APPLANATION TONOMETRY USING ONE DROP OF AN ANAESTHETIC-FLUORESCEIN MIXTURE*

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THE Goldmann applanation tonometer (1954), as modified by Goldmann and Schmidt (1957), is becoming the standard instrument for measuring the intra-ocular pressure. The accepted method of preparing the eye for a pressure reading is to anaesthetize the cornea and then to stain the pre-corneal film with fluorescein (Duke-Elder, 1962). The disadvantage of this method is that it requires two manœuvres which are frequently carried out in the dark-room under inadequate illumination. This paper introduces a method of anaesthetizing the cornea and staining the pre-corneal film with fluorescein using one drop combining the two agents (Fenton, 1964).

The problem was twofold. First, to find an anaesthetic which would mix with a fluorescein solution. Secondly, to ensure that the final concentration of the two constituents was adequate for their respective functions.

Experimental Work

Various local anaesthetic substances were investigated.

The Mixtures.—A 0.5 per cent. solution of fluorescein was made up according to the following prescription: fluorescein sodium, 0.5 per cent.; phenylmercuric nitrate, 0.004 per cent.; aqua dist. ad 100 per cent.

One part of this solution was then mixed in a neutral glass bottle† with three parts of a solution containing an anaesthetic agent. Table I shows the anaesthetic solutions used and their final strengths when mixed with the fluorescein solution. All hydrochlorides were made up with 0.1 per cent. methylhydroxybenzoate for bacteriostasis; the butacaine sulphate was made up with 0.004 per cent. phenylmercuric nitrate.

The mixtures were observed. A precipitate formed in almost every case. Table II shows the degree of precipitation after one hour at 25°C. The mixtures which precipitated to a degree indicated by one or more + were not used in further experiments.

The mixtures which had minimal precipitate were divided into three parts, each part being kept for 24 hours at 4°C., 25°C., and 37°C. Table III shows the precipitation in each case.

The character of the precipitate varied. After a week of shelf life at 25°C., all the mixtures were re-examined. The results are shown in Table IV.

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† Manufacturer's (A. Wander Ltd.) recommendation to maintain the chemical stability of Novesine.

TABLE I
ANAESTHETIC AGENTS USED AND FINAL STRENGTH OF ANAESTHETIC
AND FLUORESCEIN WHEN MIXED AS ANAESTHETIC:
0.5 PER CENT. FLUORESCEIN = 3:1

Anaesthetic Agent (Per cent.)	Amount of Anaesthetic in Mixture (Per cent.)	Amount of Fluorescein in Mixture (Per cent.)
Lignocaine hydrochloride	4	0.125
Lignocaine hydrochloride	2	0.125
Cocaine hydrochloride	4	0.125
Amethocaine hydrochloride	1	0.125
Butacaine sulphate	2	0.125
Ophthaine* (Proparacaine)	0.5	0.125
Procaine hydrochloride	10	0.125
Novesine†	0.4	0.125

* Squibb. † A. Wander, Ltd.

Precipitate.—The precipitate from a mixture of butacaine and fluorescein was filtered off, collected on sintered glass, and examined to determine its nature. The butacaine mixture was chosen because of the large amount of precipitate. The precipitate gave the reaction of the primary aromatic amines forming a bright orange-red precipitate of a resinous character, typical of an anaesthetic base (*British Pharmaceutical Codex*, 1963).

Recommended Mixture.—Novesine is recommended for use in Goldmann applanation tonometry because it has a quick anaesthetic action on the cornea (Schlegel and Swan, 1954), it has no vasodilator or vasoconstrictor effect, it does not affect the size of the pupil, it has been found not to alter the intra-ocular pressure (Emmerich, Carter, and Berens, 1955), and it has low toxicity on the conjunctiva and corneal epithelium (Swan, 1956).

Procaine has a mild vasodilator action and it is for this reason that it is not recommended in this paper for use in applanation tonometry.

The use of the Novesine-fluorescein mixture is therefore to be preferred.

Sterilization.—The two components can be mixed aseptically in a neutral glass bottle. Alternatively, the final mixture can be steamed at 98°C. to 100°C. for 30 minutes. Each of these methods gives a sterile solution in which the precipitate is so minimal that it can be ignored. If this mixture is autoclaved at 112°C. for 30 minutes at 10 lb. pressure, there is an increase in the precipitation and this method of sterilization is therefore not recommended.

TABLE II
DEGREE OF PRECIPITATION AFTER
ONE HOUR AT 25°C., OF THE
ANAESTHETIC-FLUORESCEIN
MIXTURES

Anaesthetic	Precipitate
Lignocaine 3 per cent.	++
Lignocaine 1.5 per cent.	+
Cocaine	+
Amethocaine	++++
Butacaine	++++
Ophthaine	+++
Procaine	Nil
Novesine	Negligible

TABLE III
DEGREE OF PRECIPITATION AFTER
24 HOURS OF PROCAINE-FLUORESCEIN AND
NOVESINE-FLUORESCEIN MIXTURES AT
4°C., 25°C., 37°C.

Anaesthetic	Precipitate		
	4°C.	25°C.	37°C.
Procaine	Nil	Nil	Nil
Novesine	Negligible	Negligible	Nil

TABLE IV
CHARACTER OF PRECIPITATE IN ALL
ANAESTHETIC-FLUORESCEIN
MIXTURES AFTER WEEK OF SHELF
LIFE AT 25°C.

Anaesthetic	Character of Precipitate
Lignocaine 3 per cent.	Floccular
Lignocaine 1.5 per cent.	"Murky"
Cocaine	Floccular
Amethocaine	Resinous
Butacaine	Resinous
Ophthaine	"Murky"
Procaine	—
Novesine	Resinous

Discussion

A point of interest which arose out of these experiments was that there was no visible precipitate in the Novesine-fluorescein (aseptic) and Novesine-fluorescein (steamed) mixtures when these mixtures were kept at 37°C. The same mixtures, when allowed to cool to room temperature, developed a minimal precipitate. This would suggest that in the conjunctival sac there is no precipitation. The amethocaine-fluorescein mixture formed a heavy precipitate at all temperatures; it is therefore possible that a precipitate is formed when amethocaine and fluorescein are mixed in the conjunctival sac. This may be one reason why the use of Novesine and fluorescein is less unpleasant for the patient than the use of amethocaine and fluorescein.

The amount of fluorescein in the mixture follows the recommendation by Moses (1960) that the acceptable limits of fluorescein concentration are 0.125 per cent. to 0.5 per cent. He found that acid anaesthetics quenched the fluorescence. This quenching is not apparent when using Novesine at pH 6.8 (approximate).

Grant (1963) found that 0.25 per cent. fluorescein was the minimum, and the best, strength of fluorescein when using the two-stage manoeuvre. A drop of this strength will be diluted in the pre-corneal film and may well approach the concentration of fluorescein achieved in the pre-corneal film when a drop of the Novesine-fluorescein mixture is used.

Summary

The use of one drop containing both fluorescein and an anaesthetic agent is recommended as routine for use with the Goldmann applanation tonometer. The mixture contains 0.3 per cent. Novesine and 0.125 per cent. fluorescein; it gives good corneal anaesthesia and a good fluorescent ring for applanation tonometry. It is suggested that this solution does not form a precipitate in the conjunctival sac,

whereas other commonly used anaesthetic agents may do so when combined with fluorescein.

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