A STUDY OF CHLOROFORM ANAESTHESIA IN A PRECISION SYSTEM:

I THE EFFECT ON ANION-CATION BALANCE IN MAN¹

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MUCH HAS BEEN WRITTEN during the last century about the clinical use of chloroform. Its potent effects on respiration, circulation, and hepatic activity have been stressed repeatedly. Re-evaluations have been described during the past decade (1, 2, 3, 4). The most important requirement which is still not generally available is a precision vaporizer that would facilitate gradual and accurate alterations in the concentration of inhaled vapour. An absolute requirement to avoid serious cardiovascular and metabolic derangements is the assurance that no hypoxia or hypercarbia develops during administration of chloroform. This report deals with the effect of chloroform anaesthesia on anion-cation balance when administered in a precision system.

MATERIALS AND METHODS

Data were collected from 50 patients. Each was premedicated orally the evening before an elective operation with 200 mg. meprobamate and 25 mg. promazine (Equazine ®). About one hour before induction of anaesthesia, 5 mg. of perphenazine was given intramuscularly with 0.4 mg. scopolamine. Patients over 60 years of age received 0.4 to 0.6 mg. atropine instead of scopolamine. Anaesthesia was induced with a sleep dose of 2.5 per cent thiopental intravenously, following a dose of dimethyl d'tubocurarine or gallamine that was considered sufficient to facilitate endotracheal intubation. In each case, intubation was preceded by artificial respiration with 100 per cent oxygen for about one minute. Anaesthesia was then maintained in a non-rebreathing system with nitrous oxide, oxygen (2:1) and chloroform—which was delivered through a "Chlorotec" calibrated temperature-compensating vaporizer (Fig. 1). A supplementary dose of atropine was administered after induction of anaesthesia, and this was repeated during long operative procedures, and whenever a marked slowing of the pulse rate was observed. Small doses of the muscle relaxant initially selected were given during maintenance of anaesthesia if necessary.

For each patient, pulmonary ventilation was regulated mechanically using a Takaoka respirator. This instrument cycles automatically with an inspiratory phase slightly shorter than the expiratory phase. Inspiratory pressures vary approximately between 12 and 20 mm. Hg, depending mainly on rate of gas inflow used. A fixed negative pressure of 3 to 4 mm. Hg occurs during expiration. Rate of cycling was always set at 18 per minute. Minute volume was monitored with either an Ohio minute volume meter or a Wright respirometer, and was

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FIGURE 1. Arrangement for the administration of chloroform in a precision system.

adjusted by altering the gas inflow until the patient's tidal volume approximated the volume indicated as ideal by the Radford nomogram, and corrected according to factors relating the patient's age and body build, the posture adopted for the operation, and the presence of emphysema or cardiac incompetence (5).

A stable level of anaesthesia was usually achieved within a few minutes after induction, using 0.5 to 1.0 per cent chloroform. During the operation, 5 per cent dextrose in water was administered intravenously unless a whole blood transfusion was necessary. No electrolyte solutions were administered during any of these operations. Hypothermia and hypotension were not induced intentionally in any of these patients.

Anion-cation changes were determined from blood samples which were drawn anaerobically, using the brachial artery in most cases. In a few cases arterialized blood was taken from the median cubital vein (6). The blood samples were drawn shortly before induction, at 30 to 45 min. intervals during maintenance of anaesthesia, immediately after extubation at the end of the operation, and again 30 min. later in the recovery room. They were analysed immediately for pH, total CO_2 , haematocrit value, and in most cases, for oxygen saturation, employing standard laboratory techniques that were described in previous reports (7, 8, 9). Plasma CO_2 , pCO_2 , plasma bicarbonate, and fixed acid changes were calculated from the above data. The pH and plasma bicarbonate values were plotted on a graph as recommended by Davenport and Weisberg (10, 11).

RESULTS

The pertinent data from the blood analyses appear in Table I, which is divided into four parts on the basis of the patient's age. Figure 2 shows the mean shifts in pH, pCO_2 , and plasma bicarbonate in the four age groups. Statistical analyses of the data from each group showed that a change occurred from the samples drawn before induction and those drawn 30 to 45 min. later. This change was in the direction of a moderate respiratory alkalosis. No significant metabolic change was evident. During long maintenance there was a slow return to the preoperative state. Blood samples drawn postoperatively showed only a slight reduction of fixed base.

