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Review Article

Cannula Detachment – an avoidable complication with significant harm and health economic costs, and a suggested solution

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Abstract

Purpose: Cataract surgery is an inherently safe procedure. The use of Luer lock syringes is standard practice however, despite that ocular harm is still occurring due to the cannula shooting off the end of the syringe into the eye, damaging ocular structures and resulting in visual loss or even blindness. We discuss the issue, review the published data, and suggest a simple solution.

Methods: Review of the literature and discussion of potential solution.

Results: This has been reported extensively in the literature and has been the subject of two recent safety alerts by the Royal College of Ophthalmologists in England. There are significant health economic costs associated with this issue. Based on published data and the incidence estimates derived from survey data, applying US litigation rates conservatively and reducing by 80% to account for international variation, litigation costs alone may exceed $418M per year worldwide. Additional costs from managing complications such as posterior capsule rupture are estimated at approximately $254M per year globally. These figures are likely significant underestimates given the well-recognised under-reporting of this complication.

Conclusion: There is a fundamental need for a simple, cheap and effective solution which is described. The issue is reviewed and a safe, cheap and easily manufactured solution which should potentially be adopted by all intraocular surgery providers to abolish this cause of avoidable harm is suggested. Viscoelastic providers and surgical pack providers are encouraged to utilise or develop a safety device to prevent this complication.

Introduction

Cataract surgery is one of the most commonly carried out operations in the world. It is inherently safe and outcomes are generally good. Numerous syringes and cannulae are utilised for the procedure with injections of balanced salt solution, viscoelastic devices, antibiotics and other agents. The use of Luer lock syringes is standard practice however, despite that ocular harm is still occurring. This is a result of the cannula shooting off the end of the syringe into the eye, damaging ocular structures and resulting in visual loss or even blindness in what should be a routine procedure. When injecting, we generate substantial hydraulic force as we push a large volume of liquid through a fine lumen. If the cannula is not properly and firmly attached to the syringe it can fly off with significant force and speed resulting in damage. This can happen during any medical procedure however the harm is minimal if the

tip of the needle/cannula is firmly held by the tissue it rests in. In intraocular surgery the tip of the cannula is sitting within liquid in the anterior chamber or posterior segment of the eye with no resistance to forceful forward movement.

This issue has been reported extensively in the literature and has been the subject of two recent safety alerts by the Royal College of Ophthalmologists in England [1]. The most recent safety alert states: "The NHS Improvement national patient safety team have informed the College of the continued trend of incidents involving issues with detachment of cannulas during ophthalmic surgery (cannula-associated ocular injury, COI)." It can occur for three possible reasons; not fully tightening the cannula onto the Luer lock syringe, a fault in the manufacture of the syringe and the screw moulding, or mis-threading of the cannula into the Luer lock mechanism. Unfortunately, it is likely that the first reason is the culprit in most circumstances and it is due to human error which cannot be completely abolished. Education and alerts have so far failed to prevent the complication.

The harm can range from a simple angle bleed or iris damage, through posterior capsule rupture to retinal damage and retinal detachment [2-9]. The consequences can be blinding, even potentially resulting in loss of the eye from ensuing complications, and it is completely avoidable and potentially indefensible. It usually occurs in a routine procedure and takes patients from a visual outcome of 6/6 to potential, although thankfully rare, no light perception (NPL) or even evisceration outcome. It is a well-recognised and well described phenomenon which has escaped appropriate recognition and a solution for decades. Estimates of incidence vary at between 0.009-0.07% [8,9].

A recent survey facilitated by the United Kingdom and Ireland Society of Cataract and Refractive Surgeons (UKISCRS) found that this happens quite frequently [10]. Five hundred and fifty-five eye surgeons responded. Eighty four percent of respondents had experienced detachment of the cannula during an intraocular procedure, 78.04% of respondents had seen episodes of harm due to this complication, 50.37% of respondents indicated that the last time a cannula detachment occurred there was ocular damage. Approximately 23% indicated that a cannula detachment occurred on average once per year, in 38.43% it occurred on average twice per year, 15.66% responded that it occurred three times per year while 6.92% stated that it occurred four or more times per year. Eighty seven percent felt that better cannula design or a safety device was required to prevent further occurrences.

