RELAXATION OF THE CRICOPHARYNGEAL SPHINCTER BY SUXAMETHONIUM

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SUMMARY

The pattern of relaxation of the cricopharyngeal sphincter by suxamethonium was studied in fifty patients. The pattern was variable, but a large percentage of the cases showed an abrupt initial fall in cricopharyngeal sphincteric tone concomitant with, or just preceding, the onset of fasciculations, although relaxation often only reached completion after fasciculations had ceased. Of twenty-three who exhibited marked or very marked fasciculations only three showed an increase in cricopharyngeal sphincteric tone during the fasciculations. The significance of the changes in the tone of the cricopharyngeal sphincter with respect to the possible reflux of oesophageal contents into the pharynx is discussed.

In the supine subject, fluid in the oesophagus is prevented from flowing into the pharynx by the tonic contraction of the cricopharyngeal sphincter; complete relaxation of the sphincter causes an immediate reflux of such fluid into the pharynx (O’Mullane, 1954). Cricopharyngeal sphincteric tone is thus important in preventing regurgitation of stomach contents in cases in which there is incompetence of the oesophageal cardia or where stomach contents have been forced up through a normal cardia.

The cricopharyngeal sphincter consists of the lower part of the inferior constrictor and possibly some of the adjoining circular muscle of the oesophagus and, being composed wholly of striated muscle, is paralyzed and relaxed by muscle relaxants. This investigation is designed to determine the pattern of relaxation of the sphincter produced by a large dose of suxamethonium.

METHOD

The investigation was carried out on fifty unselected adult patients who were to undergo ear, nose and throat operations. The patients were premedicated with atropine alone, or with pethidine and atropine, and were anaesthetized with thiopentone 250 mg, nitrous oxide, oxygen and halothane. Depth of anaesthesia varied but was just sufficient to prevent gagging or reflex movements during the pharyngeal manipulations.

A lax, water-filled, balloon which surrounded a catheter was then introduced into the cricopharyngeal sphincter. When in situ it measured 1.5 cm in diameter and 2.5 cm in length. The balloon was connected to a narrow-bore (low inertia) mercury manometer. Suxamethonium (approximately 80 mg) was injected rapidly and manometer readings taken approximately every 3 seconds. Fasciculations were graded as absent (−ve), slight to moderate (+), marked (++), very marked (+++).

A lax balloon 1½ cm in diameter does not give a quantitatively accurate measure of the tone of the closed sphincter but probably gives a reasonably accurate qualitative picture of the pattern of relaxation that occurs following the injection of a muscle relaxant.

Zero was arbitrarily taken as the pressure after full relaxation of the sphincter. All pressures were converted into cm H₂O.

RESULTS

Fasciculations were absent in three cases, slight to moderate in twenty-four cases, marked in sixteen cases and very marked in seven cases.

Pressure readings on the manometer, following induction of anaesthesia and before injection of suxamethonium, varied between zero (two cases) and 48 cm H₂O above the arbitrary zero. There was considerable individual variation but the average of the pressure readings was greater in the group exhibiting marked and very marked fasciculations.
Pressure exerted by the cricopharyngeal sphincter (cm H₂O)

Time after injection of exanthionium (min)

Fig. 1

Pressure exerted by the cricopharyngeal sphincter (cm H₂O)

Time after injection of exanthionium (min)

Fig. 2
Figs. 1 to 7 are charts of the seven individual cases exhibiting very marked fasciculations and show the changes of pressure exerted on a balloon by the cricopharyngeal sphincter following the injection of suxamethonium.

Figs. 1, 2 and 3 show an abrupt initial fall in sphincter tone occurring concomitant with, or just preceding, the onset of fasciculations. These three cases show a pattern of relaxation of the sphincter similar to that exhibited by 70 per cent of the fifty cases examined.

Fig. 4 shows a fall in sphincteric tone occurring only at the end of the period of fasciculations.

Figs. 5, 6 and 7 show a rise in sphincteric tone occurring during the period of fasciculations. These three are the only cases exhibiting a rise in sphincteric tone.
calculations (22.7 cm H₂O) than in the group exhibiting no fasciculations and slight to moderate fasciculations (15.2 cm H₂O).

The pattern of relaxation of the sphincter which followed the injection of suxamethonium was variable.

Thirty-five cases (70 per cent of the total) showed an abrupt initial fall in pressure which occurred concomitant with, or just preceding, the onset of fasciculations. This initial fall usually comprised between 35 to 65 per cent of the total fall in pressure and was followed by a further, but slower, fall in pressure which often did not reach completion until after the termination of fasciculations (figs. 1 and 2). In five of the cases, however, the fall in sphincter pressure occurred totally at the commencement of the fasciculations (fig. 3). Twelve cases with marked fasciculations and three cases with very marked fasciculations were included in this group.

Seven cases (14 per cent of the total) showed little appreciable change in pressure in the sphincter after the injection of suxamethonium.

Five cases (10 per cent of the total) showed only a gradual fall in pressure occurring throughout, or towards the end of, the period of fasciculations with no abrupt fall at the commencement of this period (fig. 4).

Three cases (6 per cent of the total) showed (after an initial fall in two of them) a temporary rise in sphincter pressure occurring during the period of fasciculations and reaching a level above that present prior to the injection of suxamethonium. The pressure then fell to zero towards the end of the period of fasciculations. All these cases exhibited very marked fasciculations (figs. 5, 6 and 7).

