

Intraoperative Cardiovascular Instability in a Child Following Instillation of Phenylephrine Eye Drops

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ARTICLE INFO	ABSTRACT
<p>Article type: Case Report</p> <hr/> <p>Article History: Received: 11-Dec-2020 Accepted: 16-Jun-2021</p> <hr/> <p>Key words: Anaesthesia, Ophthalmic surgery, Paediatrics, Patient Safety.</p>	<p>Introduction: The use of topical mydriatics is well described in ophthalmic surgery, one of these being phenylephrine eye drops which are available in 1%, 2.5% and 10% solutions. They are classically used to improve operating conditions but there have been recurrent concerns regarding serious adverse reactions as a direct consequence of systemic absorption.</p> <p>Case Reports: We present the case of a 10-year-old boy who presented for eyelid laceration repair and examination under general anaesthesia of the eye, after a severe dog bite injury. Shortly after instillation of 10% phenylephrine eye drops, the anaesthetist noticed a sudden bradycardia associated with profound hypertension. Surgery was temporarily stopped, volatile anaesthetic reduced and atropine boluses administered. Within minutes, blood pressure and heart rate normalized. The administration of the eye drops was determined to be the cause of this haemodynamic instability.</p> <p>Conclusion: A brief literature review has enabled us to raise awareness within our department regarding this important safety concern in paediatric ophthalmic surgery, in addition to exploring management options in the case of inadvertent intravascular absorption.</p>
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Introduction

The use of topical mydriatics is well described in ophthalmic surgery, one of these being phenylephrine eye drops which are available in 1%, 2.5% and 10% solutions. They are classically used to improve operating conditions but there have been recurrent concerns regarding serious adverse reactions as a direct consequence of systemic absorption.

Case Report

A 10-year-old 30kg previously fit and well ASA 1 male patient, presented out of hours following a dog bite injury to the left eyelid and face. He was listed for emergency theatre for examination under anaesthesia and eyelid laceration repair. He had no history of atopy or allergy. Following an uneventful gaseous induction in theatre with sevoflurane in oxygen and routine monitoring attached, intravenous access was secured with a 22-gauge cannula. He was then given 0.5mg/kg Rocuronium, 1mg/kg Propofol and 1mcg/kg Fentanyl. Towards the end of the case, he was also given 0.15mg/kg ondansetron and 0.05mg/kg morphine. A size 6 South Facing RAE tube was inserted uneventfully, after which anaesthesia was maintained with Isoflurane in air and oxygen. Unknown to the anaesthetist, the ophthalmic surgeon had administered 0.5ml total 10% phenylephrine drops to explore and subsequently repair a co-existing canicular laceration. There had been no traction on the eye at the time, nor over or under-depth of anaesthesia. Shortly after this, our patient became bradycardic and significantly hypertensive, with a heart rate of 50 beats per minute and maximum blood pressure 160/75 mmHg. Surgery was temporarily paused, atropine boluses administered to a maximum of 500mcg, and depth of anaesthesia lightened prior to deepening once atropine had been effective. Within 10 minutes, heart rate had begun to normalize, shortly followed by blood pressure. Heart rate remained in sinus throughout, with no ventilatory changes. By 30 minutes, there remained no evidence of eyelid swelling, conjunctival redness or other signs of an acute contact hypersensitivity reaction.

Our patient was extubated awake at the end of the case, with no cardiovascular, respiratory or neurological sequelae.

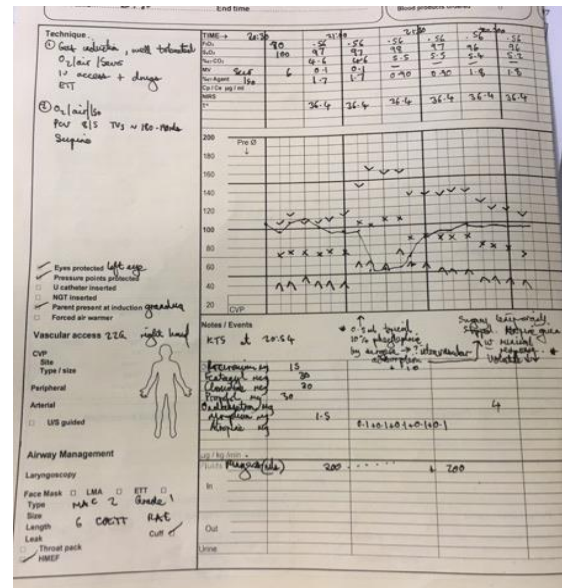


Fig 1: Anaesthetic chart demonstrating sequence of events following inadvertent intravascular absorption of Phenylephrine eye drops 10%