In the vast majority of instances, the harm will be minimal and potentially not even documented in the clinical record or mentioned to the patient. For example, a small iris or angle bleed may settle rapidly and not cause any morbidity however the harm can be severe and there is a 'Russian Roulette' of avoidable harm clearly occurring daily in our work. Data from 2015 [11] suggests that there were 232,866 ophthalmologists worldwide so it would be reasonable to assume circa 250,000 currently.

Assuming this number of ophthalmologists and utilising the results from the Journal of Cataract and Refractive Surgeons survey, if 22.95% of these surgeons experience a cannula dislocation once per year, then it occurs 57,375 times per year. If we include the numbers for those who experience it even more frequently, this results in an estimated 436,175 instances per year. Further, if clinicians acknowledge that harm is observed in 50% of cases, then avoidable ocular harm occurs in almost 218,000 cases per year worldwide. Most of this harm will be minimal/mild and will not result in litigation. There is currently no data to help us determine and precisely quantify the severity of the ocular harm that is occurring. Most will be minimal harm however a significant proportion would involve posterior capsule rupture (PCR) and in severe cases it will involve blindness or even loss of the eye.

Average compensation claims in the US for ocular injury are between $9,000 and $40,000 for moderate loss and between $50,000 and $300,000 for blindness in one eye [12]. Lawyer/solicitor fees and expenses are paid on top of these settlements and typically add 40% on to the total payout with defendant solicitor fees matching those of plaintiffs. Therefore, for a blindness claim the average payout will be circa $175,000. If the Plaintiff gets this amount, then the legal fees for the Plaintiff and Defendant will be circa $116,667 for each. This means overall litigation costs for one case of blindness due to the cannula detachment is $408,334. Furthermore, for moderate visual loss claims the average payout is $24,500. If the Plaintiff gets this amount, then the legal fees for the Plaintiff and Defendant will be circa $16,333 for each. This means overall litigation costs for one case of mild to moderate visual loss due to the cannula detachment is $57,166 [13].

Taking a conservative view, if we assume that only 1% will result in significant loss of vision and only 10% result in lesser visual loss enough to trigger litigation, then the costs will be significant. Assuming 1% of cases result in significant visual loss (2,187 cases per year) then the legal fees would be $890M per year. Assuming 10% suffer some degree of visual loss (21,870 cases) due to this complication then $1200M in legal fees are paid out annually worldwide to compensate harmed patients. These estimations are based on US litigation fees and costs and, due to differences in legal systems and legal costs, the true worldwide figure is likely significantly lower than this however even reducing these costs by 80% the worldwide health economy costs are potentially $418M per year. Thus even with conservative estimates in excess of $418M per year worldwide is wasted on legal fees due to this avoidable complication. There is also a cost in managing the complications of this issue and time lost due to time off work due to the visual loss and the economic impact therein.

The most common significant complication of the cannula dislocating is PCR costing an additional average of $4,663 to treat per patient [14]. Assuming that 25% of cases of harm is in the form of posterior capsule rupture (PCR), then there would be 54,500 cases of PCR per year worldwide caused by this complication resulting in an additional, and avoidable, annual healthcare spend of $254M.

These estimates are illustrative and intended to demonstrate potential order of magnitude rather than precise economic burden.

A survey in Eye News [15] in the UK questioned the readership as to whom was to blame for this complication. Almost half of respondents laid the blame at the foot of the surgeon and indeed there is a medicolegal 'captain of the ship' argument that it is the surgeon who is in overall control of the procedure. The scrub practitioner does no harm to the patient themselves even if they do not screw the cannula on properly, but it is the surgeon putting that cannula into the eye that causes the harm. We have a duty of care to ensure that all the equipment and devices we use are safe and fit for purpose. A paper published in Eye entitled 'Iatrogenic cannula-associated ocular injuries during anterior segment surgery: time to re-think luer-lock design?' [16] suggested:

"Simple statements that luer-locks never fail will not avoid future harm if human performance shortfalls cannot be eliminated from every possible step. The safest way to do this is at the manufacturing stage by moulding one-piece cannula-syringe devices, where syringe and cannula hub are moulded together eliminating the possibility of detachment by force or inadequate tightening." This is not financially feasible as it would be costly, and every syringe size would need to be catered for. This issue has been highlighted by a paper as far back as 2012 in the Canadian Journal of Ophthalmology [17]. They found that: "Despite the use of Luer locks, 60 cases of cannula detachment were reported; 196 respondents experienced this complication, and the most common cause of cannula detachment was stromal hydration (50%). Hydrodissection and viscoelastic were experienced by 18% and 17%, respectively. No severe damage resulted in most cases (76 cases), but some serious complications were reported: retinal damage (9%) and vitreous loss (17%)."

