EJP
European Journal of Pain

ORIGINAL ARTICLE

Randomized controlled trial to compare the effect of simple distraction interventions on pain and anxiety experienced during conscious surgery

B.F. Hudson[1], J. Ogden[1], M.S. Whiteley[2]

1 School of Psychology, University of Surrey, Guildford, UK
2 The Whiteley Clinic, Guildford, UK

Correspondence
Briony Hudson
E-mail: briony.hudson@hotmail.com

Funding sources
This research forms part of a PhD completed at The University of Surrey, funded by The Whiteley Clinic.

Conflicts of interest
None declared.

Accepted for publication
7 January 2015

doi:10.1002/ejp.675

Abstract

Background: High levels of anxiety during surgery are associated with poorer post-surgical outcomes. This prospective, non-blinded randomized controlled trial aimed to compare the effectiveness of four intraoperative distraction interventions for anxiety and pain management during minimally invasive venous surgery under local anaesthetic.
Methods: 407 patients presenting with varicose veins at a private clinic, were randomized to one of four intraoperative distraction interventions or treatment as usual. All participants received endovenous thermoablation and/or phlebectomies of varicose veins. After losses to follow-up, 398 participants were entered into the analysis. Participants were randomly allocated to one of the following intraoperative distraction techniques: patient selected music (n = 85), patient selected DVD (n = 85), interaction with nurses (n = 81), touch (stress balls) (n = 80) or treatment as usual (TAU, n = 76). The state scale of the STAI, the Short-form McGill pain questionnaire and numeric rating scales were used to assess intraoperative pain and anxiety.
Results: Intraoperative anxiety ratings were significantly lower when participants interacted with nurses, used stress balls or watched a DVD during surgery compared to treatment as usual. Intraoperative pain ratings were significantly lower than treatment as usual when participants interacted with nurses or used stress balls during surgery. Patients' satisfaction was not significantly impacted by intraoperative distractions.
Conclusions: The use of simple intraoperative distraction techniques, particularly interacting with nurses, using stress balls or watching a DVD during surgery conducted under local anaesthetic can significantly improve patients' experiences.

1. Introduction

Anxiety is a common response to surgery (Pierangotti et al., 2002), but the prospect of being conscious during local anaesthetic surgery in particular can be fraught with a range of specific fears and anxieties (Mitchell, 2003; Wetsch et al., 2009; Hudson et al., 2015). Stressors include the sounds and sights of the operating theatre (Mitchell, 2008), feeling the surgeon's touch (Mitchell, 2009) and concerns surrounding anaesthesia (Mitchell, 2010). Not only is anxiety unpleasant, but a consistent relationship has been observed between surgical anxieties, post-operative pain (Carr et al., 2005; Ip et al., 2009), increased analgesic requirements (Powell et al., 2011) and delayed

What's already known about this topic?

- Distractions can help patients relax before, during and after surgery. Increased relaxation is associated with decreased pain perception.

What does this study add?

- Anxiety was significantly lower in those watching a DVD, interacting with nurses or handling stress balls compared to TAU.
- Pain was significantly lower in those interacting with nurses and handling stress balls compared to TAU.

recovery (Mavros et al., 2011). Elevated anxiety triggers physiological and behavioural responses including immune function suppression, hyperactivation of the hypothalamic–pituitary–adrenal axis (Tsigos and Chrousos, 2002) and increased focus on threatening stimuli (Bar-Haim et al., 2007). Furthermore, increased anxiety has been reported to reduce pain thresholds (Rhudy and Meagher, 2000) and is implicated in elevated pain intensity estimates (Kain et al., 2006; Seidman et al., 2014).

A range of pain-specific anxiety components influence pain perception (Theunissen et al., 2012). Pain anxiety, including factors experienced in anticipation of, or response to pain, and pain catastrophizing (rumination about potential pain which magnifies its intensity and is associated with feelings of helplessness), have both been linked to increased pain perception in surgical contexts (Pavlin et al., 2005; Sommer et al., 2010). In addition to pain-specific anxieties, state anxiety in pre- and intraoperative periods has also been linked to poorer post-surgical outcomes (Kain et al., 2000).

Pain is described as a multidimensional, subjective experience in the literature (Melzack, 1999; Melzack and Katz, 2004). Thus, pain perception is influenced by a range of dimensions and the interactions between them. Cognitive–evaluative, motivational–affective and sensory-discriminative dimensions have all been implicated in the perception of pain (Tracey and Mantyh, 2007). Furthermore, the neurocognitive model of attention hypothesizes that pain perception could be decreased by increasing the cognitive load of a pain unrelated task or by providing additional, attention-grabbing stimuli (Legrain et al., 2011). Distraction is a method of cognitive refocusing, based on previous theories of pain, which diverts attention from pain to more pleasant stimuli, thus reducing pain perception (Ruscheweyh et al., 2011). The use of distractions such as comforting words (Shenefelt, 2013), music (Bradt et al., 2013), audiovisual stimuli (Man and Yap, 2003) and touch (Chanif et al., 2013) has been found to reduce pain and anxiety when used before, during or after surgery.

