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Tattoos and Post-Operative Pain

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Abstract

Objective: Personalised post-operative pain treatment holds the potential to minimize side effects while maximizing effectiveness. Several phonotypical factors including gender and the presence of tattoos might influence post-operative pain experience. Tattoos have grown in popularity in recent years and the number of patients with tattoos has increased rapidly. A preconception arose in our department about the pain experience of patients with tattoos. We decided to investigate whether patients with tattoos experienced more post-operative pain than patients without tattoos.

Methods: We studied the relationship between tattoos and post-operative pain in a prospective cohort study. All adults willing to provide informed consent and scheduled for surgery (elective or emergency) or placement of a venous cannula in the pre-surgery ward were enrolled in this study. Main outcome measures were post-operative pain scores (Numeric Rating Scale). Secondary outcomes included pain scores after administration of a loco-regional technique (neuraxial, plexus, peripheral nerve block) or insertion of a venous cannula.

Results: After multivariable analyses, tattoos were not associated with increased post-procedural pain. Younger people and women experienced more pain.

Conclusion: Our findings suggest that there is no relationship between the presence of tattoos and post-procedural pain.

Keywords: Post-operative pain; Anesthesia; Numeric rating scale

Introduction

Preserving and restoring patient's health while minimizing their pain lies at the heart of medicine. Pain is common and exists in many forms, of which post-operative pain is one of the most common [1]. Pain is not only associated with physical discomfort and emotional distress but is also a risk factor for prolonged hospitalization, higher morbidity, and mortality and the development of chronic pain [2,3]. All these factors have a significant impact on patients' quality of life and carry an important economic burden. A Dutch study by Sommer et al. showed that despite an acute pain protocol, 41% of surgical patients experienced moderate or severe pain the day after surgery [4]. The conclusion of a four-day follow-up of these patients was that the post-operative pain treatment was unsatisfactory, especially after intermediate or major surgical procedures on extremities or the spine. Since many patients still suffer medium to severe post-operative pain, aggressive pain treatment may seem warranted. However, overzealous pain treatment carries non-negligible risks. Currently, in the United States, an 'opioid crisis' rages which resulted in 1.68 million person-years of life lost only in 2016 [5]. This makes drug overdose the leading cause of death for Americans under the age of 50 years old. More recently, anesthesiologists in the Netherlands have issued a warning about increased usage of opioids in the Netherlands [6].

This all emphasizes the importance, but also the challenging nature of achieving adequate and safe pain management: identifying the appropriate dose of pain medication for each individual patient and thereby maximizing the therapeutic effect and minimizing side effects. Could genetics be the solution to this everyday challenge? A growing number of pharmacogenomics studies reveal the importance of genetic variations in the development of personalized pain treatment [7]. Although personalized pain treatment may play a more important role in the future, currently only a small number of genetic markers can be used in local clinical practice to guide optimal pain management. There are multiple reasons for the slow progress in this area, one being the multidimensional character of pain. Furthermore, pain is not only influenced by genotype, but also by phenotype. Some phonotypical features are known to influence pain (e.g. gender and age), while some others are based on prejudices [8].

In recent years anesthesiologists at the Maasstad Hospital in Rotterdam and their colleagues at nearby hospitals noticed a growing trend of patients with tattoos. Epidemiologic studies have shown that until recently, tattoos represented a cultural taboo in our societies but have become more of a mainstream phenomenon over the past two decades [9].

With the growing population of patients with tattoos, the preconception emerged among some of our anesthesiologists that patients with tattoos had a lower threshold for pain than patients without tattoos. We noticed that this preconception also existed among our colleagues in other hospitals.

A brief literature review showed no scientific data existed supporting or rejecting this perception. As personalized (pain) treatment is becoming more important in medicine, we decided to perform a prospective cohort study to investigate the relationship between tattoos and post-procedural pain.

Material and Methods

We started our study by performing a literature review. The literature review was conducted in PubMed, using the search terms 'Tattoo AND pain', 'Tattoo AND NRS score', 'Tattoo AND VAS score', and 'Tattoo AND pain scores'. We included articles that investigated the possible relation between tattoos and pain. We excluded articles when tattoos were used for medical reasons, described possible complications of tattooing or tattoo removal and its different methods. We found 87 articles that matched our search terms, of which only one article was relevant. However, this article did not provide us with an answer to our research question, because the article focused not only on tattoos, but also other forms of body modifications, and only among adolescents [10].

