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Auricular acupuncture for pain relief after total hip arthroplasty – a randomized controlled study

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Abstract

Auricular acupuncture (AA) is known to be effective in treatment of various pain conditions, but still there have been no randomized controlled studies of AA for treatment of acute postoperative pain. Therefore we tested whether AA of specific points is superior to sham acupuncture for complementary analgesia after total hip arthroplasty in a patient–anesthesiologist–evaluator–analyst blinded study. The patients were randomly allocated to receive true AA (lung, shenmen, thalamus and hip points) or sham procedure (4 non-acupuncture points on the auricular helix). Permanent press AA needles were retained in situ 3 days after surgery. Postoperative pain was treated with intravenous piritramide (opioid receptor agonist with analgesic potency of 0.7 compared with morphine) using a patient-controlled analgesia (PCA) pump. The time to the first analgesic request, the amount of postoperative piritramide via PCA and pain intensity on a 100-mm visual analogue scale (VAS-100) were used to evaluate postoperative analgesia. Intraoperative anesthetic requirement, incidence of analgesia-related side effects, inflammation parameters and success of patients' blinding were also recorded. Fifty-four patients (29 AA and 25 controls) completed the study. Piritramide requirement during 36 h after surgery in AA group was lower than in control: 37 ± 18 vs. 54 ± 21 mg; mean $\pm$ SD; $P = 0.004$. Pain intensity on VAS-100 and incidence of analgesia-related side effects were similar in both groups. The differences between the groups as regard patients' opinions concerning success of blinding were not significant. Findings from our study demonstrate that AA could be used to reduce postoperative analgesic requirement.

Keyword: Acupuncture

1. Introduction

Effective relief of acute pain has been associated with increased patient satisfaction in addition to shortened hospital stays and decreased morbidity and mortality (Ballantyne et al., 1998; Tsui et al., 1997).

Despite a better understanding of the pathophysiology of pain, the pharmacology of analgesics and the development of numerous analgesic techniques, many patients continue to experience distressing pain after elective surgery. A recent review of 165 papers, including nearly 20,000 patients, has shown that 29% still experienced moderate pain and 11% severe postoperative pain (Dolin et al., 2002). Even when patient-controlled analgesia (PCA) was used, which is considered to satisfy the individual patients' analgesic demand, the incidence of moderate pain was 35.8% and that of severe pain was 10.4%. Moreover, systemic opioids administered via PCA pumps can cause numerous side effects such as respiratory depression, decreased intestinal motility, nausea, vomiting and itching, which can all lead to decreased life quality after major surgery and may result in significant morbidity and even mortality (Ashburn et al., 1994; Ballantyne et al., 1998; Schug and Torrie, 1993). In order to achieve better postoperative pain relief, various complementary non-pharmacological analgesic techniques, including acupuncture, have been tested (Chen et al., 1998; Kotani et al., 2001; Lao et al., 1999).

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Auricular acupuncture (AA), an old chinese therapeutic technique, is reported to be effective in treatment of pain syndromes of various origins (Alimi et al., 2003; Simmons and Oleson, 1993; Vorobiev and Dymnikov, 2000). AA was first introduced into clinical western medicine by Nogier (1972), who empirically identified AA points.

In the last decade AA found its place as a complementary technique in perioperative medicine. Randomized controlled trials (RCT) have shown AA to decrease preoperative anxiety in patients scheduled for ambulatory surgery (Wang et al., 2001), reduce anesthetic requirement in healthy individuals (Taguchi et al., 2002) and relieve chronic pain in cancer patients (Alimi et al., 2003). To our knowledge, there has been no RCT assessing AA effectiveness in relief of acute postoperative pain. Designing control procedures in acupuncture studies is difficult (Usichenko et al., 2003b). A placebo using non-inserted needles has been reported to be a valid control procedure for evaluation of postoperative analgesic effect of acupuncture (Lao et al., 1999). However, it does not account for the non-specific physiological response of intradermal needle penetration, which has been reported in experimental and clinical studies to have analgesic properties (Le Bars et al., 1979; Lewith and Machin, 1983). To investigate whether the acupuncture has any specific effects beyond the physiological reaction of needle penetration, the control group should always receive sham acupuncture, defined as a needle insertion either into sites other than traditional points or meridians, or into inappropriate acupuncture points (White et al., 2002).

Therefore we performed the following study to test whether the AA of specific points is superior to sham acupuncture for complementary analgesia after total hip arthroplasty (THA).