While there is evidence exploring the impact of different distractions individually, little research exists comparing the effect of different distractions when used intraoperatively. In response, this research compared four distraction interventions used during surgery for their impact on intraoperative pain, anxiety and treatment satisfaction during minimally invasive, conscious surgery.

2. Methods

2.1 Patient population

Patients were recruited at a private clinic specializing in minimally invasive treatment of venous conditions in Surrey, between June 2012 and June 2013. Three hundred and eighty participants were required to detect an effect size of 0.18 at 95% power; this was based on the results of a meta-analysis conducted by this paper's authors which is currently in press (Hudson et al., accepted). To allow for a 5% drop out rate, the target sample size was 400. Information sheets were posted to potential participants along with standard pre-procedure information, and 494 patients were assessed for eligibility.

2.2 Inclusion criteria

Aged between 18 and 80, receiving endovenous thermal ablation (EVLA), TRLOP (TransLuminal Occlusion of Perforators) and/or phlebectomy for the treatment of varicose veins, good understanding of written and spoken English and to be in a position to provide informed consent. EVLA and TRLOP use lasers to close incompetent veins. EVLA is used to treat larger, closer to the surface veins, while TRLOP is used to treat smaller, perforating veins.

2.3 Exclusion criteria

The presence of leg ulcers, receiving microsclerotherapy or foam sclerotherapy treatments, being unwilling to enter into the randomization process and arriving late at the clinic. Figure 1 outlines the CONSORT diagram for participant enrolment, allocation, follow-up and analysis.

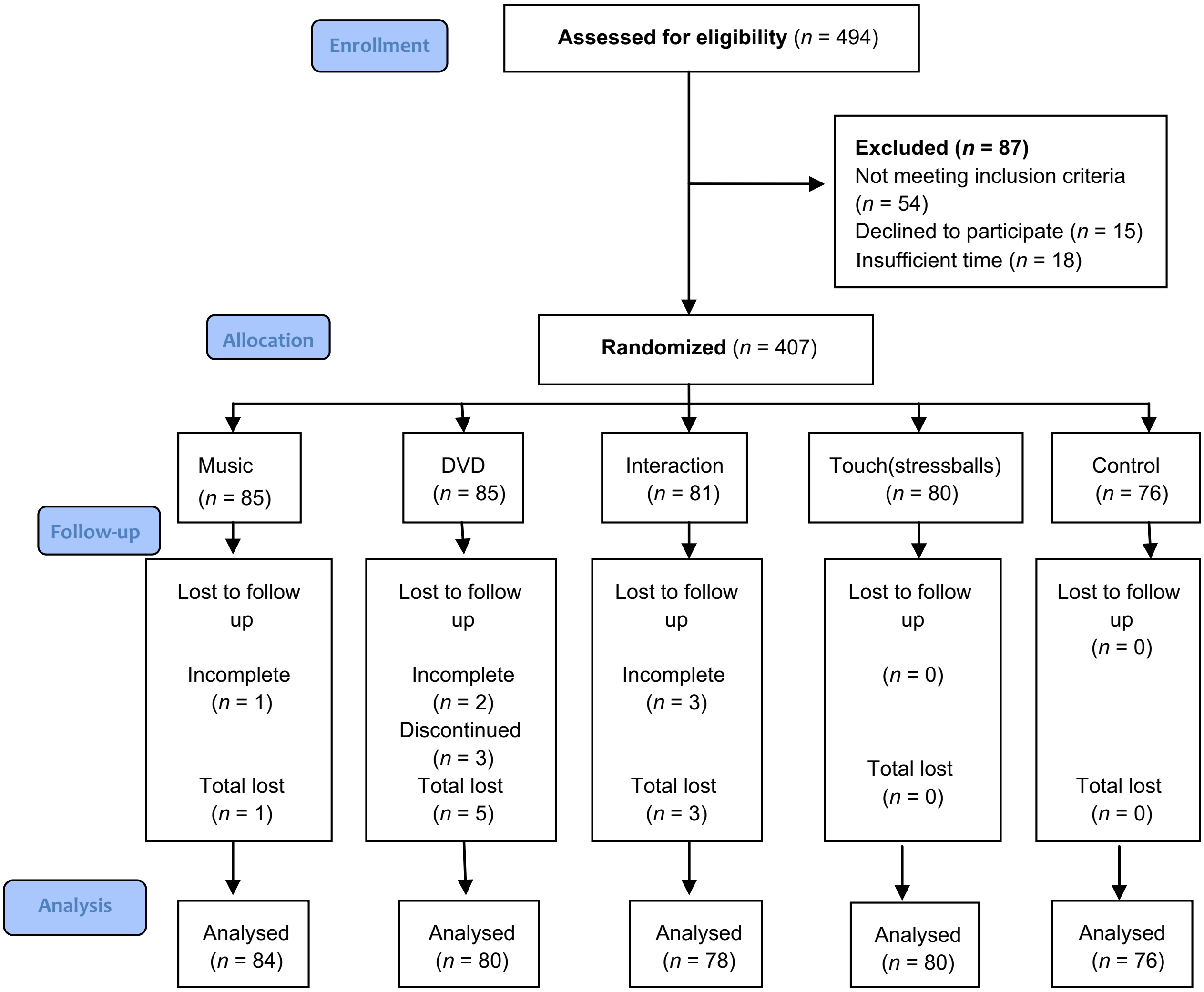

Figure 1 CONSORT diagram showing trial enrolment, allocation, follow-up and analysis.

