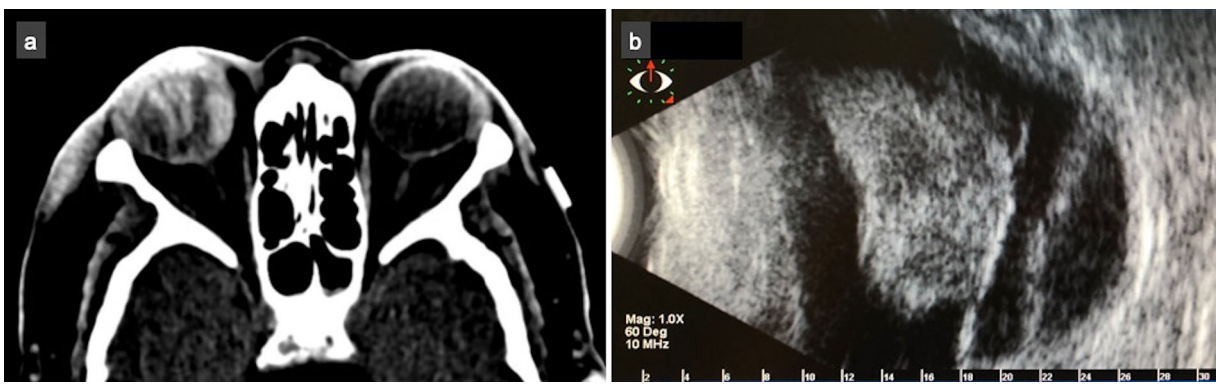

Fig. 2 **a** Orbital CT revealing an unclear anterior right eyeball contour and internal structural disorganization, suggestive of vitreous hemorrhage, and choroidal and retinal detachment. **b** B-Scan ultrasonography of the right eye, showing a central vitreous densification, and inferior choroidal and total retinal detachment

assessment. There was no light perception in the right eye, and the best-corrected visual acuity in the left was 20/25. The complex situation and the low visual potential of the right eye were explained to both the patient and her family, and the benefits and risks of the treatment and intervention options under consideration were discussed.

Consequently, ophthalmological surgery was undertaken. Following a more conservative approach, aiming to avoid a potential entry site for microorganisms, the exteriorized IOL haptic was cut, and the overlying conjunctiva was closed with an absorbable Vicryl 8-0 suture. After the procedure, the patient continued receiving antibiotic + corticosteroid ointment and drops.

After 55 days in the ICU, and able to maintain adequate oxygen saturation on room air, she was admitted to an inpatient rehabilitation care unit, where ophthalmological evaluations have been taking place regularly. One week after surgery, the patient was emotionally well and reported no pain. At the slit-lamp examination, the conjunctival suture was stable and there were no signs of infection. One month postoperatively, the Vicryl suture reabsorbed, and the remainder of the IOL haptic was fully covered by healthy conjunctiva (Fig. 3a and b).

DISCUSSION

Critically ill COVID-19 patients placed in the prone position are susceptible to ocular complications. These complications can be sight-threatening and their best management hampered by a focus on life-saving care [6]. Herein we describe the devastating case of a ruptured globe in a 78-year-old female COVID-19 patient, undergoing prone mechanical ventilation in an ICU bed.

Globe rupture occurs secondarily to a sudden increase in intraocular pressure and ensuing inside-out force that results in an open wound injury [8]. The site of rupture is usually where