2. Methods

2.1. Study design and randomization

This prospective randomized patient–anesthesiologist–evaluator–analyst blinded, sham acupuncture controlled study was approved by the local ethics committee. It was performed at the Departments of Anesthesiology and Orthopedic Surgery, University of Greifswald, Germany, from November 2002 to September 2003. Sixty-one patients scheduled for elective THA performed under general anesthesia were enrolled in the study.

The preoperative anesthesiologic evaluation along with the patients' randomization for the study and the AA procedure were performed during the day before surgery. After obtaining written informed consent, the anesthesiologist-coordinator consecutively allocated the patients to two groups using a table of random numbers (Bland, 2000). The coordinator had no personal contact with the patients after randomization and was unaware which group later received true AA or a sham procedure. Immediately after randomization the coordinator informed one of the two available acupuncturists of the group allocation of the patient. The evening before surgery, the acupuncturists performed AA of specific points (AA group) or a sham procedure (control group) according to the randomization. Only the two acupuncturists who performed AA were aware of patients' allocation to the study groups. The coordinator sent the patients' randomization list to the analyst after the last patient was enrolled in the study. The patients' grouping was unblinded only after all data analysis had been completed.

2.2. Patient selection criteria

Patients with an American Society of Anesthesiologists physical status of I–III scheduled for elective THA because of degenerative osteoarthritis were enrolled in the study. The patients were not included if they: (1) had a history of opioid medication, (2) were unable to understand the consent form or how to use a PCA device and a visual analogue scale (VAS) for pain measurement, (3) had a history of alcohol abuse and/or psychiatric disease, (4) revealed extreme obesity (body mass index >40), (5) had local or systemic infection, (6) or if they had prosthetic or damaged cardiac valves. Patients were excluded from the study: (1) when surgery time exceeded 200 min or intraoperative complications (intraoperative bleeding requiring blood transfusion of more than 4 units of packed red blood cells or cardiovascular instability requiring catecholamines) occured, (2) when there was a necessity to change perioperative treatment scheme, (3) or in the cases of auricular perichondritis or severe intercurrent disease.

2.3. Auricular acupuncture

The patients were told that they would receive acupuncture at specific points or non-acupuncture points in addition to standard postoperative analgesia via PCA. Disposable permanent press steel 'Carbo' AA needles from Helio Medical Supplies, USA, had the diameter of 0.22 mm and the length of 1.5 mm. The needles were inserted the evening before surgery, fixed with the flesh-colored adhesive tape and retained in situ during the 3 days after surgery. The AA group received acupuncture at four specific acupuncture points ipsilateral to the surgery site: hip joint, shenmen, lung and thalamus (Fig. 1). The choice of the specific AA points was based on (1) the experts' treatment protocol for acute pain in lower limbs (Oleson, 1998), (2) clinical reports (Grammel, 1981; Vorobiev and Dymnikov, 2000) and (3) frequently found patterns of AA points with lower skin resistance in patients during orthopedic surgery (Usichenko et al., 2003a). The duration of AA needle retention up to 3