TABLE I
DATA FROM SERIAL BLOOD ANALYSES TO SHOW EFFECT OF CHLOROFORM ON ANION-CATION BALANCE

Before anaesthesia				Steady anaesthesia				During maintenance				End of anaesthesia				30 min. after anaesthesia										
Age	Build	Phys. Status	Posture	Op. Site	Anaesth. time (min.)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)					
18	O	2	S	↑A	90	7.46	88	28	19	7.60	100	21	20.2	7.54	100	23	19.8	7.51	91	25	19.5	7.51	92	27	20.7	
28	O	2	S	Spine	225	7.28	68	62	25	7.39		42	23.3	7.38		43	22.8 (4)*	7.26		50	20.1	7.25	51	19.9		
33	M	1	S	↑A	170	7.42	20	20	13.5	7.45		19	13.5	7.47		20	12 (3)	7.44		27	18	7.40	30	18		
34	M	1	S	↑A	130	7.23	90	56	20.5	7.22		51	19	7.37	90	47	17.9	7.21		48	18.1	7.22	45	17.3		
37	M	1	S	↑A	150	7.33	96	46	22	7.45	89	36	23	7.37	90	39	20.2 (2)	7.36	87	39	20.2	7.30	82	22		
37	M	1	S	↑A	145	7.38	96	40	21.7	7.38	100	38	21	7.33	100	44	21.3 (2)	7.28	100	43	19.1	7.29	92	38		
39	O	2	S	↑A	280	7.29	95	51	22	7.41	97	37	21.9	7.38	98	38	20.9 (4)	7.37	97	32	17.3	7.31	96	43		
41	M	1	S	↑A	165	7.32	79	47	22.4	7.38	90	37	20.3	7.39	91	37	20.8 (2)	7.38	91	34	18.9	7.30	94	42		
43	M	1	S	↑A	100	7.38	93	34	19	7.52	100	22	17.9	7.52	99	22	17.8	7.44	99	27	18	7.35	99	36		
44	L	2	S	↑A	215	7.37	95	38	20.3	7.40	83	32	18.5	7.41	77	27	17.0 (2)	7.38	92	35	19.2	7.33	94	37		
45	M	1	S	Spine	320	7.47	93	31	20.2	7.49	78	25	18.4	7.48	80	25	18.1 (8)	7.44	100	32	20.1	7.47	100	31		
45	M	1	S	↑A	145	7.38	86	42	23	7.41	91	37	21.6	7.50	100	30	22	7.46	96	31	20.9	7.37	97	44		
45	O	2	S	↑A	180	7.39	94	33	18.8	7.41	90	30	18.2	7.40	95	32	19 (3)	7.21	88	50	18.4	7.19	96	49		
48	L	3	S	↑A	135	7.38	94	41	22.7	7.57	100	27	23	7.48	100	33	22.1	7.32	100	50	23	7.37	100	41		
50	O	2	S	Neck	110	7.46	94	36	23.5	7.48	97	29	20.9	7.48	97	29	20.2	7.48	91	29	20.3	7.47	84	31	17.2	
Mean					171	7.37	90	40	21.0	7.44	93	32	20.0	7.42	93	33	19.5	7.37	94	37	19.4	7.34	92	40	19.3	
S.D.						.07	8	11	2.7	.09	7	9	2.6	.08	8	9	2.7	.09	.09	5	9	1.4	.09	7	7	1.9
S.E.						.02	2	3	0.7	.02	2	2	0.7	.02	3	2	0.7	.02	.02	1	2	0.4	.02	2	2	0.5

↑A = lean
M = medium
O = obese

*Figures in parentheses indicate averaged data from the number of blood samples noted.

L = lean
M = medium
O = obese

†A = Upper Abdomen
‡A = Lower Abdomen

C = Intrathoracic
AP = Abdominoperineal

*Figures in parentheses indicate averaged data from the number of blood samples noted.