After our literature review, we started our study at the Maasstad Hospital, a 600-bed general hospital located in Rotterdam, the second-largest city in the Netherlands. The hospital is located in an area of Rotterdam with a relatively high prevalence of people with tattoos. The study was carried out at the pre-surgical admissions unit and the post-surgical recovery area, both containing ten beds. Every day, an estimated 60 patients undergo surgery at the Maasstad Hospital.

We conducted a prospective cohort study among consecutive surgical patients at the Maasstad Hospital. Adult patients (≥ 18 years) were eligible for the study if they were admitted to the pre-surgical admissions unit for elective surgery, underwent general anesthesia or a loco-regional technique or insertion of a venous cannula. Patients undergoing life-saving emergency surgery and patients unable (or unwilling) to provide written informed consent were excluded.

Data was collected between January 2017 and April 2018 by a research team consisting of four researchers (MA, MD, MS, SK) and four trained research assistants. Patients were selected by convenience sampling.

Before participating in the study, the research team provided all patients with an explanation about the study, a written patient information brochure and an informed consent form. The willingness of patients to participate in the study was high. Patients were asked whether they had any tattoos.

The percentage of tattoos on their bodies was measured by the Wallace 'rule of nines', an easy tool used in emergency medicine to assess the percentage of Total Body Surface Area affected (TBSA) by burns [11]. Patients were asked how much pain they expected from the insertion of a venous cannula, regional anesthesia (spinal or epidural analgesia or local block anesthetic, if applicable) and surgery (if applicable).

All pain was assessed as a number between 0-10, using the Numeric Rating Scale (NRS). Afterward, the actual pain during the procedure was assessed. After admission to the post-surgical recovery area, postsurgical pain was assessed at four-time to (0 minutes, 15 and 30 minutes) and upon departure from the general ward. When a patient was unable to answer due to the lingering effect of anesthetic agents, the question was scored as missing. Primary outcome measures were post-operative pain scores (Numeric Rating Scale).

Secondary outcomes included pain scores after administration of a loco-regional technique (neuraxial, plexus, and peripheral nerve block) or insertion of a venous cannula.

Ethics approval

This study did not fall under the scope of the Dutch medical research involving human subjects Act (WMO). Ethical approval for this study was waived by the Review Board Scientific Research Rotterdam (TWOR) (ID-number of approval: 2016-62).

This study was not funded externally. All patients provided written informed consent before participating in the study. All participants were informed that their data would be analyzed anonymously.

Statistical analysis

Baseline differences between tattooed and non-tattooed patients were explored using simple descriptive statistics. Continuous covariates were tested using the Wilcoxon rank-sum test. Categorical covariates were tested using the Pearson Chi-squared test or Fisher's exact test if any of the table's cells had an expected count of less than five. Univariate analyses for differences in pain NRS outcomes by tattoo status were performed using the Wilcoxon rank-sum test.

Multivariate analyses for pain NRS scores associated with administration of loco-regional anaesthesia or insertion of a venous cannula were performed by ordinary least squares linear regression. For patients undergoing general anaesthesia, pain NRS scores were obtained at four-time points post-surgery (0, 15, 30 minutes and upon departure on to the general ward).

These were modeled by repeated measures analysis using a covariance pattern model assuming an unstructured covariance structure among the four repeated measures and estimated by maximum likelihood estimation. In all multivariate analyses, pain NRS scores were corrected for age, gender, baseline NRS score, recreational drug use, and analgesics use. Analyses were performed using Stata 14.2 (StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP). In all analyses, a two-sided p-value <0.05 was used to indicate statistical significance.

Results

A total of 844 patients were included during the recruitment period (Figure 1). Twenty-five patients were excluded because it was unclear whether they had tattoos or not or because of incomplete forms. Of the remaining 819 patients, 818 underwent surgery of which 419 underwent general anaesthesia, had all covariate data available and were included in the analysis on post-surgery pain.

Two hundred patients underwent loco-regional anaesthesia, of which 154 were included in the analysis of pain associated with the loco-regional procedure. An intravenous cannula was placed in 819 patients, of whom 690 with complete data were included in the analysis on pain associated with cannula insertion (Figure 1).

