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ELECTROACUPUNCTURE IN ANAESTHESIA FOR HYSTERECTOMY

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SUMMARY

We have studied the effects of electroacupuncture at classical acupuncture points, applied before and during surgery in patients undergoing hysterectomy, on postoperative pain and metabolic stress responses in a prospective, randomized and patient-blinded manner. Fifty otherwise healthy women were allocated randomly to receive or not receive electroacupuncture. Electroacupuncture was begun 20 min before skin incision and continued to the end of surgery. All patients received similar general anaesthesia and all received patient-controlled analgesia (PCA) after operation. Postoperative pain in the two groups was evaluated by recording analgesic requirements by PCA and by pain-rating performed by patients and nursing staff. There were no significant differences between the two groups in postoperative analgesic requirements, pain-rating or metabolic stress responses. (Br. J. Anaesth. 1993; **71**: 835–838)

KEY WORDS

Acupuncture. Pain: postoperative, patient-controlled analgesia. Surgery: hormonal response.

Postoperative peripheral electrostimulation has been suggested to have a beneficial effect on postoperative pain when given as either transcutaneous nerve stimulation or electroacupuncture [1–3]. It has also been suggested that peripheral electrostimulation may produce analgesia during operation [4–6]. One of these studies suggested that peripheral electrostimulation given before and during the painful stimulus may produce prolonged analgesia [4]. In a previous randomized study using electroacupuncture after operation, we found a significant reduction in pethidine requirements after operation in the group given electroacupuncture [1]. In recent years there has been interest in various anaesthetic techniques which may modify the stress response to surgery [7–13], but only a few have examined electroacupuncture [11].

In this study, we have examined the effect of pre- and peroperative electroacupuncture on postoperative pain and the metabolic stress response to anaesthesia and surgery.

PATIENTS AND METHODS

This prospective, randomized and patient-blinded study of electroacupuncture was performed before and during operation in women undergoing elective hysterectomy. The study was blinded to the nursing staff performing postoperative pain rating, but not to the anaesthetist performing anaesthesia. The study was approved by the Local Human Investigations Committee and informed consent was obtained.

We studied 50 otherwise healthy women of mean age 45 yr (range 33–66 yr). On the day before operation, weight, arterial pressure, heart rate and handgrip strength (a marker of fatigue) were recorded and the patient-controlled analgesia system (PCAS) demonstrated. The patients were asked if they had previously experienced transcutaneous nerve stimulation, electroacupuncture or classical acupuncture. Preoperative anxiety was assessed by the patient on a scale from 1 to 4 (no anxiety, slight, moderate and very anxious). The acupuncture loci were identified in all patients the day before surgery. All patients were premedicated with oral diazepam 0.2 mg kg^{-1} 2 h before anaesthesia. Arterial pressure, ECG and Sp_{O_2} were monitored and 0.9 % sodium chloride was given i.v. Pethidine 1.5 mg kg^{-1} i.v. was given and anaesthesia induced with propofol 1.2–1.5 mg kg^{-1} i.v. Tracheal intubation was facilitated by administration of vecuronium 0.1 mg kg^{-1}. Ventilation was controlled manually and anaesthesia maintained with 66 % nitrous oxide in oxygen, continous infusion of propofol 4–8 mg kg^{-1} h^{-1}; pethidine 0.5 mg kg^{-1} was given before skin incision and thereafter as required, at the discretion of the anaesthetist. A Pfannenstiel incision was used in all operations.

Electroacupuncture

Immediately after induction of anaesthesia, the patients were allocated randomly to receive either electroacupuncture (group EA+) or no electroacupuncture (group EA−) (25 in each group). The

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loci for electroacupuncture were selected from standardized acupuncture formulae for anaesthesia for hysterectomy [1]: GV2 = Govenor vessel 2, Jao-Iu, in the dorsal midline between the coccyx and sacrum; GV4 = Govenor vessel 4, Ming-men, in the dorsal midline below the spinal process of the 2nd lumbar vertebra; B 32 = bladder 32, Ciliao, bilaterally in the second sacral foramen; SP 6 = spleen 6, Sanjiniao bilaterally on the medial edge of the tibia, four fingerwidths above the tip of the internal malleolus; ST 36 = stomach 36, Zusanli, one fingerwidth lateral to the tuberositas tibia.

After induction, the patients in group EA+ were placed on the side. Sterile transparent dressings were placed over each locus. Acupuncture needles were sterilized solid stainless steel, 10 cm long and 30-gauge. They were inserted to the prescribed depth for each locus, bent back against the plastic and taped in place, with wires connected to a constant current source. The patient was turned supine again. Electroacupuncture was commenced using a constant current source with pulse width 320 ms, approximately 12 V, and chain frequencies 10 Hz and 100 Hz [1], for 20 min before skin incision was allowed. A similar period passed before incision in group EA−. Electroacupuncture was given throughout the operation to group EA+; it was discontinued and the needles removed at the end of surgery, while the patient was still anaesthetized.