TABLE I (continued)

Age	Build	Phys. Status	Posture	Op. Site	Anaesth. time (min.)	Before anaesthesia				Steady anaesthesia				During maintenance				End of anaesthesia				30 min. after anaesthesia				
						pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)					
53	O	3	S	↑A	65	7.33	96	42	21.2	7.47	96	30	19.8	7.49	96	28	20	7.33	80	41	20	7.33	81	41	20.2	
54	O	2	S	↑A	155	7.39	88	46	24.9	7.45	94	38	24	7.45	93	39	24.8	7.46	90	36	36	22.5	7.38	39	21.8	
54	O	2	S	↑A	290	7.46		25	14.3	7.40		27	17	7.36		31	17.3	7.31		31	15.5	7.34		28	14.9	
54	M	3	S	↑A	165	7.24		50	19.9	7.24		47	18.7	7.32		37	18	7.31		41	19	7.17		56	19	
54	O	2	S	↑A	80	7.31	94	45	19.7	7.40	95	38	22	7.40	95	38	22	7.35	85	43	43	22.5	7.31	47	21	
55	M	2	S	↑A	135	7.52	79	25	20	7.56	94	20	17.8	7.60	95	19	18.9	7.50	99	24	18.5	7.43	100	28	18.2	
55	O	2	S	↑A	230	7.36	92	43	23.9	7.45	97	34	20.3	7.38	96	41	21.8	7.32	100	28	47	22.8	7.38	39	22	
56	O	2	S	↑A	230	7.37		32	15.9	7.44		29	19	7.44		28	18.7	7.39		28	16.5	7.36		39	16.8	
57	O	3	S	↑A	250	7.31	86	49	20.9	7.50	93	30	20	7.47	95	30	20.2	7.27	91	55	23	7.20	62	22	22.8	
57	O	3	S	↑A	150	7.44	91	35	21.2	7.40	94	42	23.5	7.37	97	47	24.4	7.37	96	45	45	23.4	7.36	43	22.8	
57	M	3	S	↑A	255	7.43	78	34	20.5	7.46	74	32	21	7.36	87	39	20.8	7.28	89	45	20	7.25	60	47	19.7	
59	O	2	S	↑A	185	7.29	92	47	19.8	7.43	91	34	20.5	7.37	92	37	20	7.18	100	53	17.9	7.34	89	39	19.8	
59	O	2	S	↑A	90	7.41	83	38	22.5	7.50	86	30	22	7.46	100	34	21	7.42	99	38	23	7.37	91	42	22.9	
59	O	2	S	↑A	150	7.42	94	34	20.9	7.43	90	36	22.4	7.36	95	38	20.1	7.24	92	56	22	7.32	91	39	19	
Mean					175	7.38	88	39	20.4	7.44	91	33	20.7	7.42	95	35	20.6	7.34	93	42	20.5	7.32	85	41	20.0	
S.D.						.08	6	8	2.7	.07	6	7	2.1	.07	3	7	2.2	.09	.07	7	10	2.6	.07	12	10	2.3
S.E.						.02	2	2	0.7	.02	.3	2	.6	.02	.3	2	0.6	.02	.02	2	3	0.7	.02	4	3	0.6

TABLE I (continued)

Age	Build	Phys. Status	Posture	Op. Site	Anaesth. time (min.)	Before anaesthesia				Steady anaesthesia				During maintenance				End of anaesthesia				30 min. after anaesthesia				
						pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	
60	M	2	S	↑A	310	7.35	94	42	20.8	7.48	96	28	19.8	7.30	90	45	19.9 (4)*	7.35	92	38	19.8	7.30	94	40	18.9	
60	M	2	S	↑A	120	7.43	92	36	22.6	7.49	94	27	20	7.39	100	35	18.9	7.38	100	38	20.9	7.36	82	39	20.9	
61	L	3	S	↑C	290	7.39	86	38	20.5	7.40	80	41	23.8	7.31	90	47	20.8 (3)	7.31	88	45	20.1	7.29	88	47	21.2	
63	O	3	S	↑A	225	7.41	88	37	22	7.35	95	40	20	7.38	97	43	20.6 (3)	7.23	90	54	20	7.35	85	37	19.8	
65	O	3	S	↑A	105	7.38	82	45	23	7.36	90	49	24.9	7.36	92	49	24.9	7.31	94	55	37	7.30	93	54	24.8	
66	O	2	S	↑A	230	7.32	93	36	17.9	7.32	91	35	17.1	7.36	92	32	17.4 (2)	7.32	96	37	18	7.16	100	58	19	
67	O	2	S	↑A	145	7.35	90	41	20	7.49	91	31	20.4	7.54	93	25	21	19.9 (2)	7.30	93	43	19.8	7.32	43	20.9	
67	L	3	S	↑A	190	7.30	90	47	20.5	7.31	88	41	20.9	7.32	97	37	20	19.9	7.25	94	51	19.9	7.35	36	18.9	
68	M	2	S	↑A	90	7.33	90	42	20	7.34	88	41	20.9	7.37	97	37	20	19.9	7.37	100	43	22	7.41	100	37	22
68	M	2	S	↑A	100	7.36	95	43	22.7	7.56	98	26	22.5	7.56	98	26	21.9	7.37	100	43	43	7.41	100	37	22	
65					180	7.36	89	42	21.0	7.41	91	36	20.9	7.38	94	38	20.5	7.34	94	42	42	7.33	93	42	20.6	
Mean						.04	5	4	1.6	.09	5	8	2.3	.09	4	9	1.9	.10	4	10	10	.08	7	8	2	2
S.D.						.01	2	1	0.5	.03	2	2	0.7	.03	1.2	3	0.6	.03	1.4	3	3	.02	2	3	3	0.6
S.E.																										