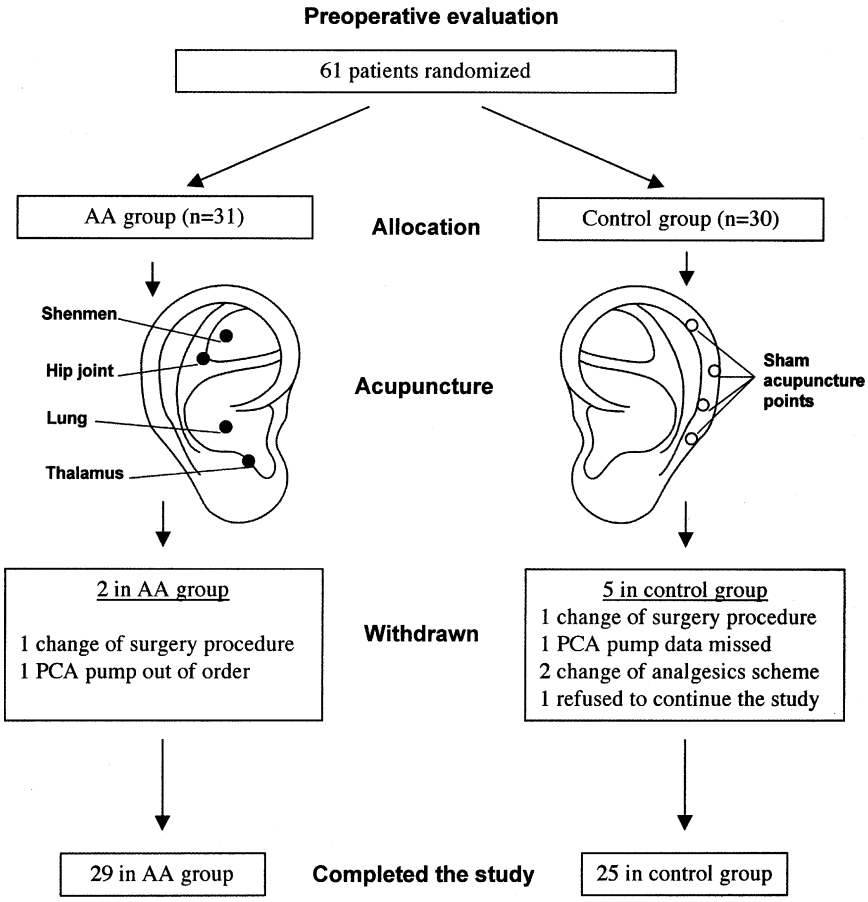

Fig. 1. Flow diagram with specific and sham auricular acupuncture points (non-acupuncture points of helix) used in the study.

days after the surgery was chosen because the usual period of maximal postoperative pain after THA is 2–3 days. The corresponding duration of intravenous opioid analgesia via PCA after elective THA in our clinic is also 3 days. The non-acupuncture points of the helix ipsilateral to the site of surgery were used for control procedure, which has been described as the most suitable for sham acupuncture (Margolin et al., 1995). The localization of both specific acupuncture points and non-acupuncture points was confirmed using the electrodermal point finder, which is able to detect the zones of low skin resistance (Usichenko et al., 2003a). AA was performed by two certified and experienced acupuncturists (each with more than 5 years of clinical acupuncture practice). Interaction between the patient and acupuncturist was limited to the time required for detection and needling of the AA points. Thereafter, acupuncturists did not have patient contact.

2.4. General anesthesia and postoperative care

Thirty minutes before surgery the patients were given oral midazolam 0.05 mg/kg. Anesthesia was induced intravenously with thiopental (4–5 mg/kg) and fentanyl (1–2 μg/kg). Cis-atracurium (0.1 mg/kg) was used to facilitate trachea intubation. Lung ventilation was mechanically controlled to keep end-tidal carbon dioxide at 4.5–5.3 kPa throughout the surgery. Anesthesia was maintained with isoflurane (0.8–1.0 vol% end-tidal concentration) in a 40% oxygen–air mixture. The fentanyl was titrated to prevent spontaneous movements during surgery and to ensure that the heart rate and mean arterial pressure were within 20% of baseline values. Active surface warming was administered if the core temperature fell below 1 °C from baseline level. The anesthesiologists performing the general anesthesia had no previous AA expertise, but were instructed how to stimulate AA needle sites. The stimulation was manually performed for 5 min by massage of the AA needles before the trachea intubation, during the most painful phase of surgery and before the extubation.

After surgery the patients were transferred to the anesthesia recovery room until they complained of pain. After the first request for pain medication the patients received the initial bolus of piritramide (opioid receptor agonist with analgesic potency of 0.7 compared with morphine) of 0.05 mg/kg and the PCA pump with piritramide was connected to the patient. The 'Vygon' PCA-pump® (Laboratories Pharmaceutiques Vygon, France) was set to deliver 2 mg piritramide with a 5-min lock-out period. The aim of the postoperative pain relief was

to keep the pain intensity reported by the patients at less than 40 mm on a 100 mm visual analogue scale (VAS-100, where 0, no pain; 100, worst pain imaginable). The patients were instructed how to stimulate the AA needles by means of massage. They were encouraged to stimulate the needles for 5 min every time they experienced pain >40 mm (VAS-100) and only after that to inject the opioid analgesic via PCA pump, if needed. If the patients still complained of pain on the first postoperative day with pain intensity >40 mm, additional doses of intravenous piritramide (3–5 mg) were administered by the orthopedic surgeon in-charge and registered at the study protocol. The PCA pump was left connected to the patient until the evening of the third postoperative day. PCA analgesia was discontinued on the second or third postoperative day if the patient reported pain intensity <40 mm (VAS-100) after a 3-h period without analgesic demand. If the patients complained of pain >40 mm (VAS-100) on the second postoperative day (36 h after surgical procedure), oral analgesia was administered (ibuprofen 400–800 mg twice a day) and was also recorded. The Orthopedic Surgery Department nurses and the physicians involved in patient management and data collection were blinded to group allocation and had no previous AA expertise.