Randomization was achieved using a list of computer-generated numbers. These were generated by a third party statistician and used to allocate participants to conditions once an information sheet had been posted to them.

2.4 Design

A non-blinded prospective randomized controlled trial with four experimental conditions and a control condition receiving TAU.

2.5 Baseline measures

After providing informed consent, participants completed a baseline questionnaire in the waiting area of the clinic to collect: demographic information, a vein-specific measure of quality of life (The Aberdeen Questionnaire, Smith et al., 1999), procedure type and ratings of pre-operative anxiety (the state scale of the state–trait anxiety inventory (S-STAI; Spielberger, 1983) and an 11-point numeric rating scale (NRS; Kindler et al., 2000): 'How would you rate any anxiety you may currently be feeling' 0 (no anxiety) and 10 (worst anxiety imaginable). Baseline anxiety measures and procedure type were entered as covariates in the final analysis. The decision to include only the state scale of the STAI and a NRS kept the burden in terms of form completion to a minimum, which aimed to reduce unnecessary frustration and the subsequent impact this may have on patient-reported anxiety.

Participants were then informed to which intervention they had been allocated, and the operating theatre was set-up accordingly.

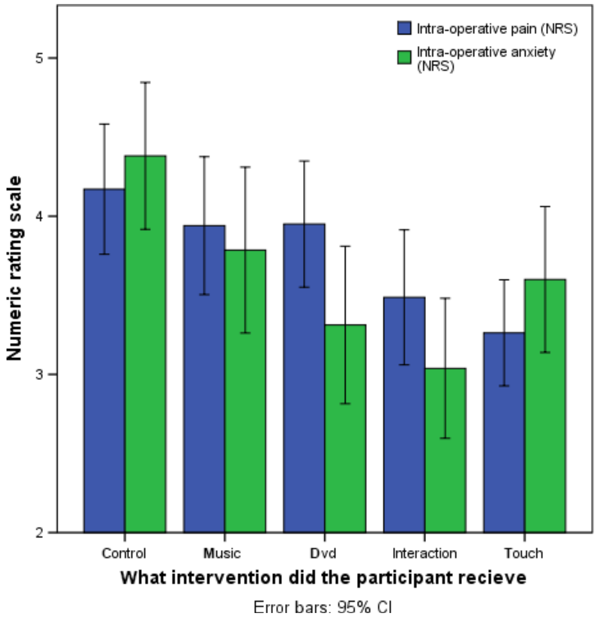

Figure 2 Bar chart to show mean numeric rating scale (NRS) scores for pain and anxiety experienced during surgery in each condition.

2.6 Distraction interventions

2.6.1 Treatment as usual

Participants received treatment as usual (TAU) from medical staff. Staff ensured that interaction with participants was kept to a minimum during the entire procedure.

2.6.2 Experimental group 1 – Music

Participants selected music from that available at the clinic (classical, easy listening and pop) or through an online music library. Wireless headphones were supplied and the volume controls demonstrated.

2.6.3 Experimental group 2 – DVD

Participants were offered a choice of DVD (comedies, documentaries and panel based quiz shows) to watch on a wall-mounted monitor positioned at a comfortable distance and angle to the participant. Wireless headphones were provided and participants were advised how to operate the controls.

2.6.4 Experimental group 3 – Interaction

A dedicated nurse was positioned next to the participant's head to interact with them throughout their procedure. The nurse was instructed not to touch the participant's hand during surgery but to try and engage them in conversation. The level of interaction with participants was greater than would usually occur in routine practice in the clinic.

2.6.5 Experimental group 4 – Stress balls

Two palm-sized stress balls were provided. Participants were instructed to squeeze these whenever they felt anxious or anticipated or experienced any uncomfortable sensations.

2.7 Outcome measures

Immediately after surgery, participants completed the following outcome measures in the recovery area:

2.7.1 Pain

The Short-form McGill Pain Questionnaire (SF-MPQ; Melzack, 1987), quantified intraoperative pain into sensory and affective elements. A single-item NRS assessed pain intensity experienced during surgery ('how would you rate any pain experienced during surgery', 0, no pain to 10, worst pain imaginable; Breivik et al., 2008).

2.7.2 Anxiety

The S-STAI and NRS were repeated. The NRS was worded in the following way 'How would you rate any anxiety you experienced DURING treatment, 0 (no anxiety) and 10 (worst anxiety imaginable)'.

2.7.3 Satisfaction with treatment

A 6-point NRS asked participants to rate how their treatment satisfaction, from 0 (completely dissatisfied) to 5 (completely satisfied).

