E.C.G. PATTERNS IN PATIENTS INFLATED WITH A HIGH ETHER CONCENTRATION

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Ether is still our main anaesthetic agent in Mulago Hospital and even more so in the upcountry hospitals. It is a relatively safe drug, but as we are all aware, very slow, painfully slow, in settling a patient quickly enough for surgery, especially when one is faced by a very long operating list.

If, however, a high concentration can be insufflated into a patient during the period of apnoea afforded by suxamethonium chloride, without harm, then the time interval between induction and surgery can be shortened considerably.

In the past many authorities frowned on this practice as being dangerous and the teaching was that a patient should be allowed to recover spontaneous respiration before an inhalational agent was switched on. Nowadays, especially with calibrated vapourisers, this has been modified and low concentration of the various inhalational agents are turned on before resumption of spontaneous respiration. However, with ether being so pungent and slow. you are left with a bucking and straining patient when you increase the concentration after the effects of suxamethonium are over. What works better with ether is to start the inflation with a high concentration — a few minutes are sufficient to settle a patient and then to lower the concentration to a maintenance level, with surgery already on its way. This method is not new — it has found favour with many anaesthetists who are still using ether. The Oxford School, notably Macintosh and Bryce-Smith, support and advise it and repudiate any serious effects on the heart and have done investigations in the past on this point, before ether receded into the background in the U.K., but I find no such investigation has been carried out in East Africa.

On questioning the anaesthetic staff and medical assistants here, I discovered that the majority inflated with varying concentrations of ether, the tendency being towards the conservative side. On this score, I decided, as an academic exercise, to put this issue locally on a more scientific basis and to be in a position to include it, specifically on work done here, in the teaching programme for students and medical assistants.

Fifty-two (52) unselected cases have been assessed so far, of ages varying between 15-65 years and all were African.

The E.M.O. Ether vapouriser, which is standard equipment in all the upcountry hospitals and in Mulago, has been used for this investigation. It is capable, as we all know, of delivering a fixed percentage V/V of ether regardless of the ambient temperature (unlike the Boyle's bottle). A Rubin's non-return valve was incorporated in the set up.

The concentrations used were 10%, 15% and 20%. 15% was used in the majority of cases following the lead given by the Oxford School.

An E.C.G. was taken in every case before induction and continuous E.C.G. monitoring was carried out throughout the procedure— standard lead II being used.

The *Blood Pressure* and *Pulse Rate* were charted at regular intervals. The sequence of events followed is depicted on the chart in Fig. I.

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FIG. 1.

Name:		Age:		Sex:
Race:		Operation:		
Pre-induction ECG: Normal			B.P:	P.R.
Abnormal				
Pre-medication:			E.C.G.	
Induction: Thiopentone			E.C.G.	
Suxamethonium			B.P.	
			P.R.	
Intubation: Yes/No.		E.C.G.		
Inflation with Ether/Air:	10%			
	15%			
	20%			
Oxygen Used: Yes/No.				
E.C.G. Pattern After:	1 min Inflation:		B.P.	P.R.
	2 ,, ,,		B.P.	P.R.
	3 ,, ,,		B.P.	P.R.
	4 ,, ,,		B.P.	P.R.
	5 ,, ,,		B.P.	P.R.
Arrhythmias (if any):				
Type:				

Pre-medication

This followed the normal procedure adopted for everyday use in our main theatres on the majority of patients, which is to give *Atropine 0.6 mg. I.V.* a few minutes before induction. A sinus tachycardia was usually in evidence two minutes after the injection. Many authorities have encountered arrhythmias provoked by I.V. Atropine, but in my series these were absent, except in two cases, where it gave rise to a few transient atrial extrasystoles.

6% of the cases were intubated and the rest were inflated through an oral airway.

No significant difference was noticed here, except that the intubated cases settled down more quickly than the non-intubated, which is not surprising as it is sometimes difficult to get a proper seal with the face-mask in some patients, with consequent dilution of the concentration. *Induction* was with thiopentone in a dose range of 250-500 mg. of a $2\frac{1}{2}$% solution. *Suxamethonium chloride* 50-75 mg. was given in every case (Table I).

The arrhythmias provoked were in 90% of cases Ectopic rhythm and consisted of a wandering pacemaker or a Nodal Rhythm.

A few words about these arrhythmias as interpreted on the E.C.G. would perhaps not be out of place.

The phenomenon of a *wandering pacemaker* is associated with a shift in the origin of the stimulus between the S.A. and A.V. nodes. This is shown by changes in the form of the P. waves and by changing of the PR intervals from beat to beat.