2.5. Outcome measures

The primary endpoint was the postoperative piritramide requirement via PCA during the first 36 h after the surgery—during this time the patients received no other analgesics. The secondary endpoints were: pain intensity assessed by patients on VAS-100 at rest, registered during 3 days after the surgery at 2 and 8 pm every day; time to first PCA request; total piritramide requirement via PCA during 3 days after the surgery; the incidence of analgesia-related side effects: nausea and vomiting, sedation and pruritus, and total ibuprofen consumption during the second and third postoperative days. Intraoperative fentanyl requirement, body temperature, heart rate and blood pressure were taken twice a day during the 3 days after the surgery. White blood cell count, erythrocyte sedimentation rate and C-reactive protein activity were obtained at baseline and on the first and third days after the surgery. The success of patients' blinding (i.e. their opinion whether they received true or sham AA and whether they would like to receive AA in the future) was tested on discharge from the hospital. The evaluator who collected the outcome data had no previous knowledge concerning AA and was blinded to the patients' group allocation.

2.6. Statistical analysis

Statistical analysis was performed using SPSS 11.0 statistic package for Mac OS X version (SPSS Inc., Chicago, IL, USA). In order to calculate the sample size we set the level of significance to 0.05 and power at 80%. In order to find a mean total piritramide difference of 35% between the treatment and control groups, we calculated the number of patients required for each of the two groups to be 27. The study size was set to a total of 60 patients. Normally distributed continuous data (demographics, piritramide requirement, pain intensity on VAS-100, heart rate and blood pressure, laboratory parameters) were compared using the unpaired Student t test. Skewed data (time to first piritramid requirement, total ibuprofen consumption) were compared using Mann–Whitney test. Chi-square test was used to analyze the success of patients' blinding and the incidence of analgesia-related side effects. $P<0.05$ was considered statistically significant.

3. Results

3.1. Patients characteristics

Sixty-one out of 75 patients who initially agreed to take part in this study met the inclusion criteria and were randomized. The groups were well balanced for age, weight and gender (Table 1). All patients in this study were Caucasians who had never previously received AA. Fifty-four patients completed the study: 29 patients in AA group and 25 in the control group. The difference between the study groups regarding withdrawal rate was not statistically significant. One patient from the control group refused to continue the study on the first postoperative day because of local pain at the sham acupuncture site. The data of the remaining six patients was withdrawn from the final assessment because they met one or more of the exclusion criteria (Fig. 1).

3.2. Success of blinding

Twenty-five patients from the AA group vs. 21 from the control group believed they had received true acupuncture and wanted to repeat this procedure for pain relief in the future (Table 2). Three patients out of 29 from AA group and three out of 25 from the control group thought they had

Table 1
Patients' characteristics

	AA group ($n=29$)	Control group ($n=25$)
Age (year)[a]	68±10	66±11
Weight (kg)[a]	86±15	82±14
Body-mass index (kg/m^2)[a]	30.4±4.8	28.1±3.8
Gender, m/f[b]	12/17	12/13
Withdrawn, m/f[b]	1/1	1/4

AA, auricular acupuncture.
[a] Values are mean±SD.
[b] Values are number of patients.

Table 2
Success of patients' blinding

Considered	AA group ($n=29$)	Control group ($n=25$)
– AA was true	25 (86)	21 (84)
– sham	3 (10)	3 (12)
– don't know	1 (3)	1 (4)
– ready to repeat AA	25 (86)	21 (84)

Values are number of patients (%); AA, auricular acupuncture.

received sham acupuncture. One patient from the AA group and one patient from the control group were unsure whether they had received true AA or sham acupuncture. The differences of patients' opinion concerning success of blinding between the groups were not significant.

3.3. Analgesic requirement and pain intensity

The AA group required 32% less piritramide than the control group during the first 36 h after surgery: mean 37 vs. 54 mg, $P=0.004$ (Fig. 2A). When adjusted to the patients' weight this effect was more pronounced, with a piritramide reduction of 35%, $P=0.001$ (Table 3). The total amount of piritramide required by the patients from AA group through the third postoperative day was reduced by 36% in comparison with control group: mean 0.54 vs. 0.84 mg/kg, $P=0.002$. The time to first request for piritramide was longer in AA group than in control: median 40 vs. 25 min, $P=0.04$. Pain intensity on VAS-100 was similar in AA and control groups at all time-points registered (Fig. 2B). Nine patients from the AA group vs. six controls did not require ibuprofen on the second and third days after the surgery. Twenty patients from AA group who received ibuprofen on the second and third postoperative days, required less of this drug than controls (median 1600 vs. 2100 mg). However, the overall difference in the ibuprofen consumption between the groups was not statistically significant. Intraoperative fentanyl requirement and duration of general anesthesia were comparable in both groups (Table 3). Heart rate, blood pressure, body temperature and laboratory parameters were similar in both groups during the course of postoperative monitoring (data not shown).