2.8 Data analysis

The data were analysed in SPSS (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY, USA) and screened for missing data and outliers. As six participants were excluded due to missing outcomes, an intention to treat analysis was not conducted. The data were analysed to assess the impact of the interventions on intraoperative pain and anxiety. Analyses of covariance assessed the impact of interventions on intraoperative anxiety, using the baseline S-STAI and the NRS anxiety scores and procedure type as covariates for anxiety ratings and procedure type only as a covariate for pain ratings and satisfaction. Significant ANCOVAs were followed up with Sidak multiple comparison *post hoc* tests.

2.9 Ethics approval

The study was approved by the National Health Service, South East Coast Research Ethics Committee, The University of Surrey Ethics Committee and was registered with clinicaltrials.gov (Trial registration – NCT01508624).

3. Results

The demographic and baseline variables of the sample are displayed in Table 1. No significant differences were observed between groups at baseline. The study population had a mean age of 52.7 years, 77.4% of the sample were female ($n = 308$) and 22.6% were male ($n = 90$).

3.1 Outcome variables

The impact of the interventions on anxiety, pain and satisfaction are shown in Table 2. Anxiety and pain are further illustrated in Figure 2.

3.1.1 Anxiety

3.1.1.1 Numeric rating scale

Baseline NRS scores were significantly related to intraoperative NRS anxiety, $F(1, 392) = 134.84$, $p < 0.001$, $\eta_p^2 = 0.26$. Procedure type was not related to intraoperative NRS ratings, $F(1, 392) = 0.64$, $p = 0.43$. There was a significant effect of distraction type after controlling for baseline NRS scores and procedure type, $F(4, 391) = 6.53$, $p < 0.0001$, $\eta_p^2 = 0.06$. *Post hoc* analyses using the Sidak method indicated that anxiety NRS scores were significantly lower in the DVD ($p < 0.001$, 95% CI = 0.39–2.07), interaction ($p < 0.001$, 95% CI = 0.51–2.21) and touch ($p = 0.009$, 95% CI = 0.16–1.84) conditions compared to TAU. No significant differences were noted between the control and music conditions ($p = 0.21$).

3.1.1.2 State scale of the state trait anxiety inventory

There was no main effect for baseline S-STAI scores, $F(1, 382) = 0.29$, $p = 0.59$, $\eta_p^2 = 0.001$. There was a significant effect for procedure type, $F(2, 382) = 3.20$, $p = 0.042$, and distraction type, $F(4, 382) = 3.39$, $p = 0.01$. The interaction between procedure type and distraction was not significant, $F(8, 382) = 0.57$, $p = 0.80$.

A significant difference between conditions, after controlling for baseline S-STAI scores and procedure type was observed, $F(4, 39) = 3.5$, $p = 0.008$, $\eta_p^2 = 0.04$. S-STAI was significantly lower in the interaction than TAU condition ($p = 0.003$, 95% CI = 1.38–10.31). *Post hoc* analyses using the Sidak comparison method indicated that participants who received phlebectomies reported significantly higher scores (mean score 40.13) using the intraoperative S-STAI than participants who received a combination of EVLA and TRLOP (mean score of 36.8). There were no significant differences in anxiety between the other conditions.

Table 1 Demographic and baseline characteristics of participants by intervention and tests of difference at baseline.

	Control (N = 76)	Music (N = 84)	DVD (N = 80)	Interaction (N = 78)	Touch (N = 80)	Test statistic ANOVA	Test statistic χ^2	p
Mean age (SD)	55.06 (11.86)	53.71 (13.17)	50.51 (12.23)	52.1 (14.49)	53 (13.01)	2.05		0.09
Male/Female	18/58	18/66	13/67	20/58	21/59		2.98	0.56
Ethnicity								
White	74	81	80	75	76		6.03	0.64
Black	0	0	0	1	1			
Asian	2	3	0	2	3			
Procedure (%)								
EVLA ± Phlebectomy	24	21	25	28	23		8.10 (8)	0.42
EVLA and TRLOP ± Phlebectomy	24	41	35	31	31			
Phlebectomy alone	28	22	20	19	26			
Mean Aberdeen Questionnaire (SD)	19.86 (4.31)	18.92 (4.69)	18.85 (4.53)	19.00 (4.64)	20.52 (4.52)	2.10 (4.00)		0.08
Mean pre-treatment anxiety								
NRS (SD)	4.33 (2.13)	4.49 (2.71)	4.65 (2.32)	4.33 (2.31)	4.8 (2.43)	0.58		0.68
STAI (SD)	39.01 (7.72)	38.64 (8.78)	39.86 (10.31)	37.74 (9.19)	41.54 (11.03)	1.86		0.12

TRLOP, TransLuminal Occlusion of Perforators; EVLA, EndoVenous Thermal Ablation.

Table 2 Comparison of anxiety and pain measures experienced during surgery and satisfaction between each intervention and the control condition (TAU).

