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The impact of emergency department patient-controlled analgesia (PCA) on the incidence of chronic pain following trauma and non-traumatic abdominal pain.

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Title Page:

The impact of patient controlled analgesia in the emergency department on the incidence of persistent pain following trauma and non-traumatic abdominal pain. The CHronIc Pain Study (CHIPS).

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Summary

The effect of patient-controlled analgesia during the emergency phase of care on the prevalence of persistent pain is unknown. We studied individuals six months after admission to hospital via the emergency department with traumatic injuries or abdominal pain. This opportunistic observational study was conducted using postal questionnaires, sent to participants recruited to the multi-centre PAin SoluTions In the Emergency Setting (PASTIES) study. Patients with prior chronic pain states or opioid use were excluded. Questionnaires included the EQ5D, the brief pain inventory and the hospital anxiety and depression scale. Overall, 141 patients were included in this follow up study (49% response rate (141/286), 95% confidence interval (CI): 44% to 56%). Participants presenting with trauma were more likely to develop persistent pain than those presenting with abdominal pain (70% (45/64) versus 31% (24/77), 95% CI for difference: 24% to 54%, $p<0.001$). There were no statistically significant associations between analgesic modality during hospital admission, age or gender and persistent pain. Across both abdominal pain and traumatic injury groups, participants with persistent pain had lower EQ5D mobility scores, lower overall health, and higher anxiety and depression scores ($p<0.05$). In the abdominal pain group, 26% (13/50) of those using patient-controlled analgesia developed persistent pain versus 41% (11/27) of those with usual treatment (95% CI for difference (control minus PCA): -8% to 39%, $p=0.183$). Acute pain scores at the time of hospital admission were higher in participants who developed persistent pain (95% CI for difference: 0.7 to 23.6, $p=0.039$). For traumatic pain, 71% (25/35) of those given patient-controlled analgesia developed persistent pain versus 69% (20/29) with usual treatment (95% CI for difference (control minus PCA): -30% to 24%, $p=0.830$). In conclusion, persistent pain is common six months after hospital admission, particularly following trauma. The study findings suggest that it may be possible to reduce persistent pain, at least in patients with abdominal pain, by delivering better acute pain management. Further research is needed to confirm this hypothesis.

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Introduction

Pain is the commonest reason for presentation to the emergency department (ED) [1]. Two common diagnostic groups are patients with traumatic injury and non-traumatic abdominal pain. These patients frequently experience severe acute pain, often managed in the ED with opioid analgesics [2,3]. Although pain scores usually reduce after discharge from hospital, 21% of individuals experience persistent pain [4]. In the post-operative setting, an adverse "pain trajectory" has been correlated with persistent post-surgical pain and it is reasonable to suspect that this might also pre-dispose to persistent pain in the ED patient population [5]. Persistent pain may be defined as pain continuing beyond the expected time of healing, usually 3-6 months [6].

Persistent pain following surgery is common in the general population [7,8]. The incidence of significant persistent post-surgical pain (PPSP), for all operation types is 11.8% at one year [9]. Persistent non-cancer pain is correlated with poor mental health, loss of employment and a poor quality of life [10].

The transition from acute to persistent pain has been less well investigated after trauma and following an episode of acute abdominal pain. Following traumatic injury, persistent pain is common, with 44% of patients reporting accident-related pain three years later in one prospective study [11]. Little is known about the development of persistent abdominal pain after the initial presentation. Recurrent or chronic abdominal pain is common in children, occurring in up to one fifth of individuals [12]. In adults, abdominal and pelvic pain are also frequent. The monthly prevalence and incidence rates of chronic pelvic pain are 21.5/1000 and 1.58/1000, respectively, with an annual prevalence of 38.3/1000 [13].

There are multiple risk factors for the progression from acute to persistent pain [14]. These include the type of injury, surgery or other pathology (nerve injury, tissue trauma and inflammation are all important) and a number of patient-specific factors including gender, age, genetics, anxiety, depression and abnormal coping responses [11,15]. The presence of severe acute post-operative pain consistently correlates with the development of persistent pain [16]. It is possible that improved pain relief in the acute phase following a traumatic injury or during an episode of non-traumatic abdominal pain may reduce the frequency of persistent pain six months later.

We have demonstrated that patient controlled analgesia (PCA) results in improved analgesia in the short term in patients admitted to hospital from ED, in a group of patients with abdominal pain [3]. The impact of PCA on the incidence of persistent pain is unknown. The aim of this study was to determine whether PCA use in the first twelve hours of care alters the prevalence of persistent pain six months later, in patients presenting to ED with severe acute pain from trauma and non-traumatic abdominal pain. Secondary aims were to assess the impact of persistent pain on mental health and quality of life. This is the first study to investigate the incidence of persistent pain in a population without pre-existing pain or opioid use and may suggest hypotheses for future research into its prevention after trauma or acute abdominal pain.