A recent study looked at the timing of PCR during the cataract procedure at Moorfields Eye Hospital [18]. They found that in 1% the PCR occurred during stromal hydration. This is almost the final step of the cataract procedure and therefore can only have occurred due to cannula detachment. If 1% of our most common surgical complication of cataract surgery is occurring due to this phenomenon then it is occurring more frequently than the literature would suggest. The significance of this patient safety concern has been formally recognised at regulatory level. In the United Kingdom, a formal patient safety concern submission has been logged with the Medicines and Healthcare products Regulatory Agency (MHRA), reference 39490299 (May 2026). The French national competent authority (ANSM) has confirmed the matter has been incorporated into their active market surveillance activities. These regulatory developments reflect growing institutional recognition of the structural nature of the risk. Furthermore, any solution to the cannula detachment problem would ideally also address the mandatory syringe labelling requirements of ISO 26825:2020, which requires clear drug identification labelling on syringes used in ophthalmic surgical procedures to minimise the risk of medication error. An integrated solution addressing both cannula retention and syringe identification simultaneously therefore carries a dual patient safety benefit.

For 19 years since substantive publications on this issue emerged, there has been no solution available and from a medico-legal perspective, it is indefensible. As shown in the Canadian Journal of Ophthalmology paper, this most commonly occurs during stromal hydration, which is likely at the end of an otherwise uncomplicated procedure taking a patient from a perfect outcome to potential blindness in an instant. Some viscoelastic suppliers have adopted a screw cap that goes over the cannula and screws to the body of the syringe. While this is a welcome acknowledgement of the issue, and the manufacturer should be commended for trying to address the problem, it is not feasible for all the other cannulas used during the procedure and indeed, as shown above, the viscoelastic is not the main culprit but instead stromal hydration from a Luer lock syringe of volume ranging between 2-5ml.

The screw cap represents a reasonable and commendable interim measure where it is applicable. However, ideally a solution should be applicable to all the syringes used during the procedure, particularly for the high-risk stromal hydration step where the viscoelastic is not involved. Assuming screw caps (weighing 2 grams each) were adopted universally for every case worldwide, and assuming 24 million cataract procedures annually, it would mean 48 tonnes extra plastic wastage per year. If a screw cap solution were adopted for the additional 5 cannulae/syringes used during our cataract surgery, then it would mean a staggering extra 288 tonnes of plastic wastage every year worldwide. This is not consistent with the moves to maximise the eco-credentials of our practice. Any form of plastic solution involving arms, clips or other solutions will have the same environmental implications.

It is clear that patients are coming to avoidable harm, there is strong evidence that the problem is occurring regularly with patients coming to varying degrees of morbidity including potential blindness, current safety protocols are ineffective, and current solutions only address the viscoelastic cannula which is not the major cause of harm. There are also significant health economic costs to this complication in addition to the risk of avoidable visual loss to patients. We are currently using syringes and cannulas with a known risk, and we need a solution which is cheap, easy to apply to all our syringes, fast to use, and effective. We and our hospitals have a duty of care to minimise the risk to our patients. It is important for viscoelastic manufacturers and phaco pack providers to engage in safety work to try and remedy the situation which I believe they are. One issue they face is the lack of reporting. If a syringe or cannula malfunctioned or fell apart during a procedure this would immediately be reported to the manufacturer and raised with a regulatory body as a device flaw. When the junction between the syringe and cannula fails it is seen to be a simple misfortune and "one of those things".

We simply assume that the scrub practitioner simply did not tighten the cannula enough and it goes unreported leading to a significant underestimation and lack of awareness of the issue. Indeed, patients may not even realise that their complication was due to this issue and accept their visual loss as a normal consequence of complicated surgery. These complications, and the visual loss that ensues, occur not in complex patients who have a heightened material risk of harm, but instead in routine cases who would otherwise achieve an excellent outcome from their surgery.

Industry partners, including viscoelastic manufacturers and phaco pack providers, are well placed to address the interface risk at the syringe-cannula junction, and some have already begun to do so. This is an area where collaborative engagement between clinicians, manufacturers, and regulatory bodies can make a meaningful difference to patient outcomes.