TABLE I (continued)

Age	Build	Phys. Status	Posture	Op. Site	Anaesth. time (min.)	Before anaesthesia				Steady anaesthesia				During maintenance				End of anaesthesia				30 min. after anaesthesia					
						pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)	pH	O ₂ sat. (%)	pCO ₂ (mm. Hg)	HCO ₃ ⁻ (mM/L)		
71	L	3	S	↑A	90	7.32	98	45	21.6	7.32	98	48	23	7.32	99	48	23	23	7.32	100	49	23	7.30	100	49	22.9	
71	L	3	S	↑A	170	7.38	96	47	25	7.23	97	69	26	7.51	99	35	26	25.5	7.38	100	35	25.5	7.38	100	47	25.5	
71	L	2	S	↑A	125	7.36	96	43	22.5	7.45	97	31	20.9	7.45	99	31	21	21.1	7.32	99	43	21.1	7.32	99	40	19.8	
71	M	3	TL	↑AP	250	7.35	95	35	18	7.39	98	27	15.5	7.29	100	29	13.9	16	7.06	96	48	16	7.06	96	58	15.5	
72	M	3	S	↑A	105	7.40	95	38	22	7.59	98	24	22.6	7.56	100	25	21.8	19.9	7.34	96	29	19.9	7.34	96	41	21.2	
73	M	2	TL	↑AP	170	7.37	86	42	23	7.43	91	34	21.4	7.49	91	30	21.9	20.8	7.36	92	34	20.8	7.36	92	43	23	
73	O	4	S	↑A	270	7.52	92	28	22	7.56	100	25	17.6	7.39	100	30	17.6	18.9	7.28	96	42	18.9	7.28	92	41	17.4	
73	O	4	S	↑A	170	7.28	88	43	18.7	7.41	94	30	18.3	7.46	97	26	18	18	7.28	89	25	18	7.28	89	41	18.7	
76	M	1	S	↑A	135	7.31	81	43	20.6	7.39	98	35	19.9	7.38	100	30	17	18.9	7.31	100	39	18.9	7.32	100	38	18.6	
79	L	3	S	↑A	120	7.26	81	42	18	7.34	98	36	18.7	7.34	100	36	18.9	16.9	7.24	100	44	16.9	7.24	100	45	18.7	
81	M	3	S	↑A	80	7.34		28	15	7.47		22	15.9	7.42		22	14	14.8	7.38		20	14.8	7.38		31	17.9	
74	Mean				153	7.35	91	39	20.4	7.42	97	35	20.2	7.42	98	31	19.4	19.4	7.36	99	37	19.4	7.29	95	43	19.9	
	S.D.					.07	6	6	2.9	0.10	3	14	3.1	.08	3	7	3.7	3.1	.09	4	9	9	3.1	.09	4	7	2.7
	S.S.E.					.02	2	2	0.9	.03	1	4	0.9	.03	1	2	1.1	0.9	.03	2	3	3	0.9	.03	2	2	0.8

FIGURE 2. Represents the mean plasma bicarbonate, pH, and $p\text{CO}_2$ in the arterial blood in four groups of patients during chloroform-nitrous oxide anaesthesia. The numbered points indicate: (1) before induction of anaesthesia; (2) after a stable surgical plane of anaesthesia was in progress for 30 to 45 min.; (3) mean values from blood data obtained at 30 to 45 min. intervals during maintenance; (4) immediately after extubation and breathing spontaneously; (5) 30 min. after anaesthesia.