Methods

This was an opportunistic observational study. The study sample was drawn from participants enrolled in the PASTIES study. In summary, PASTIES comprised two parallel multi-centre open label randomised trials of patient-controlled analgesia (PCA) versus treatment as usual (control) that were statistically powered separately but run side-by-side using a shared protocol. Participants enrolled in the PASTIES study were adults presenting to the ED with either traumatic injury or non-traumatic abdominal pain requiring intravenous opioid analgesia and hospital admission. Exclusion criteria included age >75

years and a history of other chronic pain conditions or opioid use. Visual analogue pain scores were recorded hourly for the first 12 hours, and the "total pain experienced" was calculated as the area under the pain score against time curve, standardised to a score from 0 to 100 units [17]. Acute pain at the time of hospital admission was measured over 12 hours in the PASTIES study as described above and quality of life measured using the EQ5D. Anxiety and depression were assessed using the hospital anxiety and depression scale (HADS). Scores of ≥8/21 on either the anxiety or depression subscale of the HADS were clinically significant.

Questionnaire booklets were sent to study participants recruited at three centres six months after admission to hospital. If no reply was received within two weeks, a second questionnaire pack was sent. If no reply was received to the second questionnaire pack, the participants were contacted by telephone and a third pack was sent.

The primary outcome measure was the presence of pain at six months. This was defined as a positive answer to the question: "Do you continue to experience pain, which you attribute to the injury or episode of abdominal pain you experienced approximately six months ago when you attended the Emergency Department?". Persistent pain was assessed using the Brief Pain Inventory (BPI). Significant persistent pain was defined as average pain ≥4 or worst pain ≥8.

The proportion of participants with significant persistent pain at six months was calculated and compared between randomised groups (control or PCA, on intention-to-treat basis), overall and separately for each group (abdominal pain or trauma), using tests of proportions at the 5% significance level and corresponding 95% confidence intervals (CI). As this was an exploratory follow up study, no adjustments were made for multiple testing.

The hypothesis was that use of a PCA device to manage an episode of acute non-traumatic abdominal pain or pain from traumatic injury may result in a reduction in the risk of significant persistent pain six months later. The secondary aims were to assess the impact of acute pain on the prevalence of significant persistent pain at six months. We also assessed the impact of persistent pain on quality of life measures. Finally, we compared the levels of anxiety and depression in patients with and without significant persistent pain following an acute pain episode.

Results

One hundred and forty one participants were included in this follow up study (49% (141/286) response rate, 95% CI: 43% to 55%), as described in table 1. The diagnostic categories of participants are listed in table 2. Almost half of the respondents continued to experience pain six months after the index event (49% (69/141), 95% CI: 40% to 58%). The proportion of participants experiencing persistent pain differed between the two groups, with 31% (24/77) of the non-traumatic abdominal pain group and 70% (45/64) of the traumatic injury pain group affected. The difference in the prevalence of significant persistent pain at six months between the two groups was statistically significant (95% CI for difference (trauma minus abdominal related pain): 24% to 54%, $p<0.001$), and they were therefore analysed separately.

If it is conservatively assumed that participants who did not return their questionnaire did not have significant pain at six months, then the estimated prevalence of significant persistent pain is 13% (24/180) and 46% (45/99) for the abdominal pain group and traumatic injury pain group, respectively.

Abdominal pain (n=77):

At six months, 70% (54/77) of these participants were pain free, 14% (11/77) had mild pain and 16% (12/77) had significant pain. Forty one percent (11/27) of those allocated to the control group

reported persistent pain versus 26% (13/50) of those allocated to patient-controlled analgesia (PCA). This difference was not statistically significant (95% CI for difference (control minus PCA): -8% to 39%, p=0.183). The association between persistent pain and gender was not statistically significant, with 19% (5/27) of males reporting persistent pain at 6 months compared with 38% (19/50) of females (95% CI for difference (females minus males): 0% to 42%; p=0.078). Those with persistent abdominal pain at 6 months had experienced statistically significantly higher standardised pain scores in the first 12 hours of the PASTIES study (mean difference (persistent pain minus no persistent pain): 12.1 units, 95% CI for difference: 0.7 to 23.6, p=0.039).

Data from the EQ5D questionnaire revealed a marked impact on mobility. Thirty eight percent (9/24) of participants with persistent pain stated they had reduced mobility versus 8% (4/52) of those without ongoing pain (95% CI for difference (persistent pain minus no persistent pain): 18% to 73%, p=0.003). General health state was also lower with persistent pain (mean difference (persistent pain minus no persistent pain): -12.9 units, 95% CI: -24.5 to -1.4, p=0.029). There were significantly higher anxiety and depression scores in the group with persistent abdominal pain than the group without (anxiety: mean difference (persistent pain minus no persistent pain): 3.2 units, 95% CI: 1.2 to 5.2, p=0.003; depression: mean difference: 3.3 units, 95% CI: 1.1 to 5.5, p=0.005). See figure 1.