Eighty percent of respondents to the Journal of Cataract and Refractive Surgeons survey [19] expressed a wish for a safety device. Any such safety device has to be cheap as it would create an unacceptable burden on healthcare providers to escalate costs per case significantly. Working with manufacturers we have developed an adhesive sheet-based solution to the issue. A solution such as this, or another one which is developed, should ideally become compulsory for all intraocular procedures worldwide. The potential safety device consists of a piece of sterile medical tape with an orifice in it. The cannula is attached to the Luer lock syringe as per usual practice and then the cannula is passed through the hole in the tape. The ends of the tape are then secured to the sides of the syringe thus rendering it safe. It also has the benefit that it will incorporate labelling which will minimise the risk of medication error and thus will have a dual patient safety role. If the cannula does detach it cannot shoot into the eye and thus harm and visual loss is avoided. Viscoelastic providers and consumable pack providers have a rare opportunity to abolish an endemic and ongoing complication.

Figure 1 shows the application of the tape. The tape is lifted from the sheet and the hole exposed. The cannula is then passed through the hole ensuring that fingers are kept clear. The clear adhesive legs of the tape are simply attached to the body of the syringe. It can be applied to any syringe size and utilised with any cannula or needle.

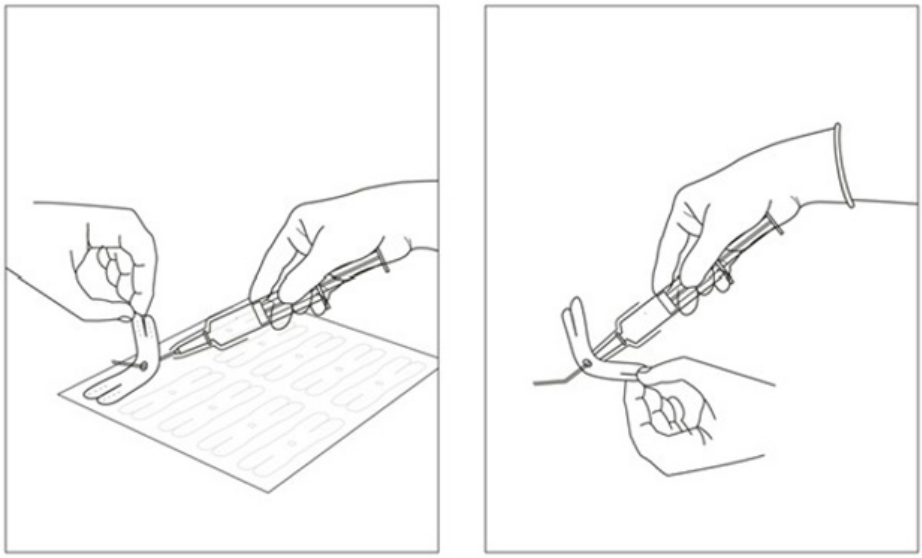

Figure 1: The safety sleeve tape is lifted from the sheet and then the cannula tip safely passed through. The clear adhesive ends of the tape are then attached to the sides of the syringe.

It is applied by the scrub practitioner as part of their preparations before the case commences and takes a moment to apply to the syringes and therefore, importantly, it does not increase surgical time or involve the operating surgeon at all. It is easily removed and does not increase the plastic wastage related to our surgeries. Ideally security of the syringe/cannula complex should form part of the surgical safety checklist. In line with questioning about the sterility of the equipment, it would be reasonable to add an additional question "are the cannulae secure?".

The use of a safety device will abolish this complication, have significant health economy benefits, lower litigation costs, remove the finger of blame on the surgeon and scrub practitioner for poor surgical practice, and, most importantly, prevent avoidable visual loss in patients who would have otherwise achieved a perfect surgical outcome.

With such a simple, cheap and effective safety solution available, or any alternative which is developed by viscoelastic or consumables manufacturers, adoption should be considered as a matter of good clinical and risk management practice for all intraocular surgery providers. The safety of our patients has to be paramount, and a solution such as this one presented or something similar should be adopted as a matter of routine.

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None.

Competing Interests

The author declares a potential commercial interest in this area. In response to the patient safety concern identified through many years of clinical and medicolegal practice, the author has been working to develop the safety device described as a commercial product. No financial benefit has been received to date and no formal commercial agreement is in place at the time of submission.

Author Contributions

Sole work of corresponding author.

Ethics Approval

Not needed.

Consent to Participate

Not needed.

Consent to Publish

Not applicable.

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