	Treatment as usual (N = 76)	Music (N = 84)	DVD (N = 80)	Interaction (N = 78)	Touch (N = 80)	F	df	η_p^2
Anxiety[a]								
Numeric rating scale–NRS (SD)[c]	4.38 (2.03)	3.79 (2.42)	3.31 (2.24)	3.04 (1.96)	3.60 (2.07)	6.54***	4	0.06
Mean difference to control (SE)		0.59 (0.29)	1.07 (0.29)**	1.34 (0.30)***	0.78 (0.29)**			
STAI	41.29 (9.72)	38.60 (10.31)	37.56 (10.28)	35.29 (8.94)	38.54 (8.58)	3.70**	4	0.03
Mean difference to control (SE)		2.69 (1.50)	3.73 (1.60)	6.00 (1.63)**	2.75 (1.61)			
Pain[b]								
Numeric Rating Scale (SD)[c]	4.17 (1.80)	3.94 (2.01)	3.95 (1.79)	3.49 (1.93)	3.26 (1.51)	3.37**	4	0.03
Mean difference to control (SE)		0.23 (0.29)	0.22 (0.29)	0.68 (0.29)*	0.91 (0.21)**			
Pain rating index from SF-MPQ (SD)[d]	25.20 (5.83)	25.37 (5.22)	25.52 (4.69)	24.40 (5.57)	24.43 (5.59)	0.81	4	0.01
Mean difference to control (SE)		−0.17(0.80)	−0.32 (0.81)	0.80 (0.82)	0.77 (0.81)			
Sensory pain (SD)	16.22 (2.68)	16.44 (4.02)	16.61 (4.42)	15.67 (3.78)	15.59 (2.25)	1.31	4	0.01
Mean difference to control (SE)		−0.22 (0.56)	−0.39 (0.57)	0.55 (0.57)	0.63 (0.57)			
Affective pain (SD)	6.22 (1.39)	6.09 (1.64)	6.06 (1.11)	6.08 (1.55)	6.05 (1.04)	0.20	4	0.00
Mean difference to control (SE)		0.13 (0.22)	0.16 (0.22)	0.14 (0.22)	0.17 (0.22)			
Overall satisfaction (SD)[e]	4.58 (0.06)	4.76 (0.06)	4.70 (0.06)	4.64 (0.06)	4.70 (0.06)	1.37	4	0.01
Mean difference to control (SE)		0.17 (0.08)	0.12 (0.08)	0.06 (0.09)	0.12 (0.08)			

[a]Analysed using analysis of covariance with Sidak multiple comparison tests.
[b]Analysed with analysis of covariance with Sidak multiple comparisons tests.
[c]11-point numeric rating scales, from 0 to 10.
[d]Short-form McGill Pain Questionnaire.
[e]6-point numeric rating scale from 0 to 5.
***$p < 0.001$.
**$p < 0.01$.
*$p < 0.05$.

3.1.2 Pain

3.1.2.1 Numeric rating scale

Procedure type was unrelated to NRS intraoperative pain, $F(1, 392) = 0.17$, $p = 0.68$. Intraoperative distraction type significantly impacted intraoperative NRS pain scores, $F(4, 343) = 3.37$, $p = 0.010$, $\eta_p^2 = 0.03$. Intraoperative pain NRS scores were significantly lower in the interaction ($p = 0.022$, 95% CI = 0.12–1.27) and touch conditions ($p = 0.002$, 95% CI = 0.34–1.48) than TAU. Compared with other distraction techniques, patients in the touch condition reported significantly lower pain ratings than those in music ($p = 00.17$, 95% CI = −1.23 to −1.20) and DVD conditions ($p = 0.018$, 95% CI = −1.24 to −1.19).

3.1.2.2 McGill Pain questionnaire

Sensory pain – Procedure type was unrelated to sensory pain experienced during treatment, $F(1, 392) = 0.016$, $p = 0.89$, and no significant effects were observed for distraction type, $F(4, 392) = 1.30$, $p = 0.27$.

Affective pain – There was no significant relationship between procedure type and intraoperative affective pain ratings, $F(1, 392) = 0.33$, $p = 0.57$, and no significant effects for distraction were observed, $F(4, 392) = 0.21$, $p = 0.94$.

3.2 The impact of age, gender and anxiety on intraoperative pain

To explore whether the results outlined above were the result of factors other than the distraction interventions employed, moderation analyses were conducted which revealed that neither age nor gender exerted a significant influence over the intraoperative pain and anxiety reported by the sample.

3.2.1 Pre-operative anxiety

Pre-operative anxiety NRS scores were found to be a significant predictor of intraoperative pain NRS scores, $F(1, 396) = 36.29$, $p < 0.001$, and also SF-MPQ scores. $F(1, 396) = 11.24$, $p = 0.001$, accounting for 8.4% of the variance in intraoperative pain NRS scores and 2.8% of the variance in intraoperative SF-MPQ scores.

3.2.2 Intraoperative anxiety

Intraoperative NRS anxiety was not found to be a significant predictor of intraoperative pain when measured using a NRS or the SF-MPQ.