3.4. Side effects

The incidence of analgesic-induced side effects was similar in both groups (Table 4). No patient developed respiratory depression. Three patients (2 controls and 1 from AA group) complained of local pain at the AA needles insertion sites. One patient from the control group who refused to participate further in the study was excluded from the final assessment (Fig. 1). Minor auricular hemorrhages occurred at the insertion sites of AA needles in 2 patients. In both cases the acupuncture needles were withdrawn on the second postoperative day and the site of hemorrhage appropriately treated without further complications. One patient from the AA group reported a headache ipsilateral to acupuncture site the morning prior to surgery. After the surgical procedure the headache disappeared and postoperative AA treatment was completed. Two patients from the AA group reported increased pain at the site of surgery after the withdrawal of acupuncture needles on the third postoperative day.

4. Discussion

4.1. Analgesic properties of AA

Auricular acupuncture applied to specific acupuncture points appeared to be more effective than sham acupuncture

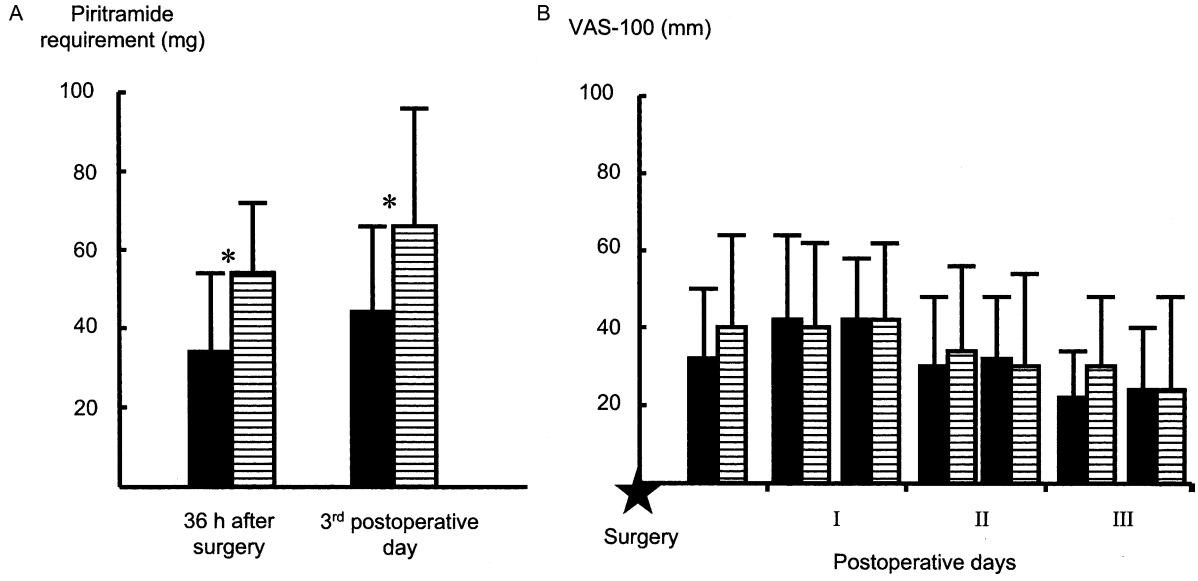

Fig. 2. (A) Postoperative piritramide requirement via PCA 36 h after the surgery and total requirement on the third postoperative day. (B) Intensity of postoperative pain on visual analogue scale (VAS-100) measured during 3 postoperative days at 2 and 8 pm. Filled bars, patients who received true auricular acupuncture; hatched bars, control group with sham acupuncture as mean ± SD, * for $P<0.005$.

Table 3
Main results

Outcome measures	AA group ($n=29$)	Control group ($n=25$)	P
Duration of anesthesia (min)[a]	132±31	122±24	n.s.
Intraoperative fentanyl requirement (μg)[a]	365±131	380±108	n.s.
Time to first piritramide request (min)[b]	40 (15–59)	25 (10–35)	0.04
Piritramide requirement 36 h after surgery (mg)[a]	37±18	54±21	0.004
Piritramide 36 h after surgery adjusted to weight (mg/kg)[a]	0.44±0.22	0.67±0.27	0.001
Pain intensity (VAS-100) 36 h after surgery[a]	44±17	44±22	n.s.
Total piritramide requirement (mg)[a]	46±22	67±31	0.005
Total piritramide adjusted to weight (mg/kg)[a]	0.54±0.25	0.84±0.41	0.002
Total ibuprofen (mg)[b]	1600 (800–3000)	2100 (1200–3200)	n.s.