In most of the patients, there was an improvement in oxygen saturation after induction of anaesthesia, which was maintained until the end of the operation. In some patients this fell sharply in the immediate postoperative period necessitating the administration of oxygen in the recovery room. This was done routinely for the elderly and poor risk patients, to avoid hypoxia.

Smooth anaesthesia was maintained without difficulty, chloroform being employed in a concentration which exceeded 1 per cent briefly in only two instances. The remaining patients required no more than 0.5 to 1 per cent chloroform even during the strong stimulation that occurred during upper abdominal operations. During many operations when stimulation was minimal,

less than 0.5 per cent chloroform was sufficient. After peritoneal closure in the long operations, the chloroform could usually be turned off completely, as sufficient anaesthesia persisted until surgical stimulation terminated. Most of the patients were fully conscious soon after extubation, or after they reached the recovery room. Three anaesthetic charts and corresponding protocols of blood data are reproduced to show the typical course observed during intra-thoracic and upper and lower abdominal operations (Figs. 3, 4, 5).

DISCUSSION

The minor alterations accompanying chloroform-N₂O anaesthesia which were observed during this study were almost identical to those seen in a similar study in which trichlorethylene-N₂O, halothane-N₂O, and the azeotropic mixture of halothane-ether were used (7, 8, 9). On the basis of anion-cation balance, therefore, no difference is evident between these three agents as long as adequate pulmonary ventilation is assured throughout the period of administration of chloroform anaesthesia. However, smooth anaesthesia was very easy to maintain with this agent as has been reported by others (2, 3, 4).

SUMMARY

Chloroform anaesthesia was administered with nitrous oxide-oxygen during elective major operations to 50 patients, employing a specially calibrated vaporizer (Chlorotec) in a non-rebreathing system. Artificial respiration was provided with a Takaoka ventilator which has a fixed negative pressure during expiration and a variable minute volume which can be regulated. The tidal volume of the ventilator was adjusted to the requirements of each individual patient according to his age, size, posture, and cardiorespiratory status. Data derived from blood samples indicated that chloroform anaesthesia did not disturb anion-cation balance when administered in this way, and the administration of chloroform had no depressant effect on the oxygen saturation of the blood. The maintenance of a stable level of surgical anaesthesia was accomplished in this system with less than 1 per cent chloroform. On the basis of these observations, little difference was evident between chloroform and other potent anaesthetic agents which have been studied in a similar manner.

RÉSUMÉ

A 50 malades au cours d'opération majeures, nous avons donné une anesthésie au chloroforme avec protoxide et oxygène en employant un vaporisateur (Chlorotec) calibré spécialement pour le chloroforme et un circuit sans réinspiration. Nous avons entretenu une respiration artificielle à l'aide du ventilateur de Takaoka; ce ventilateur applique une pression négative uniforme à l'expiration et peut donner un volume minute variable que l'on peut déterminer. L'air courant du ventilateur a été fixé selon les exigences des malades, exigences variant selon leur âge, leur taille, leur position et leur état cardiorespiratoire. D'après les résultats des ana-

Patient AJ Hosp. # 89549C Age 61 Sex M Ht. 66" Wt. 116 B.S.A. 1.60 Physical State 3 Build Lean
 Anaesth. # 364-60 Premed.: Perphenazine 5mg. + Scop.: 0.4mg. Anaesth.: Thiop. 350 + G 100 + N₂O - Chloroform
 Pulm. Vent.: Method- TAKAOKA Amplitude +13, -4 Phases 2
 Blood Pressure: Preop.: 106/60 During Anaesth.: Steady - 104/78 Postop.: Steady - 126/84

Ventilation Data	Control	General Anaesthesia						Postop.
Time	12.00	1.30	2.15	3.00	4.30	5.00	5.30	
Tidal Volume ml.	S.R.	550	550	550	550	A.R.	S.R.	
Rate / min.	15	18	18	18	18	20	24	
Minute Volume liters		9.9	9.9	9.9	9.9			
Arterial Blood DATA								
Hgb.	13.7							14.0
Hct.	39	39	41	43	43	42	41	
pH	7.39	7.40	7.38	7.27	7.29	7.31	7.29	
Total CO ₂ content mM/L	23.3	26.2	23.0	25.5	24.5	23.0	23.0	
Plasma HCO ₃ ⁻ mM/L	20.5	23.8	23.2	22.6	21.4	20.1	21.2	
pCO ₂ mm.Hg.	38	41	38	54	50	45	47	
% O ₂ saturation.	80	86	92	92	88	90	88	