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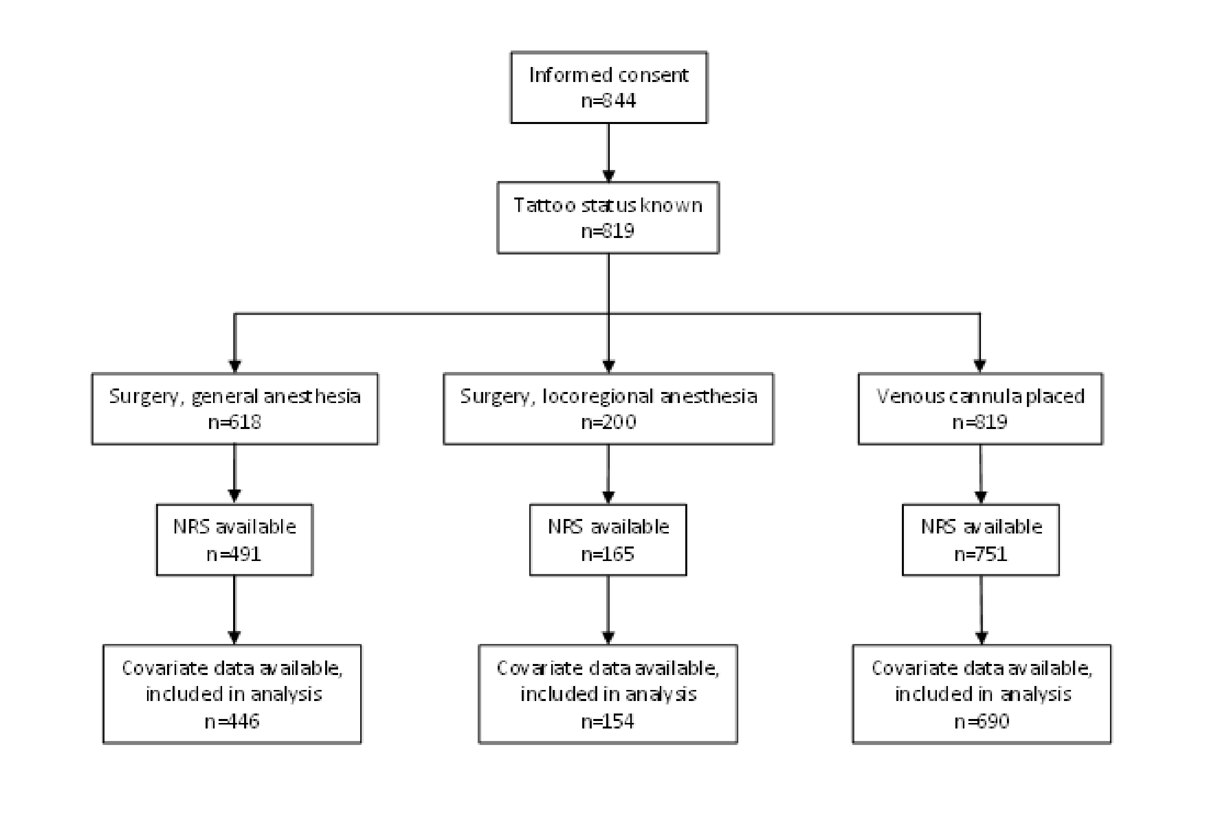

Figure 1: Inclusion flowchart.

For the primary endpoint, NRS score after surgery, patients were included in the analysis if any available NRS score was available (at the entrance of recovery ward, after 15 minutes, 30 minutes or before discharge to the general ward). For the secondary endpoints, NRS score after venous cannula placement or after administration of a loco-regional technique (neuraxial, plexus or peripheral nerve block) were used. Patients with missing data on those specific endpoints were excluded. In one patient, a venous cannula was placed without the need for subsequent surgery.

	Non-tattoo	**Tattoo**	**p-value¥**	
	n=531	n=288		
Demographic characteristics				
Age, mean (sd)	55.6 (16.3)	43.7 (13.6)	<0.001§	
Gender, n (%)			0.004	
Male	274 (51.6)	118 (41.0)		
Female	257 (48.4)	170 (59.0)		
BMI, mean (sd)	27.8 (5.6)	28.6 (6.7)	0.239§	
Postal code SES, mean (sd)	-0.48 (-0.14)	-0.64 (-0.35)	0.090§	
Smoking	142 (26.9)	142 (49.5)	<0.001	
Alcohol use	261 (49.5)	126 (44.1)	0.136	
Recreational drug use	12 (2.3)	30 (10.5)	<0.001	