[a] Values are mean±SD.
[b] Values are median (interquartile range).

in reducing postoperative piritramide requirement after elective THA. In order to obtain reliable results in pain measurement using PCA requirement, the piritramide titration was adjusted to achieve similar pain values on VAS (McQuay and Moore, 1999). We found the mean reduction of VAS to be 44 mm, 36 h after THA procedure in both groups. Although it was slightly higher than the desirable value of 40 mm, considered adequate for postoperative acute pain (Rawal and Berggren, 1994), the majority of patients in both groups found the postoperative pain relief satisfactory and were ready to repeat this modality of analgesia in future. The prolonged time before the first piritramide request after surgery in AA group vs. control provided further evidence for analgesic effectiveness of AA. Intraoperative factors were similar in both groups, so the potential to confound the postoperative analgesic requirement is unlikely.

AA procedure was safe, although some patients had minor transitory complications. AA was easy to perform under perioperative clinical conditions using permanent press needles, which were retained in situ for 3 days after surgery.

4.2. Methodological aspects

The study protocol was based on the experts' recommendations for RCT of acupuncture, which follow CONSORT guidelines for specific requirements of acupuncture studies (MacPherson et al., 2001; Moher et al., 2001). The groups were well balanced regarding potential confounders such as age, gender and body mass index. The quadruple (patient–anesthesiologist–evaluator–analyst) blinded study design and the choice of primary endpoint of the study (analgesic requirement via PCA) minimized the potential biases. The reliability of results obtained was strengthened by adequate blinding of patients, which was confirmed by the test on the success of blinding.

The study design allowed us to avoid one of the major questions of clinical acupuncture research—whether to use individualized or formulaic acupuncture (Hogeboom et al., 2001). Original acupuncture textbooks state that individualized acupuncture provides better outcomes than the formulaic one. One meta-analysis on treatment of chronic pain with acupuncture confirmed this statement and showed that individualized acupuncture compromised the methodological quality of the trials (Patel et al., 1989). However, in our study the homogeneous population and comparable nociceptive field of THA was well suited for formulaic AA. The pattern of four specific AA points can be easily learned and used by anesthesiologists/pain management practitioners who have no previous acupuncture knowledge.

4.3. Comparison with prior studies

Findings from our study confirm the old observation of Oleson et al. (1980) about the positive correspondence between painful body regions and specific auricular points with high electrical conductivity, although there is still no neurophysiological explanation of that phenomenon.

Our data on postoperative pain relief and reduction of analgesics requirement due to AA are in agreement with previously reported studies which favor AA applied to specific acupuncture points (Grammel, 1981; Taguchi et al., 2002; Vorobiev and Dymnikov, 2000). Grammel reported a 75% reduction of weak opioid analgesic (mixture of tilidine/pethidine) in 20 patients scheduled for THA who received

Table 4
Incidence of reported side effects

Side effects	AA group ($n=29$)	Control group ($n=25$)
Analgesia related		
Drowsiness	14 (48)	16 (64)
Nausea	7 (24)	4 (16)
Vomiting	4 (14)	4 (16)
Pruritus	2 (7)	2 (8)
AA related		
Auricular hemorrhage	1 (3)	1 (4)
Local pain	1 (3)	2 (8)
Headache	1 (3)	0
Hip pain after needles withdrawal	2 (7)	0

Values are number of patients (%); AA, auricular acupuncture.

AA in specific acupuncture points compared to standard pain relief. The absence of randomization and blinding in that study may have influenced the postoperative pain relief management to a great extent. Although the PCA devices were also unavailable at the time, when the Grammel study was performed, the reduction of postoperative opioid analgesics deserves attention and an attempt at replication.

The somewhat modest piritramide reduction effect of 36% in our study can be explained by the use of a sham acupuncture as a control procedure. Sham acupuncture—an invasive procedure (needling of non-acupuncture points in our study), always causes physiological reaction, e.g. triggering of neural pathways resulting in diffuse noxious inhibitory control (Le Bars et al., 1979) and is reported to have an analgesic effect in 40–50% of patients vs. 60% for true acupuncture (Lewith and Machin, 1983). This may have contributed to a placebo effect of sham acupuncture and diminished the comparative effect of AA applied to specific points in our study.

The needles were inserted in the evening before surgery in order to decrease preoperative anxiety (Wang et al., 2001) and to treat the postoperative pain preemptively (Lao et al., 1999).

