Commentary: Iatrogenic retinal breaks secondary to jet stream injury

We thank the authors for presenting an interesting case series of jet stream injury-related iatrogenic retinal breaks following vitreous surgery.[1] The authors in their case series have presented various reasons for the development of such kinds of iatrogenic retinal breaks and possible maneuvers for preventing them. In this commentary, we put forth some interesting theories for the development of jet stream-related iatrogenic retinal breaks.

Pressure is defined as the force per unit area. Hence, in a flowing fluid, pressure of the flow would change directly with a change in force with which it is injected and inversely with the surface area of the cannula through which it is flowing.[2] Jet stream injury-related iatrogenic retinal breaks can occur due to a mismatch in the inflow–outflow pressures or while injecting surgical adjuvants with increased pressure.[3,4] The newer generation vitrectomy machines have refined the pressure control system to stabilize intraoperative pressure compensation and maintain constant intraocular pressure (IOP) independent of aspiration flow rates during cutting/aspiration modes.[7,8] The infusion pressure is increased as close to real-time as possible to allow rapid infusion pressure changes required to be instituted. Extraordinary flow rates are achieved if instruments are taken off from the ports or ports are non-valved. The sudden drop in IOP alerts the IOP control system, which automatically increases the inflow, resulting in rapidly evolving fountain effect from the ports. As previously described, the fluid pressure is higher when it flows through a smaller surface area. Thus, the newer and smaller gauge 25G or 27G systems are more likely to cause jet stream injury-related iatrogenic retinal breaks. Hence, the inflow–outflow mismatch can be more serious while performing air–fluid exchange through 25G or 27G system using active aspiration or when the sclerotomy port is left open. Air outflow can be extremely high under these circumstances, whereas fluid inflow is low by comparison. This leads to a sudden, but transient hypotony, activating the IOP compensation mechanism leading to a dramatic increase in the inflow that can cause a mechanical injury to the retina at the diagonally opposite quadrant of the infusion port where the fluid jet falls. Also, while injecting surgical adjuvants such as perfluorocarbon liquid (PFCL), brilliant blue G (BBG), intravitreal triamcinolone (IVTA), or intraocular antibiotics during vitreous surgery, one should be aware of the pressure with which these agents are injected inside the eyeball. The impact of damage is the maximum when distance between the retinal surface and tip of the cannula is minimum. Thin atrophic retina can give away more easily developing an iatrogenic retinal break.

To summarize, after understanding the various mechanisms that can cause the jet stream injury-related iatrogenic retinal breaks, we suggest a few practical tips during surgery to prevent these iatrogenic retinal breaks.

These include:
A. Using valved cannulas or plugs to close the sclerotomy ports while removing instruments to prevent sudden hypotony.
B. Active aspiration while performing fluid–air exchange should be done in a controlled manner to prevent hypotony.
C. Injection of surgical adjuvants such as BBG, IVTA, or PFCL should be slowly done manually with low injection pressure or using an automated infusion system.
D. Keeping tip of the injecting cannula away from the retinal surface and directing it away from the macula and fovea.
E. While replacing the air with fluid, avoid sudden escape of air and thereby sudden hypotony. Using a 30-gauge needle placed at the sclerotomy port helps in allowing the air to escape in a slow and controlled fashion, thus preventing sudden hypotony.

F. One can also increase the fluid infusion pressure slowly in a graded manner to prevent sudden increased pressure.

G. Alternatively, one can also use the flute needle to interrupt the path of flow through the infusion cannula into the vitreous cavity and thus reduce its impact on the retinal surface.

Intraoperative management of these iatrogenic retinal breaks secondary to jet stream mechanism involves endolaser to the retinal break (in case of extrafoveal retinal breaks) and use of tamponading agents.

In conclusion, jet stream injury-related iatrogenic retinal breaks can have adverse impact on outcomes. Minor changes in the surgical technique especially while doing air–fluid exchange and while injecting surgical adjuvants can reduce the incidence of these unwanted, vision-threatening accidents.

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