In a Nodal Rhythm the P wave (which may be deformed) occurs slightly before

TABLE 1

No. of cases	*Arrhythmias during Inflation with Ether*	*Percentage*
52	A. After 3 min. Inflation 10	19%
52	B. After 5 mins. Inflation 25	48%

or after or may be swallowed up in the ventricular complex. There are three types of Nodal Rhythm. If the impulse arises in the upper part of the node, the P. wave is just before the Q.R.S. complex — this is *superior N.R.* If the impulse arises in the middle part of the node, the P. wave is encountered within the Q.R.S. complex and is therefore not visible — this is *mid N.R.* If the impulse arises in the lower part of the node, the P. wave occurs shortly after the Q.R.S. complex — this is *inferior N.R.* These arrhythmias are broadly vagal in character and do not give rise to serious concern. They are often encountered during ether anaesthesia even when no inflation with a high concentration has been performed or indeed during any other type of anaesthesia and according to many authorities have no special significance — the patient does not come to any harm, and how often, in routine anaesthesia do we use an E.C.G. monitor to tell us whether they are there or not?

The incidence of worrying arrhythmias that occasionally are provoked by suxamethonium and the everyday manoeuvre of intubation, were fortunately absent from my series. Although we are aware that these can occur, it still does not prevent us from performing these necessary techniques, which makes me feel even more strongly that the E.C.G. patterns encountered during inflation with a high Ether concentration are not serious enough for the method to be discounted.

From Table I the incidence of arrhythmias after 5 minutes inflation appears to be rather high, even though they are not serious; on the other hand, the percentage was not excessive when inflation was carried out for 3 minutes. This is quite enough in most cases to settle a patient and a lower concentration can be used for the rest of the period of inflation if so desired.

Restoration of a normal E.C.G. pattern was found after reduction of the concentration in the majority of the patients showing an arrhythmia. All had a normal E.C.G. after the operation.

What was slightly disturbing and where my series differ markedly from those of Hart and Bryce-Smith (1963) was the high percentage of Blood Pressure drop — 40 mm. Hg. or more as compared to pre-induction level — after 5 minutes inflation with 15% or 20% concentration (Table 2).

The E.C.G. pattern in four of these patients, who had earlier shown a Nodal Rhythm, revealed depression of the ST segment, flattening and disappearance of the T waves — an E.C.G. pattern that is sometimes encountered and has been described during hypotensive anaesthesia.

However, the Blood Pressure invariably rose without difficulty to pre-inflation level or slightly under when the concentration was reduced, which leads me to assume that the change in the E.C.G. pattern was dependent on the low Blood Pressure as the pattern reverted to normal on its rise.

The incidence of cardiac arrest following inflation with high concentration of Ether has been reported, but as pointed out by Hart and Bryce-Smith and with which I concur, this did not occur when an E.M.O. vapouriser was used. As much as 30% Ether can be obtained from a Boyle's Ether bottle fully switched on for the first few minutes.

It is not inconceivable on the findings (Table 2) to assume that cardiac arrest can occur if the inflation with a high concentration is carried on and on, when a pa-

TABLE 2

No of cases	*Blood Pressure Drop of 40 mm Hg. or more*	*Percentage*
A.	After 3 mins. Inflation 15	28%
52	B. After 5 mins. Inflation 32	61%

tient drops his blood pressure precipitously. Patients showing a severe drop in BP were immediately inflated with air or a much lower concentration than that being used initially. The B.P. invariably rose to a more satisfying level.

The possibility of a cardiac arrest following the injection of suxamethonium and/or intubation must not be forgotten and some of the cases of cardiac arrest reported or unreported, after inflation with high ether concentration, may have had that, as the primary cause.

I feel that none of the findings in my investigation were sufficiently disturbing to warrant the term dangerous to be applied to this method.

Inflation with 15% Ether certainly gives rise to less trouble than a recalcitrant patient who takes 15-20 minutes to settle for an operation.

15% concentration is high enough and no advantage is gained by going higher. The patient inflated with 20% did not do any better, and in view of the drop in Blood Pressure, there is no reason for using this concentration.

Inflation with 15% Ether for 3 minutes caused the least concern and was enough to settle most patients. It is suggested that this time be taken as a general guide with variations for the individual patients, if need be .Regular taking of the pulse, noting its rate and volume is a prerequisite of this method — better still, taking the Blood Pressure after 3 minutes inflation gives you a good base line for determining whether or not to lower the concentration in haste or at leisure.

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Reference

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