Comorbidity				
Baseline NRS score, mean (sd)	2.18 (2.06)	2.15 (2.15)	0.575§	
ASA score, n(%)			0.004¤	
Missing	3 (0.6)	2 (0.7)		
1	186 (35.0)	124 (43.1)		
2	266 (50.1)	142 (49.3)		
3	76 (14.3)	20 (6.9)		
Myocardial infarction, n (%)	29 (5.5)	7 (2.4)	0.044	
Type 2 diabetes mellitus, n (%)	51 (9.6)	14 (4.9)	0.016	
Cerebrovascular accident, n (%)	23 (4.4)	5 (1.7)	0.049	
Psychiatric disorder, n (%)	27 (5.1)	17 (5.9)	0.624	
Fibromyalgia, n (%)	4 (0.8)	9 (3.2)	0.016¤	
Back pain/joint complaints, n (%)	155 (29.3)	79 (27.4)	0.572	
Pain syndrome (other), n (%)	12 (2.3)	11 (3.8)	0.196	
Previous surgery, n (%)	456 (86.4)	250 (87.1)	0.766	
Analgesics				
Home use				
Paracetamol, n (%)	82 (15.4)	42 (14.6)	0.743	
NSAIDs, n (%)	73 (13.8)	36 (12.5)	0.629	
Opioids, n (%)	59 (11.1)	30 (10.5)	0.766	
Anti-depressants, n (%)	28 (5.3)	21 (7.3)	0.245	
Pregabalin, n (%)	11 (2.1)	6 (2.1)	0.997	
Premedication				
Paracetamol, n (%)	494 (93.0)	269 (93.4)		0.841
NSAIDs, n (%)	386 (72.7)	216 (75.0)		0.475
Opioids, n (%)	13 (2.5)	14 (4.9)		0.066
Type of anaesthesia, n (%)				0.047¤
General anaesthesia	385 (72.5)	234 (81.3)		
Spinal	93 (17.5)	34 (11.8)		
Epidural	5 (0.9)	2 (0.7)		
Peripheral nerve/plexus block	48 (9.0)	18 (6.3)		
Type of surgery, n (%)				<0.001
General surgery	217 (40.9)	111 (38.5)		
Gynaecology and obstetrics	38 (7.2)	38 (13.2)		
Dental surgery	4 (0.8)	10 (3.5)		
Ear, nose, throat surgery	34 (6.4)	22 (7.6)		

Neurological surgery	14 (2.6)	21 (7.3)		
Orthopedic surgery	109 (20.5)	43 (14.9)		
Plastic surgery	36 (6.8)	22 (7.6)		
Pain surgery	4 (0.8)	6 (2.1)		
Urology	72 (13.6)	13 (4.5)		
Other	3 (0.6)	3 (0.7)		
¥Pearson's chi-squared was used to test for group differences unless specified otherwise §Wilcoxon rank-sum test ¤Fisher's exact test ASA: American Society for Anesthesiologists; BMI: Body Mass Index, NSAIDs: Non-Steroidal Anti-Inflammatory Drugs, SES: Social Economic Status, NRS: Numeric Rating Scale				

Table 1: Baseline characteristic.

Baseline characteristics are presented in Table 1. Overall, 288 (35%) patients had tattoos and 531 (65%) did not have tattoos. The mean age was lower in the tattoo group. The tattoo group consisted of more female patients and there were significantly more smokers and recreational drug users (e.g. Cannabis) compared to the non-tattoo group. There were more ASA 3 patients in the non-tattoo group. There were more patients with diabetes, myocardial infarction or a cerebrovascular accident in the group without tattoos. The group with tattoos had more patients with fibromyalgia. Home use of analgesics and premedication did not differ between groups. There was a significant difference in the type of surgery and anaesthesia technique between the two groups (Table 2).

	Non-tattoo	Tattoo	p-value¥
Post-surgery			
Perceived			
0 minutes	1.7 (1.7) (236)	1.9 (1.7) (139)	0.01
15 minutes	2.3 (2.0) (249)	2.7 (2.2) (157)	0.006
30 minutes	2.5 (2.0) (225)	2.6 (1.8) (140)	0.038
Back at the ward	2.0 (1.3) (296)	2.2 (1.2) (176)	0.012
Expected	4.5 (2.5) (249)	4.9 (2.4) (158)	0.314
Locoregional anaesthesia			
Perceived	3.0 (2.1) (121)	3.0 (2.1) (44)	0.979
Expected	4.2 (2.4) (144)	4.1 (2.4) (50)	0.475
Venous cannula			
Perceived	2.6 (1.9) (480)	2.9 (2.3) (271)	0.245
Expected	3.4 (2.0) (526)	3.8 (2.4) (288)	0.205
¥Wilcoxon rank-sum test NRS: Numeric Rating Scale			

Table 2: Univariate analysis of perceived and expected pain.