Patient-controlled analgesia and pain rating

After tracheal extubation and transport to the recovery room, all patients in both groups were connected to a patient-controlled analgesia system (PCAS) providing pethidine i.v. with boluses of 20 mg in the first 1 h and 10 mg in the subsequent 3 h with a lockout time of 10 min. Doses were registered on a chart recorder. Arterial pressure, heart rate and Sp_{O_2} were recorded every 30 min for the first 2 h and thereafter at 1-h intervals. Supplementary oxygen 2 litre min^{-1} was given via a nasal catheter. All patients were given prophylactic metoclopromide 12.5 mg i.v. as antiemetic. No additional analgesia was administered by the nurse in the recovery room.

One hour after arrival in the recovery room, the patient was asked to complete a 100-mm vertical visual analogue scale (VAS score) for pain at rest and after coughing and to perform a pain rating on a scale 1–4 (none, slight, moderate and heavy pain). A contemporary rating on the same scale was performed by a recovery nurse. These recordings were repeated after 4 h, the PCAS disconnected and the patient discharged to the ward.

Stress markers

Venous blood samples were obtained and the temperature recorded on the morning of admission and on the first and second days after operation. Blood concentrations of glucose, transferrin and orosomucoid, white and red blood cell counts and serum concentrations of haemoglobin, TSH and T4 were measured. Venous samples were obtained 1, 2 and 6 h after skin incision for measurement of T4, TSH, and glucose. Urine was collected for 24-h periods (08:00 to 08:00) on the day before operation, the day of operation and the first and second days after operation for measurement of daily urinary cortisol excretion. Handgrip strength (dominant hand with patient in supine position) was recorded on the morning before and the first and second days after surgery.

Statistics

The size of the groups was calculated using power analysis with a type 1 error of 0.05, a type 2 error of 0.20 and a minimal clinical difference of interest between groups of pethidine 20 mg used in the recovery room. Statistical analyses were performed using non-parametric tests: Wilcoxon rank sum test for paired differences and the Multiple ANOVA for analyses of variance.

RESULTS

The two groups were similar in age and weight (table I). Two patients in each group had experienced acupuncture before. There was no difference in distribution of anxious patients between groups, the majority being slightly anxious. There were no problems in placing the needles, the operations were

TABLE I. *Patient data (mean (range)). † Between groups*

	Age (yr)	Weight (kg)	Duration of anaesthesia (min)	Propofol requirement (mg)
Group EA+ ($n = 25$)	45 (33–58)	68 (53–96)	133 (95–180)	690 (180–900)
Group EA− ($n = 25$)	43 (33–60)	64 (54–92)	120 (85–180)	605 (380–850)
†P	0.62	0.47	0.07	0.12

TABLE II. *Mean (range) pethidine requirements during operation, during 1 h and 2 h after operation and the total postoperative requirement for pethidine in the recovery room. † Between groups*

	Pethidine requirement (mg)			
	During operation	0–60 min	0–120 min	0–240 min
Group EA+ ($n = 25$)	147 (100–250)	57 (0–100)	82 (0–180)	139 (20–230)
Group EA− ($n = 25$)	142 (100–220)	66 (20–120)	90 (20–180)	150 (50–250)
†P	0.19	0.33	0.54	0.48

TABLE III. *Mean (range) of visual analogue scale (VAS) scores for pain, at rest and while coughing. No statistical differences between groups*

	VAS score for pain			
	At rest		Coughing	
	2 h	4 h	2 h	4 h
Group EA+ ($n = 25$)	51 (12–95)	43 (5–80)	64 (22–95)	58 (17–95)
Group EA− ($n = 25$)	51 (20–90)	65 (20–90)	63 (30–90)	87 (32–90)

TABLE IV. *Mean (range) of blood samples and 24-h urinary cortisol measurements in patients receiving electroacupuncture (group EA+) or no treatment (group EA−). Normal values are indicated. No statistical differences between groups*