The optimal time for AA needles retention in situ for pain relief is not very well defined in the literature. In this study the duration of treatment was similar to an earlier non-randomized single-blinded clinical trial of Vorobiev and Dymnikov (2000). They also reported reduction of pain score and analgesics consumption in 28 patients who received AA of specific acupuncture points in comparison with 10 patients who received sham AA. In that study AA was performed after surgery (minor procedures on extremities) and the permanent needles were retained for 5 days. Their results mirrored our observation that the most substantial analgesic AA effect occurred during the first 2 days after surgery.

The withdrawal rate in our study was 11% (7 out of 61 randomized patients) with a slight prevalence in the control group (2 vs. 5 withdrawals). This parameter is on the lower limit to other previous studies, where the withdrawal/drop-out rates of 13–28% were found (Leibing et al., 2002; Sakurai et al., 2003).

4.4. Limitations of the study

The major limitation of this study was the use of mechanical PCA pumps instead of electronic ones for postoperative analgesia, because mechanical PCA pumps cannot register and save data. Consequently, the records of two patients were lost for the final analysis. Processor-controlled electronic PCA pumps allow for the automatic recording of the number and time of single analgesic requests with subsequent registration of quantities consumed in digital form and a printout option. In our study, general anesthesia was adjusted and monitored in a classic way by using the heart rate, blood pressure and spontaneous movements. In order to avoid any influence of intraoperative factors on postoperative analgesic requirement, the monitoring of the general anesthesia in future studies should be strengthened by measuring the bispectral index (Sebel et al., 1997).

The evaluator in our study was successfully blinded since the pattern of specific AA points could not be distinguished from the sham pattern on the auricular helix. The tape used to attach the AA needles was flesh colored and was barely noticeable on the auricular surface. Nevertheless, we believe that in order to increase the reliability of future studies, evaluator blinding should also be tested.

Since we have now tested the specificity of AA using sham acupuncture as a control procedure, in the next study we would like to evaluate the effectiveness of AA without the beneficial influence of non-specific physiological stimulation due to intradermal needle penetration. A variety of control procedures could be used for this purpose (1) comparison of AA with standard therapy (e.g. PCA for postoperative analgesia); (2) placebo acupuncture (non-inserted needle, as proposed by Park et al. (2001)) and, the most exciting for further testing of AA specificity, (3) needling of AA points which are not normally used for treatment of a specific condition (non-specific AA points).

5. Conclusion

Findings from our study demonstrate that AA could be used to reduce postoperative analgesic requirement. Further large-scale randomized investigation of this treatment modality comparing it with standard therapy and placebo acupuncture (non-inserted needle) appears to be necessary.

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References

Alimi D, Rubino C, Pichard-Leandri E, Fermand-Brule S, Dubreuil-Lemaire ML, Hill C. Analgesic effect of auricular acupuncture for cancer pain: a randomized, blinded, controlled trial. J Clin Oncol 2003; 21:4120–6.

Ashburn MA, Love G, Pace NL. Respiratory-related critical events with intravenous patient-controlled analgesia. Clin J Pain 1994;10:52–6.

Ballantyne JC, Carr DB, deFerranti S, Suarez T, Lau J, Chalmers TC, Angelillo IF, Mosteller F. The comparative effects of postoperative analgesic therapies on pulmonary outcome: cumulative meta-analyses of randomized, controlled trials. Anesth Analg 1998;86:598–612.

Bland M. An introduction to medical statistics. Oxford: Oxford University Press; 2000.

Chen L, Tang J, White PF, Sloninsky A, Wender RH, Naruse R, Kariger R. The effect of location of transcutaneous electrical nerve stimulation on postoperative opioid requirement: acupoint versus non-acupoint stimulation. Anesth Analg 1998;87:1129–34.

Dolin SJ, Cashman JN, Bland JM. Effectiveness of acute postoperative pain management: I. Evidence from published data. Br J Anaesth 2002;89: 409–23.

Grammel B. Die Verbrauchsreduzierung postoperativer Analgetika durch intraoperative Applikation von Dauernadeln im OP-Korrespondenzgebiet des Ohres. Der Akupunkturarzt/Aurikulotherapeut 1981;5:160–2.

Hogeboom CJ, Sherman KJ, Cherkin DC. Variation in diagnosis and treatment of chronic low back pain by traditional Chinese medicine acupuncturists. Complement Ther Med 2001;9:154–66.

Kotani N, Hashimoto H, Sato Y, Sessler DI, Yoshioka H, Kitayama M, Yasuda T, Matsuki A. Preoperative intradermal acupuncture reduces postoperative pain, nausea and vomiting, analgesic requirement, and sympathoadrenal responses. Anesthesiology 2001;95:349–56.