3.3 Satisfaction

There was no significant effect of procedure type on treatment satisfaction, $F(1, 392) = 0.01$, $p = 0.97$, and no significant differences were observed in ratings of treatment satisfaction between conditions, $F(4, 393) = 1.37$, $p = 0.245$.

4. Discussion

Intraoperative interaction, touch and DVDs resulted in significantly lower reports of intraoperative anxiety than treatment as usual. In addition, participants allocated to the intraoperative touch and interaction conditions reported significantly lower intraoperative pain than those receiving treatment as usual. No differences were found for satisfaction, which could be due to a ceiling effect (mean satisfaction in the TAU condition was rated as 4.58 on a 5-point scale).

A surprising finding from this research was the lack of a significant effect for the use of intraoperative music. This is in contrast to previous research (Ayoub et al., 2005; Bradt et al., 2013). However, while many studies have found music to be beneficial for pain and anxiety reduction in surgical contexts, this conclusion has not been unanimously observed. A systematic review conducted by Nilsson (2008) indicated that musical interventions significantly impacted only 50% of outcome measures studied. In addition, McLeod (2012) found no significant differences in post-operative anxiety measures with the addition of a musical intervention. Although patients in the music condition displayed lower mean anxiety post-operatively, this difference was not significant. McLeod's findings have been replicated in this research which suggests that while the addition of music to TAU did not negatively impact patient experience, it did not significantly improve it either.

Our findings concur with research reporting benefits in response to intraoperative DVDs (Man and Yap, 2003) which is consistent with theories promoting cognitive refocusing as a pain management tool. From this perspective, it is intuitive that audiovisual stimuli proved more beneficial in terms of pain and anxiety reduction than music alone, given the greater cognitive demands of the stimuli.

Mixed results have emerged from previous research exploring the use of touch in medical settings (Ernst, 2009; Lafreniere et al., 1999) in this sample; touch significantly reduced both pain and anxiety. Providing participants with an intervention over which they had control could have increased feelings of empowerment, which has been suggested as an effective tool for anxiety management during conscious surgery (Rogan, 2004).

The significant reductions in pain and anxiety reported in the interaction condition emphasizes the importance of patient–healthcare professional relationships (McCaffrey, 2007; Mitchell, 2010). Little previous research has looked specifically at the impact of talking during surgery; however, much research has championed the use of patient-focused care and the development and maintenance of a supportive atmosphere during surgery (Grieve, 2002; McCaffrey, 2007), with which this research concurs.

Differences observed when using different tools demonstrate the importance of including a range of tools in the measurement of subjective factors such as pain and anxiety. While pain ratings on the NRS indicated intraoperative pain was significantly lower in the touch and interaction conditions than TAU, this was not mirrored in the results of the SF-MPQ. This is surprising as the SF-MPQ, and in particular affective pain ratings have previously been found to be influenced by psychological interventions.

Similarly, while intraoperative anxiety was found to be significantly lower in the touch, interaction and DVD conditions in comparison to TAU when measured using the NRS, the only significant differences observed using the S-STAI were observed between TAU and the interaction condition. While both tools measure the anxiety participants experienced in relation to surgery, perhaps the NRS provides a more specific measure of anxiety, representing anxiety intensity, rather than its qualities. It is also interesting that previous research utilizing both the STAI and a patient-reported rating scale to assess the impact of psychological interventions on anxiety during conscious surgery found the same discrepancies, with significant differences observed on rating scales but not the STAI (Cruise et al., 1997).

This randomized controlled trial appears to be the first to directly compare the impact of four different intraoperative interventions during conscious surgery. The large sample size and naturalistic setting support the robustness of the findings. In addition, the same nurses were present for each operation performed; limiting the opportunity for contamination from individual characteristics of nursing staff.

There are some limitations that need to be considered. It was not possible to blind the researchers to participant allocation due to nature of each intervention and subsequent operating theatre modifications required. Secondly, self-reported measures of key outcome variables were used. These were considered less intrusive than objective measures, which may raise patients' anxiety. Measures of intraoperative pain and anxiety were collected immediately after, rather than during surgery. Consistent with psychological theories of pain perception, it was predicted that the collection of pain and anxiety ratings during surgery would have altered patients' experiences by drawing attention to pain and anxiety perception, thus exacerbating rather than reflecting experiences. Such measures may have a level of error, yet it has been recommended such retrospective reflections are valid as long as the feelings were recently experienced (Spielberger, 1983). Further rationale for this method of data collection related to difficulties in standardizing the collection of intraoperative measures. As we could not standardize the timing of intraoperative data collection, pain and anxiety experienced during surgery were assessed immediately afterwards, to allow the timing of data collection to be uniform for all participants. Participants rated the administration of the local anaesthetic as the most painful part of the procedure, thus if pain and anxiety assessments were completed during this period, estimates may be higher than at other points during the procedure. This could introduce a greater risk of bias. Completing measures during the procedure would in itself have been an intervention, which may have influenced results. It was therefore deemed better to enable patients to experience the procedure without interruption and then complete ratings once the procedure was complete. Furthermore, this decision was taken to avoid placing additional and unnecessary burdens on theatre nurses.

