Quantification of droplet aerosol generation during cataract surgery and pars plana vitrectomy

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AIMS:

This study aims to quantify the number of droplet-aerosols sized between 0.12-8.00µm that are generated during phacoemulsification cataract surgery in human cadaveric eyes, using 2.2mm and 2.75mm incisions, and aerosol production during the different steps of 23-gauge pars plana vitrectomy(PPV).

METHODS:

A printed optical particle spectrometer was used to measure droplet-aerosol generation during phacoemulsification surgery on human cadaveric eyes with either 2.2mm or 2.75mm main incision; both with and without usage of hydroxypropyl methylcellulose(HPMC) and during various stages of 23-gauge PPV.

RESULTS:

Compared to 2.2mm incisions without HPMC, the mean particle number concentration (PNC) and particle size generated are much higher with 2.75mm incisions without HPMC. The mean PNC and the number of droplet-aerosols greater than 1 micron in size, reduce when HPMC is used. The maximum measured mean PNC without HPMC was 88/cm^3 which reduced to 66/ cm^3 with HPMC using 2.2mm corneal incisions ($P<0.05$). With 2.75mm corneal incisions the maximum measured mean PNC without HPMC was 493/cm^3 which reduced to 61/cm^3 with HPMC ($P<0.05$). No droplet-aerosol generation was detected during PPV apart from during air infusion through a leaking trocar valve (mean PNC of 123/cm^3).



Fig 1. Cadaveric eye in model head with POPS probe in position for droplet aerosol detection

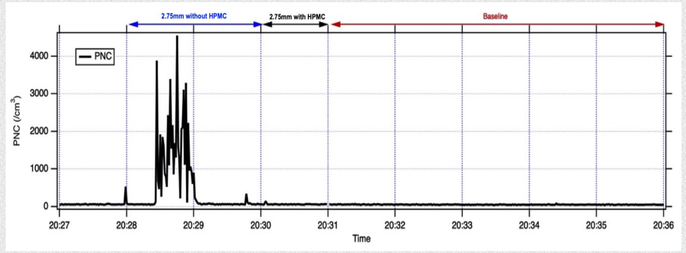


Fig 2. Increase in detected PNC during 2.75mm incision phacoemulsification without HPMC in a cadaveric eye which is reduced on application of HPMC

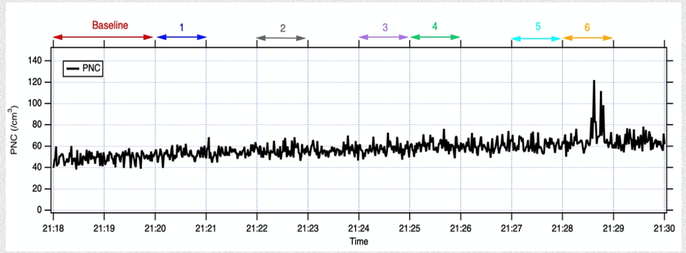


Fig 3. Increase in detected PNC during stage air exchange through a leaking trocar valve in a cadaveric eye

WHAT IS KNOWN:

1. Phacoemulsification surgery produces droplet aerosol in model and porcine/sheep eyes.
2. 2.2mm incision phacoemulsification surgery produces lower levels of droplet aerosol compared to 2.75mm incision phacoemulsification surgery.
3. Droplet aerosol production during phacoemulsification surgery can be reduced by coating corneal incisions with HPMC.

WHAT THIS STUDY ADDS:

1. Phacoemulsification surgery produces droplet aerosols in cadaveric human eyes.
2. Droplet aerosols may be generated during vitrectomy surgery during air infusion, in the setting of a leaking trocar valve.
3. High sensitivity optical particle detectors are very useful for measuring the number and size of droplet aerosols that are generated during intraocular surgery and may detect smaller droplets which are not detected by visual means.

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