	Before op.		Day 1		Day 2		Day 3	
Normal range	EA+ ($n = 25$)	EA− ($n = 25$)	EA+ ($n = 25$)	EA− ($n = 25$)	EA+ ($n = 25$)	EA− ($n = 25$)	EA+ ($n = 25$)	EA− ($n = 25$)
Urinary cortisol	135	107	1659	1324	308	253	170	287
(nmol litre^{-1}) 50–230	(39–279)	(38–195)	(148–4405)	(102–3694)	(55–1029)	(53–1169)	(64–289)	(57–2025)
Transferrin	42	40			33	32	30	30
(μmol litre^{-1}) 22–55	(30–64)	(32–54)			(20–58)	(24–43)	(21–44)	(21–44)
Orosomucoid	0.8	0.7			0.86	0.89	1.22	1.23
(g litre^{-1}) 0.4–1.2	(0.37–1.3)	(0.5–0.93)			(0.57–1.24)	(0.6–1.64)	(0.1–1.1)	(0.81–1.69)
Leucocytes	5.8	6.7			9.8	9.7	9.1	8.6
($\times 10^9$ litre^{-1}) 4.0–10.0	(3.6–9.5)	(3.3–13.2)			(6.9–15.2)	(6.2–15.2)	(6–12.8)	(4.5–14.3)
T4	99	99			85	86	95	95
(nmol litre^{-1}) 60–140	(83–104)	(69–144)			(63–134)	(55–124)	(69–135)	(71–135)
TSH	1.8	1.4			1.8	1.4	1.7	1.5
(mu. litre^{-1}) 0.4–4.0	(0.4–7.5)	(0.6–4.4)			(0.3–4.7)	(0.3–6.8)	(0.4–5.4)	(0.6–5.0)
Blood sugar	4.8	4.8			4.9	4.7	4.7	4.9
(mmol litre^{-1})	(2.7–7.5)	(3.7–5.8)			(4.0–7.8)	(3.3–6.1)	(2.9–6.0)	(3.8–7.1)
Temperature	36.6	36.6			37.3	37.2	37.6	37.7
(°C)	(35.8–37.6)	(36.0–37.5)			(36.7–38.1)	(36.4–37.6)	(37.3–38.4)	(37.4–38.2)
Handgrip strength	0.8	0.8			0.8	0.7	0.9	0.7
(Barr)	(0.7–1.2)	(0.6–1.3)			(0.5–1.1)	(0.4–0.8)	(0.5–1.4)	(0.5–1.1)

TABLE V. *Mean (range) blood sugar and serum TSH concentrations just before incision and 1 and 6 h after incision in patients receiving electroacupuncture (EA+) or no treatment (EA−). Significant difference from before incision within group: *P < 0.05. No significant difference between groups*

	Blood sugar (mmol litre^{-1})			TSH (mu. litre^{-1})		
	Before incision	1 h after incision	6 h after incision	Before incision	1 h after incision	6 h after incision
Group EA+	5.2	5.6	7.5	4.2	4.03*	1.7*
($n = 25$)	(3.5–6.7)	(0.28–7.4)	(4.1–7.8)	(0.81–19.1)	(0.74–12.81)	(0.31–6.97)
Group EA−	5.3	5.6	6.5	2.9	2.7*	1.2*
($n = 25$)	(3.6–7.7)	(3–7.1)	(4.6–10.1)	(0.82–9.12)	(0.71–7.91)	(0.39–3.41)

uneventful and no patient required blood transfusion. There was no significant difference in duration of anaesthesia between the two groups.

There was no significant difference in pethidine consumption between groups for cumulative periods of 60, 120 and 240 min after operation (table II) or for VAS scores (table III).

There was no significant difference between the two groups in the markers of metabolic stress response and no significant difference in handgrip strength throughout the study, or significant change within both groups from preoperative to postoperative values (tables IV and V).

DISCUSSION

This study was prospective, randomized and patient-blinded, but observer blinded only for the postoperative period as blinding the anaesthetist would have been difficult. Reproducibility was attempted by precise specification of acupuncture loci and mode of stimulus and assessment of effects by the use of both subjective and objective measures—mainly VAS score and PCAS.

In a previous randomized and patient-blinded study [1], electroacupuncture was used after operation in women undergoing elective hysterectomy, while they were still anaesthetized. Postoperative analgesia was assessed using PCAS consumption of pethidine. There was 40 % less pethidine used by the group given electroacupuncture. The failure of the present study to demonstrate an effect of electroacupuncture may be attributed to several reasons.

It is possible that the effects of electroacupuncture given before and during operation may have terminated before the postoperative observation period. This accords with the results of our previous study, in which the effects of postoperative electroacupuncture were significant only within the first 2 h after operation. Although we may have expected to observe an effect on the peroperative requirement for pethidine in the EA+ group, such an effect may have been masked by the relatively large amounts of pethidine used for induction and maintenance (1.5 mg kg^{-1} at induction and 0.5 mg kg^{-1} at skin incision), which may also have induced a pre-emptive effect [14]. In addition, in the present study we used propofol rather than thiopentone as in our previous study, and this may have been a confounding factor.

The surgical stress response was not modified by pre- and peroperative electroacupuncture as was also the case in two other studies of electroacupuncture [11, 13]. Kho and colleagues used electroacupuncture supplemented with pethidine in awake patients, but the study was performed without a control group [11]. In a later study [13], the same

group used electroacupuncture after induction of general anaesthesia but 30 min before surgery; there was no difference between the EA+ and EA− groups.

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