Our findings have highlighted several avenues for future research. In particular, exploration of the role of patient choice would be informative. A preference trial would allow the impact of empowering patients in combination with the benefits observed in this sample. The impact of intraoperative experiences on longer term outcomes such as wound healing and recovery could also be investigated. Future studies could consider the inclusion of objective, physiological measures of anxiety.

In conclusion, this research has highlighted how the addition of low cost, intraoperative distraction interventions can be beneficial in the management of intraoperative pain and anxiety; supporting previous research promoting distraction as a useful tool for pain and anxiety management and laying the groundwork for further investigations. The authors believe that given the minimal cost and invasiveness of the distraction interventions studied, and the benefits observed in response to their addition to treatment as usual, that patients and health care providers should be aware of these findings to allow them to make informed decisions regarding the management of intraoperative pain and anxiety. At the very least, none of the interventions studied worsened patient experience. Therefore, we support their use or the option of their use in routine practice.

Author contributions

All authors discussed the results and commented on the manuscript.

References

Ayoub, C.M., Rizk, L.B., Yaacoub, C.I., Gall, D., Kain, Z.N. (2005). Music and ambient operating theatre noise in patients undergoing spinal anesthesia. *Anesth Analg* 100, 1316–1319.

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M.J., Van Ijzendoorn, M.H. (2007). Threat related attentional bias in anxious and non anxious individuals: A meta-analytic study. *Psychol Bull* 133, 1–24.

Bradt, J., Dileo, C., Shim, M. (2013). Music interventions for preoperative anxiety. *Cochrane Database Syst Rev* 6, doi: 10.1002/14651858.CD006908.pub2.

Breivik, H., Borchgrevink, P.C., Allen, S.M., Rosseland, L.A., Romundstad, L., Breivik Hals, E.K., Kvarstein, G., Stubhaug, A. (2008). Assessment of pain. *Br J Anaesth* 101, 17–24.

Carr, E.C.J., Thomas, V., Wilson-Barnet, J. (2005). Patient experiences of anxiety, depression and acute pain after surgery: A longitudinal perspective. *Int J Nurs Stud* 42, 521–530.

Chanif, C., Petpichetchian, W., Chongchareon, W. (2013). Does foot massage relieve acute postoperative pain? A literature review. *Nurse Media J Nurs* 3, 483–497.

Cruise, C.J., Chung, F., Yogendran, S., Little, D. (1997). Music increases satisfaction in elderly patients undergoing cataract surgery. *Can J Anaesth* 44, 43–48.

Grieve, R.J. (2002). Day surgery preoperative anxiety reduction and coping strategies. *Br J Nurs* 11, 670–678.

Ernst, E. (2009). Is reflexology an effective intervention? A systematic review of randomised controlled trials. *Med J Aus* 191, 263–266.

Hudson, B.F., Ogden, J., Whiteley, M.S. (accepted). Exploring the impact of intra-operative interventions for pain and anxiety management during local anaesthetic surgery – A systematic review and meta-analysis. *J PeriAnesth Nurs*.

Hudson, B. F., Ogden, J., Whiteley, M. S. (2015). A thematic analysis of experiences of varicose veins and minimally invasive surgery under local anaesthesia. *Journal of Clinical Nursing* doi: 10.1111/jocn.12719. [Epub ahead of print]

Ip, H.Y.V., Abrishami, A., Peng, P., Wong, J., Chung, F. (2009). Predictors of postoperative pain and analgesic consumption. *Anesthesiology* 111, 657–677.

Kain, Z.N., Sevarino, F., Alexander, G.M., Pincas, S., Mayes, L.C. (2000). Preoperative anxiety and postoperative pain in women undergoing hysterectomy. *J Psychosom Res* 49, 417–422.

Kain, Z.N., Mayes, L.C., Caldwell-Andrews, A.A., Karas, D.E., McClain, B. (2006). Preoperative anxiety, postoperative pain and behavioural recovery in young children undergoing surgery. *Pediatrics* 118, 651–658.

Kindler, C.H., Harms, C., Amsler, F., Ihde-Scholl, T., Scheidegger, D. (2000). The visual analog scale allows effective measurement of preoperative anxiety and detection of patients' anesthetic concerns. *Anest Analg* 90, 706–712.

Lafreniere, K.D., Mutus, B., Cameron, S., Tannous, M., Giannotti, M., Abu Zahra, H. (1999). Effects of therapeutic touch on biochemical and mood indicators in women. *J Alt Comp Med* 5, 367–370.

Legrain, V., Crombez, G., Verhoeven, K., Mouraux, A. (2011). The role of working memory in the attentional control of pain. *Pain* 152, 453–459.

Man, A.K.Y., Yap, J.C.M. (2003). The effect of intraoperative video on patient anxiety. *Anaesthesia* 58, 64–68.