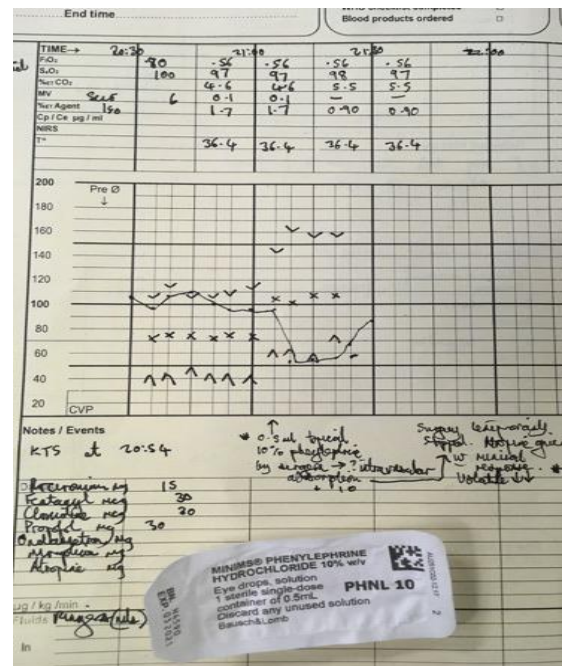


Fig 2: The above included the offending packet of Phenylephrine eye drops 10%

Discussion

Phenylephrine is an alpha 1 adrenergic agonist, causing cycloplegia free mydriasis by direct action upon the pupillary dilator alpha adrenergic receptors (1). When applied topically to the eye, it bypasses first-

pass metabolism and hence is directly systemically absorbed (2). As a consequence of this, and its action on Beta receptors at high doses, a profound vagal bradycardic, hypertensive response may be seen in addition to the alpha agonist induced rise in peripheral vascular resistance (3). Additionally, there are multiple reports in the literature of further cardiovascular instability following inadvertent systemic absorption of phenylephrine. These include ventricular arrhythmias, myocardial infarction, dyskinesias, mitral valve regurgitation, pulmonary oedema, raised pulmonary arterial pressures and even subarachnoid haemorrhage and cardiac arrest (4-6). Most systemic effects of topical medications are dose-related. In our patient, 10% phenylephrine had been inadvertently stocked and subsequently instilled, which with a total of 0.5ml equates to 50mg (i.e. over dosage). Further evidence of complications with phenylephrine were reported in a recent retrospective cohort study of 187 paediatric patients in Italy, where major complications from topical use were seen in 2.1% of patients (7). The FDA (Food and Drug Administration) in the United States of America have issued the following advice regarding 10% phenylephrine eye drops (8): "Serious cardiovascular reactions with 10% strength: Reactions have included ventricular arrhythmias and some have been fatal. Monitor blood pressure in patients with cardiovascular disease. Significant elevations in blood pressure: caution in paediatric patients less than 5 years of age" The United Kingdom appears to go one step further- 10% being contraindicated in both paediatrics and the elderly due to increased risks of systemic toxicity in the Minims patient information leaflet (9). The Central Mersey Diabetic Retinopathy Screening programme is similarly conservative. After a literature review, they currently only permit 1 drop of 2.5% phenylephrine if Tropicamide 1% has provided inadequate mydriasis. In this case, it excludes children below 12 years old, and elderly patients over 80 years (10).

Treatment of inadvertent intravascular absorption is largely based on prevention, which includes using minimal concentration

of phenylephrine drops (if necessary), discussion with the anaesthetist prior to application, wiping excess drops after administration, avoiding immediate 'knife to skin' following administration, and applying digital pressure to the lacrimal punctus for at least one minute to minimize drug entry into the nasolacrimal passage (11).

Fortunately, phenylephrine has a short duration of action and as such many hypertensive and tachy or bradycardias may resolve spontaneously. Treatment with beta or calcium channel blockade is not advised due to their potential to further worsen cardiac output. Safer options for treatment following a pause in surgery, include increasing depth of anaesthesia (if suitable), alpha receptor antagonists or direct vasodilators (7,11) such as magnesium sulphate. Following on from this event, we proceeded to liaise with the ophthalmic surgical lead, pharmacy and our anaesthetic department to highlight this as a patient safety issue. We are aiming to remove 10% solution from our stocks and instead replace with the safer 2.5% solution. We have also discussed with our lead for ophthalmic surgery regarding encouraging use of safer topical alternatives to phenylephrine when clinically suitable. Additionally, we are distributing a circular to all ophthalmic surgeons to communicate with the anaesthetist prior to application of any phenylephrine eye drops, and education among our anaesthetic colleagues on how to manage inadvertent systemic absorption of this drug.

Conclusion

This case report presents a very important patient safety issue regarding the use of phenylephrine eye drops in ophthalmic surgery and the potential catastrophic consequences of intravascular absorption. We have highlighted ways in which these risks can be minimised.

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