There was little correlation between the grade of fasciculations and the pattern of relaxation, with the exception of the three cases (above) that showed a marked rise in sphincteric pressure, each case exhibiting very marked fasciculations. Of the remaining twenty cases exhibiting marked and very marked fasciculations, seventeen showed a diminished, and in a few cases a zero, pressure during the whole period of the fasciculations.

**DISCUSSION**

In a large percentage of cases suxamethonium caused an abrupt initial fall in cricopharyngeal sphincter tone concomitant with, or just preceding, the onset of fasciculations although in the majority of these cases full relaxation was not immediately complete and often only reached completion after fasciculations had ceased. This initial fall in sphincteric tone could favour the regurgitation into the pharynx of fluid in the oesophagus at a very early stage after the injection of suxamethonium, although the maintenance, usually, of a slight tone throughout the period of fasciculations might act to some extent as a barrier to oesophageal reflux during this period.

Increase in intragastric pressure during marked fasciculations has been demonstrated by Roe (1962) and Andersen (1962) and this increase in pressure might, at the time of anaesthetic induction, constitute a hazard with respect to the regurgitation of gastric contents into the pharynx, despite the use of a steep foot-down tilt. One might expect that the cricopharyngeal sphincter would in a similar way show, in most cases, an increase in tone during marked fasciculations and if this did occur it would, during this danger period, provide some safeguard against a possible reflux into the pharynx. In fact, however, of the twenty-three patients who exhibited marked or very marked fasciculations only three showed an increase in tone of the cricopharyngeal sphincter during the fasciculations; of the remaining twenty patients the majority showed, at this time, a considerably diminished tone in the sphincter—a sphincteric tone which might offer little appreciable barrier to the reflux into the pharynx of gastric contents, should such be ejected into the oesophagus under pressure.

**REFERENCES**


**SOMMAIRE**

L'auteur a fait une étude du mode de relâchement du sphincter crico-pharyngé chez 50 patients. Ce mode variait, mais dans un pourcentage élevé des cas il y eut tout d'abord une réduction brute initiale du tonus de ce sphincter, survenant immédiatement avant ou en même temps que le début des contractions fasciculées. Néanmoins le relâchement ne fut souvent obtenu de façon complète que lorsque les contractions fasciculées avaient cessé. De 23 patients présentant des fascicul-
RELAXATION OF THE CRICOPHARYNGEAL SPHINCTER

...tions marquées ou très marquées, trois seulement ont montré une augmentation du tonus du sphincter cricopharyngé pendant la fasciculation. L'auteur discute la signification des modifications du tonus du sphincter cricopharyngé et leur influence possible du contenu de l'oesophage dans le pharynx.

ZUSAMMENFASSUNG

BOOK REVIEW


This 89-page book is one in the series of American Lectures in Pharmacology and is dedicated to the Pioneers of Psychopharmacology. Opinions expressed in this review are those of an anaesthetist with an interest in psychopharmacology and not those of a psychiatrist or pharmacologist. However, since the book is "designed to give essential information with a minimum of effort" and is intended to be a "concise, ready reference guide to the confusing array of psychotherapeutic compounds introduced in the last decade", it may be interesting to know the opinion on its contents of a member of another discipline.

The first half of the book deals with the tranquilizing drugs and devotes several pages to the phenothiazines. It is this section which is likely to be of most value to the anaesthetist, as some of the thirteen compounds listed have been used as anti-emetics or as premedication. Their side effects are dealt with in some detail but they are not the toxic reactions which an anaesthetist would normally associate with these drugs, since they are based on long-term oral therapy rather than single-dose parenteral injection. The rauwolfia group of tranquilizers is also discussed in detail, as are the minor tranquilizers such as meprobamate, hydroxyzine, benactyzine and chlordiazepoxide, and this section concludes with the non-barbiturate sedatives and calmatives. It presents a clear, concise, picture of the different chemical groups, the uses and some of the disadvantages of the available tranquilizers.

This clarity cannot be fully maintained in the second half of the book which is devoted to the antidepressive drugs, because of their more recent introduction and a lack of knowledge of their precise action. However, they are grouped in a convenient and seemingly logical order which enables one to get a broad view of the action of different types of compounds. This section does not underrate the side effects of these drugs and on page 65 it states: "The impression is gained that the tranquilizing and antidepressive medications are associated with a high percentage of troublesome side reactions and a significant degree of toxicity. Relatively speaking, this appears to be true... the risks of therapy are fairly high." The value of persisting with the study and clinical use of drugs of such toxicity is emphasized as "... with persistent efforts, patients having nervous and mental illnesses—our most important medical and social problem—can be benefited much as those having bacterial infections were benefited by the introduction of the sulfonamides" (page 66).

To the reviewer the most important part of this book is the excellent 14-page summary and the glossary of fifty-five drugs which gives their generic name, trade names, classification (general, chemical and pharmacological) and dosage. This latter contains one obvious error where the classifications of chlormezanone and chlorpromazine are transposed. A perusal of the trade names was most interesting and revealed such suggestive names as Trepidone, Vistaril, Striatran, Har- monyl, Sofiran and Listica. There is also a useful reference to 164 papers, some of which are general reviews of the subject.

Of what value and interest is this book to the anaesthetist? The main answer to this must surely lie in the glossary referred to above. With an ever-increasing number of drugs being given to patients in the weeks or months before operation, it is of value to have some source of reference in the event of an untoward effect occurring during anaesthesia. This book provides such a source and is, in fact, the "concise, ready reference guide" it is claimed to be. One would hope that a later edition will point to the danger of some of these drugs before anaesthesia, and suggest that, when necessary, they should be discontinued for the time necessary for their excretion.

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