Mavros, M.N., Athanasiou, S., Gkegkes, I.D., Polyzos, K.A., Peppas, G., Falagas, M.E. (2011). Do psychological variables affect early surgical recovery? *PLoS ONE* 6: e20306. doi: 10.1371/journal.pone.0020306.

McCaffrey, A.M., Pugh, G.F., O'Conner, B.B. (2007). Understanding patient preference for integrative medical care: Results from patient focus groups. *J Gen Int Med* 22, 1500–1505.

McLeod, R. (2012). Evaluating the effect of music on patient anxiety during minor plastic surgery. *J Perioper Pract* 22, 14–18.

Melzack, R. (1987). The short-form McGill Pain Questionnaire. *Pain* 30, 191–197.

Melzack, R. (1999). From the gate to the neuromatrix. *Pain Suppl* 6, S121–S126.

Melzack, R., Katz, J. (2004). The Gate Control theory: Reaching for the brain. In *Pain: Psychological Perspectives*, Hadjistavropoulos, T., Craig, K.D., eds. (Mahwah, NJ: Lawrence Erlbaum Associates Publishers) pp. 13–34.

Mitchell, M. (2003). Patient anxiety and modern elective surgery: A literature review. *J Clin Nurs* 12, 806–815. doi:10.1046/j.1365-2702.2003.00812.x.

Mitchell, M. (2008). Conscious surgery: Influence of the environment on patient anxiety. *J Adv Nurs* 64, 261–271.

Mitchell, M. (2009). Patient anxiety and conscious surgery. *J Perioper Pract* 19, 168–173.

Mitchell, M. (2010). General anesthesia and day-case patient anxiety. *J Adv Nurs* 66, 1059–1071.

Nilsson, U. (2008). The anxiety and pain reducing effects of music interventions: A systematic review. *AORN J* 8, 780–807.

Pavlin, D.J., Sullivan, M.J., Freund, P.R., Roesen, K. (2005). Catastrophising: A risk factor for posr-surgical pain. *Clin J Pain* 21, 83–90.

Pierangotti, P., Covelli, G., Vario, M. (2002). Anxiety, stress and preoperative nursing. *Prof Inferm* 55, 180–191.

Powell, R., Johnston, M., Smith, W.C., King, P.M., Chambers, W.A., Krukowski, Z. (2011). Psychological risk factors for chronic post-surgical pain after inguinal hernia repair surgery: A prospective cohort study. *Eur J Pain* 16, 600–610.

Rhudy, J.L., Meagher, M.W. (2000). Fear and anxiety: Divergent effects on human pain thresholds. *Pain* 84, 65–75.

Rogan, C. (2004). Improving communication in day surgery settings. *Nurs Stand* 19, 37–42.

Ruscheweyh, R., Kreusch, A., Albers, C., Sommer, J., Marziniak, M. (2011). The effect of distraction strategies on pain perception and the nociceptive flexor reflex (RIII reflex). *Pain* 152, 2662–2671.

Seidman, L., Lung, K., Nailboff, B., Zelter, L., Tsao, J. (2014). Sensitisation to laboratory pain stimuli in healthy children and adolescents is associated with higher ratings of anxiety, pain intensity and pain bother. *J Pain* 15, S53.

Shenefelt, P.D. (2013). Anxiety reduction using hypnotic induction and self guided imagery for relaxation during dermatologic procedures. *Int J Clin Exp Hypn* 61, 305–318.

Smith, J.J., Garratt, A.M., Guest, M., Greenhalgh, R.M., Davies, A.H. (1999). Evaluating and improving health related quality of life in patients with varicose veins. *J Vasc Surg* 30, 710–719.

Sommer, M., de Rijike, J.M., van Kleef, M., Kessels, A.G.H., Peters, M., Geurts, J.W., Jacob, P., Gramke, H.F., Marco, M. (2010). Predictors of actue postoperative pain after elective surgery. *Clin J Pain* 26, 87–94.

Spielberger, C.D. (1983). *State-trait Anxiety Inventory for Adults* (Redwood City, CA: Mind Garden).

Theunissen, M., Peters, M.L., Bruce, J., Gramke, H., Marcos, M. (2012). Preoperative anxiety and catastrophizing: A systematic review and meta-analysis of the association with chronic postsurgical pain. *Clin J Pain* 28, 819–841.

Tracey, I., Mantyh, P.W. (2007). The cerebral signature for pain perception and its modulation. *Neuron* 55, 377–391.

Tsigos, C., Chrousos, G.P. (2002). Hypothalamic–pituitary–adrenal axis, neuroendocrine factors and stress. *J Psych Res* 53, 865–871.

Wetsch, W.A., Pircher, I., Lederer, W., Kinzl, J.F., Traweger, C., Heinz-Erian, P. (2009). Preoperative stress and anxiety in day-care patients and inpatients undergoing fast-track surgery. *Br J Anaesth* 103, 199–205.

Yilmaz, M., Sezer, H., Gurler, H., Bekar, M. (2011). Predictors of preoperative aniety in surgical inpatients. *J Clin Nurs* 21, 956–964.