Lao L, Bergman S, Hamilton GR, Langenberg P, Berman B. Evaluation of acupuncture for pain control after oral surgery: a placebo-controlled trial. Arch Otolaryngol Head Neck Surg 1999;125:567–72.

Le Bars D, Dickenson AH, Besson JM. Diffuse noxious inhibitory controls (DNIC). I. Effects on dorsal horn convergent neurones in the rat. Pain 1979;6:283–304.

Leibing E, Leonhardt U, Koster G, Goerlitz A, Rosenfeldt JA, Hilgers R, Ramadori G. Acupuncture treatment of chronic low-back pain—a randomized, blinded, placebo-controlled trial with 9-month follow-up. Pain 2002;96:189–96.

Lewith GT, Machin D. On the evaluation of the clinical effects of acupuncture. Pain 1983;16:111–27.

MacPherson H, White A, Cummings M, Jobst K, Rose K, Niemtzow R. Standards for reporting interventions in controlled trials of acupuncture: the STRICTA recommendations. Complement Ther Med 2001;9: 246–9.

Margolin A, Avants KS, Chang P, Birch S, Kosten TR. A single-blind investigation of four auricular needle puncture configurations. Am J Chin Med 1995;2:105–14.

McQuay HJ, Moore RA. Methods of therapeutic trials. In: Wall PD, Melzack R, editors. Textbook of pain. Edinburgh: Churchill Livingstone; 1999. p. 1125–38.

Moher D, Schulz KF, Altman DG, CONSORT GROUP (Consolidated Standards of Reporting Trials). The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomized trials. Ann Intern Med 2001;134:657–62.

Nogier PFM. Traité d'auriculotherapie. Moulinlés-Metz: Maisonneuve; 1972.

Oleson T. Auriculotherapy manual. Los Angeles, CA: Health Care Alternatives; 1998.

Oleson T, Kroening RJ, Bresler DE. An experimental evaluation of auricular diagnosis: the somatotopic mapping of musculoskeletal pain at ear acupuncture points. Pain 1980;8:217–29.

Park J, White AR, Ernst E. New sham method in auricular acupuncture. Arch Intern Med 2001;161:894.

Patel M, Gutzwiller F, Paccaud F, Marazzi A. A meta-analysis of acupuncture for chronic pain. Int J Epidemiol 1989;18:900–6.

Rawal N, Berggren L. Organization of acute pain services: a low-cost model. Pain 1994;57:117–23.

Sakurai M, Suleman MI, Morioka N, Akca O, Sessler DI. Minute sphere acupressure does not reduce postoperative pain or morphine consumption. Anesth Analg 2003;96:493–7.

Schug SA, Torrie JJ. Safety assessment of postoperative pain management by an acute pain service. Pain 1993;55:387–91.

Sebel PS, Lang E, Rampil IJ, White PF, Cork R, Jopling M, Smith NT, Glass PS, Manberg P. A multicenter study of bispectral electroencephalogram analysis for monitoring anesthetic effect. Anesth Analg 1997; 84:891–9.

Simmons M, Oleson T. Auricular electrical stimulation and dental pain threshold. Anesth Prog 1993;40:14–19.

Taguchi A, Sharma N, Ali SZ, Dave B, Sessler DI, Kurz A. The effect of auricular acupuncture on anaesthesia with desflurane. Anaesthesia 2002;57:1159–63.

Tsui SL, Law S, Fok M, Lo JR, Ho E, Yang J, Wong J. Postoperative analgesia reduces mortality and morbidity after esophagoektomy. Am J Surg 1997;173:472–8.

Usichenko TI, Lysenjuk VP, Groth M, Pavlovic D. Measurement of the electrical skin resistance of ear acupuncture points in patients before, during and after orthopedic surgery performed under general anesthesia. Acupunct Electrother Res 2003a;28:167–73.

Usichenko TI, Pavlovic D, Groth M. The effect of auricular acupuncture on anaesthesia: a search for optimal design. Anaesthesia 2003b;58:928–9.

Vorobiev VV, Dymnikov AA. The effectiveness of auricular microneedle acupuncture at the early postoperative period under conditions of the day surgical department. Vestn Khir im I I Grek 2000;159:48–50.

Wang SM, Peloquin C, Kain ZN. The use of auricular acupuncture to reduce preoperative anxiety. Anesth Analg 2001;93:178–80.

White AR, Filshie J, Cummings TM. Clinical trials on acupuncture: consensus recommendations for optimal treatment, sham controls and blinding. Complement Ther Med 2002;9:237–45.