Univariate analysis of perceived and expected NRS scores by tattoo status post-surgery, upon application of loco-regional anaesthesia and upon placement of a venous cannula. Results are presented as mean (sd) (n). Univariably, patients with tattoos experienced more pain post-surgery.

Sensitivity analyses of in and excluded patients because of missing data showed some significant differences (supplementary data Table S1 and S2). These were minor and differed between the three analyses. Patients with tattoos undergoing general anaesthesia experienced significantly more pain post-surgery in the univariate analysis (mean NRS score) at 0 minutes (tattoo 1.9, non-tattoo 1.7, p=0.010), 15 minutes (tattoo 2.3, non-tattoo 2.7, p=0.006) and 30 minutes post-surgery (tattoo 2.5, non-tattoo 2.6, p=0.038) and upon departure to the general ward (tattoo 2.0, non-tattoo 2.2, p=0.012) (Table 2). There were no differences between the two groups for the insertion of a venous cannula or loco-regional technique. Also, there were no differences in pain expectations between groups before any procedure or surgery. After correction for known and expected confounders, no relationship between tattoos and post-procedural pain was found (Table 3).

	Post-surgery		**Locoregional anaesthesia**		**Venous cannula**	
	n=446		n=154		n=690	
Tattoo (yes/no)	-0.04	(-0.27,0.20)	-0.17	(-0.90,0.56)	0.15	(-0.19,0.49)
Age§ (years)	-0.01***	(-0.02,-0.01)	0	(-0.02,0.03)	-0.01*	(-0.02,-0.00)
Female	0.56***	(0.33,0.80)	0.78*	(0.14,1.42)	0.82***	(0.50,1.14)

Baseline NRS score	0.04	(-0.01,0.09)	0.35***	(0.21,0.49)	0.13***	(0.06,0.21)
Recreational drug use	0.09	(-0.39,0.56)	0.63	(-1.20,2.47)	0.15	(-0.59,0.89)
Type of anaesthesia						
General anaesthesia	ref	ref	NA	NA		
Spinal	NA	NA	ref	ref		
Epidural	NA	NA	-0.16	(-1.96,1.64)		
Peripheral nerve/plexus block	NA	NA	1.23***	(0.56,1.90)		
Analgesics (home)						
Non-opioids	-0.2	(-0.49,0.09)	-0.6	(-1.39,0.18)	0	(-0.41,0.42)
Opioids	0.31	(-0.08,0.69)	-0.14	(-1.16,0.89)	0.07	(-0.50,0.64)
Co-analgesics	0.65**	(0.22,1.08)	1.02	(-0.30,2.33)	-0.12	(-0.72,0.47)
Premedication						
Non-opioids	0.35	(-0.14,0.83)	-0.26	(-1.84,1.31)	0.4	(-0.28,1.07)
Opioids	0.11	(-0.50,0.72)	0.6	(-0.99,2.19)	0.28	(-0.56,1.12)
Type of surgery						
General surgery	ref	ref				
Gynaecology and obstetrics	-0.19	(-0.56,0.18)				
Dental surgery	-0.74*	(-1.39,-0.09)				
Ear, nose, throat surgery	-0.16	(-0.54,0.23)				
Neurolgical surgery	-0.05	(-0.53,0.43)				
Orthopedic surgery	-0.46*	(-0.84,-0.08)				
Plastic surgery	-0.31	(-0.74,0.12)				
Pain surgery	-0.69	(-1.56,0.18)				
Urology	0.29	(-0.07,0.65)				
Other	-0.15	(-1.26,0.96)				
Time since surgery						
0 minutes	ref	ref				
15 minutes	0.69***	(0.49,0.88)				
30 minutes	0.69***	(0.49,0.90)				
Back at the ward	0.20*	(0.02,0.37)				
Constant	1.25	(0.70,1.80)	1.76	(0.13,3.39)	1.56	(0.84,2.28)

*p<0.05, **p<0.01, ***p<0.001

§Centred at 50 years

Table 3: Multiple linear regression analyses.