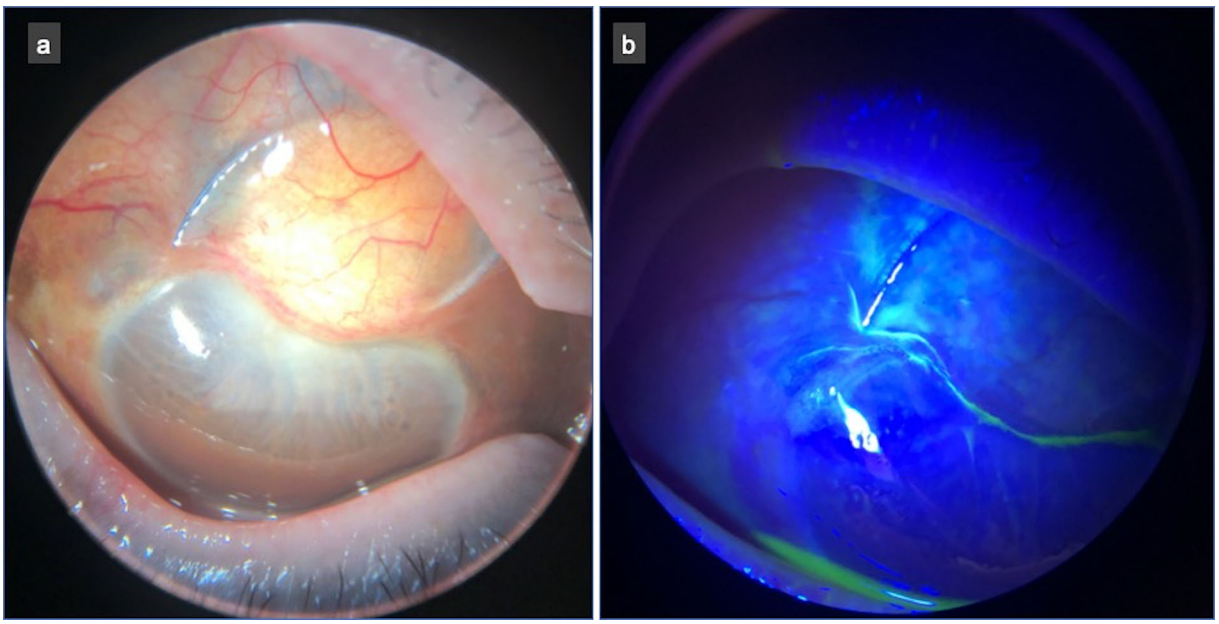

Fig. 3 **a** Slit-lamp photograph of the patient's right eye 1 month after the surgery. Conjunctival Vicryl suture reabsorbed, and the remainder of the IOL haptic remained in the subconjunctival space, with no contact with the corneal epithelium. **b** Slit-lamp photograph of the same eye, at the same time, with cobalt blue light after fluorescein dye, showing no corneal or conjunctival staining

the eyeball wall is weakest, for example, sites of previous eye surgery or damage by ocular exposure [9, 10]. In our case, there were no exposure lesions, but an anatomical risk factor was present, as the patient had undergone large-incision cataract removal, with an obvious area of scleral fragility.

The prone position is associated with elevated intraocular pressure, and that increase correlates with the duration of the prone period, as demonstrated by Saran et al. [11]. The exact mechanism underlying this elevation remains uncertain, but the gravitational effect leading to increased orbital venous pressure, the subsequent periorbital edema, and direct compression on the eye are reliable explanations. This is further exacerbated by positive-pressure ventilation that compromises orbital venous return, as well as high intra-abdominal pressure in obese critically ill patients frequently under fluid replacement therapy, as was indeed the case [1, 6]. Since reduction of prone positioning time is not always feasible in critically ill patients, regular eye assessments by trained intensivists and nurses, both before and during prone, should be undertaken to avoid ocular injuries. It is critical to ensure that the ocular surface is well lubricated and eyelids closed, and that no direct pressure is being put on the eyes [1]. Alternate face turns are advised to frequently switch the dependent eye, and eye protection with silicone pads or fox shields can reduce the risk of ocular compression [6].

We postulate that, in our patient, the potential increase in intraocular pressure during prolonged prone positioning, in an anatomically predisposed eye, dramatically culminated in a ruptured globe.

CONCLUSION

Although rare, reports of devastating sight-threatening ocular complications can potentially increase due to the impressive surge of patients requiring intensive critical care during the COVID-19 pandemic [1]. To the best of our knowledge, this case describes the first ruptured globe during mechanical ventilation in prone position reported in the literature.

We highlight the need for strong cooperation between ophthalmologists and intensivists to promote regular eye evaluations in ICU admitted patients, especially those who present with red flags such as refractory chemosis, eye redness or discharge, lagophthalmos, and corneal opacities [1]. Furthermore, the identification of more vulnerable patients, and the adoption of the protective preventive measures mentioned above, can be crucial to minimize irreversible sight-threatening ocular complications.

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Compliance with ethics guidelines. This case report complies with the guidelines for human studies and was conducted ethically in

accordance with the World Medical Association Declaration of Helsinki. The patient was informed of the delicate nature of her ocular condition and gave her consent to publish this report and any accompanying images.

Data availability. Data sharing is not applicable to this article as no datasets were generated or analyzed for this article.

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