Summary & Remarks: Rt. radical pneumectomy. Lateral flexed position. Anaesthesia was maintained for 290 minutes with Chloroform (0.5 - 1%) in a Chlorotoc vaporizer and Nitrous oxide - Oxygen (2:1) in a nonrebreathing system. Pulmonary ventilation was controlled with a TAKAOKA respirator and monitored with the Wright respirometer. ECG lead 2 was monitored throughout - no arrhythmias were observed. Slight respiratory acidosis developed after the right bronchus was opened and the lung was removed. Otherwise the patient's course during anaesthesia was uneventful and his postoperative course was free from anaesthetic and surgical complications in spite of myocardial ischaemia, severe bronchitis and emphysema.

FIGURE 3. Anaesthetic chart and blood data protocol. Observe the relatively stable vital signs during 4 hrs. of thoracic surgery. Muscle relaxant was required only for intubation. 0.8 per cent chloroform was administered until chest closure was started.

NAME		JC		PHYSICAL STA	4	AGE	73	SEX	M	HT	69"	WT	180#	ANESTHESIA NO	2953-59	UNIVERSITY HOSPITAL UNIV. of SASKATCHEWAN COLLEGE OF MEDICINE										
PROPOSED OPERATION		Cholecystectomy & C.B.D. Exploration																								
PRE OP DIAG		Jaundice, cholelithiasis, cholecystitis																								
PRE ANES MED.		Perphenazine 5mg. + atropine 0.6mg.																								
IDENTITY		X		CONSENT	X		RESP	X		WILTH	O		ET-TH	O		PUPILS	=	R	L	TIME	6.30a	ST	X	U	HL	15.7
POSITIVE FINDINGS		Myoc. Ischaemia, auric. fibrillation, severe emphysema, obese, jaundice																								
TIME		8am		9		10		11																		
N2O		10 liters																								
ETHER																										
CYCLO																										
T C E																										
CHCI ₃		1%																								
MUSCLE RELAX		dMc 10		4		4																				
INTRAV. THERAP		5% D/W																								
ANALG																										
OXYGEN		5 liters																								
SPECIAL STUDIES		Arterial blood samples																								
PREPARATORY THERAPY																										
PHYSICAL STATUS																										
ABSORPTION		X		O																						
TIME OF REWARDS		INDUCTION		PRIMARY		SECONDARY		TEST ART		EMERGENCE		ADJUVANTS		REGIONAL												
AGE OF PATIENT		Thiop. 2.5%		Metubine 1.5%		CHCI ₃ 0.7-1%		N ₂ O 65%																		
YEAR		10		10		10		10																		
SURGEON		W																								
ANESTHETIST		Johnson		Dobkin																						

Patient JC Hosp.# 48056 Age 73 Sex M Ht. 69" Wt. 180# B.S.A. 1.96 Physical State 4 Build Obese
 Anaesth.# 2953-59 Premed.: Perphenazine 5mg. + Scop. 0.4mg. Anaesth.: Thiop. 300 + dMc 22 + N₂O - Chloroform
 Pulm. Vent.: Method-TAKAOKA Amplitude +15, -4 Phases 2
 Blood Pressure: Preop.: 138/78 During Anaesth.: Steady - 144/78 Postop.: Steady - 130/90

Ventilation Data	Control	General Anaesthesia					Postop.
Time //	7.30	8.30	9.00	9.30	10.00	10.45	11.15
Tidal Volume ml.	S.R.	500	500	500	500	S.R.	S.R.
Rate/min.	16	18	18	18	18	22	20
Minute Volume liters		9	9	9	9		
Arterial Blood Data							
Hgb.	15.7						15.4
Hct.	47						
pH	7.28	7.41	7.46	7.47	7.45	7.47	7.28
Total CO ₂ content mM/L	21.2	19.5	18.0	18.0	19.2	18.5	20.0
Plasma HCO ₃ ⁻ mM/L	18.7	18.3	18.0	18.0	18.0	18.0	18.7
pCO ₂ mm.Hg.	43	30	26	25	27	25	41
% O ₂ saturation	88	94	97	97	97	96	89

Summary & Remarks: Cholecystectomy & C.B.D. Exploration. Supine horizontal position. Anaesthesia was maintained for 170 minutes with Chloroform (0.7 - 1%) in a Chlorotec vaporizer and Nitrous oxide - Oxygen (2:1) in a nonrebreathing system. Pulmonary ventilation was controlled with a TAKAOKA respirator and monitored with the OHIO ventilation meter. ECG lead 2 was monitored throughout (auricular fibrillation). Even though this patient was a poor risk (myocardial ischaemia, severe emphysema, jaundice, obese) he had a smooth anaesthetic and an uneventful postoperative course.