Multiple linear regression analyses evaluating the effect of tattoo status on pain VAS post-surgery (model 1), upon administration of loco-regional anesthesia (model 2) and upon placement of a venous cannula (model 3). Model 1 was analyzed using repeated measures analysis, models 2 and 3 by ordinary least squares linear regression. As can be seen, there is no relationship between tattoos and post-procedural pain scores. Younger people and female patients have higher post-procedural pain scores 95% confidence intervals in the bracket.

Younger people and female patients did experience more post-operative pain. A peripheral nerve/plexus block was more painful than spinal or epidural anesthesia. Also, a time effect was observed for post-procedural pain scores, with higher scores after 15 and 30 minutes post-surgery and upon discharge, to the general ward as compared to the moment immediately after surgery. After correction for included covariates, there was no relationship between comorbidity or chronic pain syndromes and post-procedural pain scores. Therefore, no additional correction was needed for these in the regression analysis. Inclusion of the percentage of body surface covered by tattoos on an ordinal scale rather than the presence of tattoos as a dichotomous predictor did not influence the results (data not shown).

Discussion

In this study, we found no relationship between the presence of tattoos and post-procedural pain scores. We did, however, find a relationship between gender and age and post-procedural pain scores. Women and younger people experienced more pain after most procedures. This study provides the first insight into the possible relationship between tattoos and post-procedural pain. Although many anaesthesiologists in our clinic believed that patients with tattoos could endure less pain than patients without tattoos, there is no data available supporting this preconception. Our first analysis showed significantly higher pain scores in the tattoo group, but after correction for age and gender, this difference between patients with and without tattoos disappeared. Our finding that younger and female patients experience more pain is in line with previous studies [12-15]. Research has shown that gender and age are the main biological factors that influence pain perception [12-15]. The majority of chronic pain patients are women and studies have shown that women are more sensitive to pain than men [16].

In Western countries, tattooing has gained considerable popularity. Studies show that in Western countries approximately 10%-14.5% of the population has at least one tattoo [8,17]. In 2014, in the Netherlands 11% of the population had at least one tattoo [18]. In our population, 35% of all patients had at least one tattoo, confirming our assumption of high tattoo incidence in our hospital population. The characteristics of the tattoo group at the Maasstad Hospital resemble the characteristics of tattooed people found in other studies [8,17].

A strength of this study is the fact that a large group of over 200 patients with tattoos could be included, with a control group consisting of over 500 patients. Despite this large sample size, we were unable to find an effect of tattoo status on post-operative pain scores. Therefore, it seems likely that if such an effect is present at all, the effect size is small and is unlikely to be of clinical significance. One limitation to our study is its observational nature. Although on methodological grounds a randomized controlled trial is the preferred method to make causal inferences, the randomized allocation of tattoos is obviously not feasible for ethical reasons. Therefore, to minimize the effect of bias due to confounding, care was taken to include known and possible confounders for pain in the analysis. Despite this, bias due to omitted confounders or model misspecification always remains a possibility. However, given that no effect for tattoo status was observed in the multivariate analysis, we believe it is unlikely that the presence of such bias would lead to different conclusions. Another potential limitation is the exclusion of patients from the analysis due to missing outcomes or covariates. To investigate the potential impact of this, baseline characteristics of patients included and excluded from the analysis were compared (Supplemental Tables S1 and S2). Although some significant differences were observed, these were minor, differed between the three analyses and were therefore unlikely to have influenced the results. The study was performed in a single center what could be accounted for as a limitation. Although the Maasstad Hospital is a large hospital, this might diminish the generalizability of the findings of our study. The overall socioeconomic status of patients around the Maasstad Hospital is lower than in other parts of Rotterdam/the Netherlands. This might influence post-operative pain scores. However, correcting for the postal code did not influence our findings suggesting that socioeconomic status did not influence our findings. Another limitation is that we were not able to investigate the differences between pain scores and ethnicity. Research has shown that the experience of pain is likely also influenced by ethnicity, although this relationship is difficult to investigate because of the multidimensional character of pain [15].

As stated in the introduction, the ultimate goal of personalized pain treatment is to minimize side effects and maximize effectiveness. Our study indicates that patients with tattoos do not require more aggressive post-operative pain treatment or special precautions. Young people and women might require more pain treatment, but the impact of this finding on clinical practice warrants further investigation.

Conclusion

In conclusion, our findings contradict the commonly held belief that patients with tattoos experience more post-operative pain nor was such an association found for pain related to locoregional anesthesia or placement of venous cannulas. We did confirm the previously known findings that younger people and women experience more intense post-operative pain.

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