FIGURE 4. Anaesthetic chart and blood data protocol. Observe the stable vital signs throughout the anaesthetic. This patient required more muscle relaxant than was usual.

NAME	JA		SEX	M	HT	64"	WT	130#	ESTIMATED	100-60
PROPOSED OPERATION	Abdominal-Perineal Resection									
PRE OP DIAG	Carcinoma of rectum									
PRE ANESTH. MED	Perphenazine 5mg. + atropine 0.6mg.									
IDENTITY	X	CONSENT	X	ESP	X	0	PUPILS	=	P	L
POSITIVE FINDINGS	Emphysema									
TIME	11am	12	1	2						
WATER	10 liters									
ETHER	CHCl ₃ 0.8%									
CYCLO	G 100									
T.C.S.	5% D/W									
MUSCLE RELAX.	Blood transfusions									
INTRA-THORAC.	5 liters									
ANALG.	Arterial blood samples									
OXYGEN										
REMARKS	Smooth Induction with Thiopental 325mg. Gallamine 100mg. Chloroform 0.8% (Chlorotec)									
FLUID LOSS	592ml.									
FLUID INTAKE	Takaoka @ 18									
TOTAL FLUIDS	400ml. 5% D/W									
	750ml. Blood									
AGE OF PATIENT	Thiop. 2.5% Gallamine CHCl ₃ N ₂ O									
	I.v. 325mg 100mg. 0.8% 65%									
	non rebreathing									
	as above									
SURGEONS	Skinner Dobkin									

Patient JA Hosp.# 52411 Age 73 Sex M Ht. 64" Wt. 130# B.S.A. 1.62 Physical State 2 Build Medium
 Anaesth.# 100-60 Premed.: Perphenazine 5mg. + Atr. 0.6mg. Anaesth.: Thiop. 325 + G 100 + N₂O - Chloroform
 Pulm. Vent.: Method- TAKAOKA Amplitude +15, -4 Phases 2
 Blood Pressure: Preop.: 120/84 During Anaesth.: 124/86 (Steady) Postop.: 138/90 (Steady)

Ventilation Data	Control	General Anaesthesia	Postop.
Time	10.15	11.15	12.15
Tidal Volume ml	S.R.	600	600
Rate/min.	15	18	18
Minute Volume liters	10.8	10.8	10.8
Arterial Blood Data			
Hgb.	12.5		11.7
Hct.	38	40	40
pH	7.37	7.43	7.42
Total CO ₂ content mM/L	24.5	22.5	22.5
Plasma HCO ₃ ⁻ mM/L	23.2	21.4	20.8
pCO ₂ mm.Hg.	42	34	34
% O ₂ saturation	86	91	97

Summary & Remarks: Resection Large Bowel (Ca. Recto-sigmoid), Lithotomy - head low position. Anaesthesia was maintained for 170 minutes with Chloroform (0.5 - 1%) in a Chlorotec vaporizer and Nitrous oxide - Oxygen (2:1) in a nonrebreathing system. Ventilation was controlled with a TAKAOKA respirator and monitored with a Wright respirometer. Anaesthetic and postoperative course were uneventful.

FIGURE 5. Anaesthetic chart and blood data protocol. Observe very smooth anaesthetic course during an abdominal perineal operation.

lyses de sang, nous avons observé que l'anesthésie au chloroforme, administrée de cette façon, n'a pas modifié l'équilibre électrolytique et, de plus, n'a pas diminué la saturation en oxygène du sang. Nous avons réussi, avec ce système, à maintenir un plan constant d'anesthésie chirurgicale avec moins de 1% de chloroforme. A la suite de ces expériences, nous n'avons observé que peu de différence entre le chloroforme et les autres agents anesthésiques puissants qui ont été étudiés de la même façon.

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