Trauma (n=64):

At six months follow up, 30% (19/64) of these participants were pain free, 47% (30/64) had mild pain and 23% (15/64) significant persistent pain. Use of PCA in the first 12 hours had little effect on the occurrence of persistent pain at six months in this group. Sixty nine percent of participants (20/29) allocated to the control group reported ongoing pain at six months compared with 71% (25/35) allocated to PCA (95% CI for difference (control minus PCA): -30% to 24%, p=0.830). The association between gender and persistent pain in the trauma group was not statistically significant, with 78% (29/37) of males reporting continuing pain at six months compared with 59% (16/27) of females (95% CI for difference (females minus males): -46% to 4%, p=0.098). In the trauma group, there was no association between standardised pain scores in the first twelve hours and persistent pain at six months (mean difference (persistent pain minus no persistent pain): 0.6 units, 95% CI for difference: -13.7 to 14.9, p=0.936).

The impact of persistent pain after trauma was noteworthy. Mobility was impaired for 64% (28/44) of participants with persistent pain versus 16% (3/19) for those without persistent pain (95% CI for difference (persistent pain minus no persistent pain): 20% to 61%, p=0.008). The proportion of participants reporting moderate pain or discomfort on EQ5D was 81% (35/43) amongst participants with persistent pain versus 53% (10/19) for those without persistent pain (95% CI for difference (persistent pain minus no persistent pain): 4% to 57%, p=0.030). General health state was also lower with persistent pain (mean difference (persistent pain minus no persistent pain): -15.8 units, 95% CI: -22.7 to -8.9, p<0.001). There were significantly higher anxiety and depression scores in the group with persistent abdominal pain than the group without (anxiety: mean difference (persistent pain minus no persistent pain): 2.7 units, 95% CI: 0.7 to 4.8, p=0.010; depression: mean difference: 2.7 units, 95% CI: 0.9 to 4.4, p=0.004). See figure 1.

Discussion

This study has revealed the significant burden of persistent pain following admission to hospital with pain due to traumatic injuries or non-traumatic abdominal pain. This is the first study designed to investigate the incidence of persistent pain in an ED patient population without pre-existing pain problems, and to characterise that pain and its impact on wellbeing.

The response rate was 49% by the end of data collection. Sixty percent of the useable questionnaires were received after the first posting and 40% after the second. Telephone calls and a third posting did not result in any further useable questionnaires. Three questionnaires were unusable. There may have been a response bias, as it might be expected that participants without pain after a brief hospital visit six months earlier would be less likely to return their follow up questionnaires. All participants in this study had successfully completed the questionnaires included in the acute pain study.

Following an episode of acute abdominal pain, persistent pain was common. For this group, there was no statistically significant gender difference in the prevalence of persistent pain, with 38% of females and 19% of males affected. Anxiety and depression were higher in patients with persistent pain, and overall health status lower. Mobility was significantly impaired by persistent abdominal pain. Participants with persistent pain had experienced significantly higher standardised acute pain scores in the first 12 hours. Fewer patients experienced persistent pain if treated with a PCA, although this was not statistically significant in this opportunistic sample (26% in the PCA group versus 41% in the control group). These findings are perhaps not surprising, as severe acute pain is known to be a predictor of persistent pain in the surgical setting and the PASTIES study demonstrated that PCA use resulted in better analgesia in the abdominal pain group [5].

A different picture was observed in participants with acute pain from traumatic injuries. The prevalence of persistent pain in this group was significantly higher than in the non-traumatic abdominal pain group. Acute pain scores did not differ from patients with non-traumatic abdominal pain, but persistent pain was a more common outcome in the trauma pain group. The severity of acute pain or the use of PCA did not correlate with the presence of persistent pain for the traumatic injuries pain group. The impact of persistent pain was marked, with lower quality of life scores, higher rates of anxiety and depression, and interference with mobility.

Conclusions

Persistent pain is common following ED admission with acute pain in those with no prior history of pain problems, analgesia use or mental illness. Substantial numbers of individuals will be affected by significant persistent pain, resulting in a low quality of life and high rates of psychological illness. For the non-traumatic abdominal pain group, it is imperative to manage acute pain effectively to reduce the incidence of persistent pain and disability. This study was not powered to detect a difference in persistent pain prevalence with PCA use, but the results permit an appropriately powered study to be designed. PCA use costs an additional £20.18 (€22.63 US$26.45) per 12 hours in patients with abdominal pain [18]. If PCA reduces the prevalence of persistent pain following acute abdominal pain, it would be the first effective and cost-effective intervention discovered to date.

Participants presenting with pain due to traumatic injuries frequently suffer persistent pain, but there appears to be a lack of correlation between the severity of acute pain and persistent pain prevalence in this group. This finding warrants further study.

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Authors' contributions

MR conceived the CHIPS study, JS was the chief investigator for the PASTIES study. MR wrote the initial manuscript. MR, JS and RS co-wrote the initial protocol, and have been involved with the conduct of the study throughout. SC was the trial statistician, has been involved in conduct of the study from its inception, and contributed to the manuscript. The CHIPS writing group members CH and CP are listed in the appendix.

CH was the initial trial manager and helped to develop the study protocol to its final version. PE, AB and CP provided methodological advice and edited the protocol and versions of this manuscript. VE took over as trial manager during the study, and LC was the data manager, who helped to draft the results. JB contributed to the initial and final drafts of the protocol, and has provided advice regarding patient recruitment and the effective conduct of the study. All authors have contributed to and approved the final manuscript.

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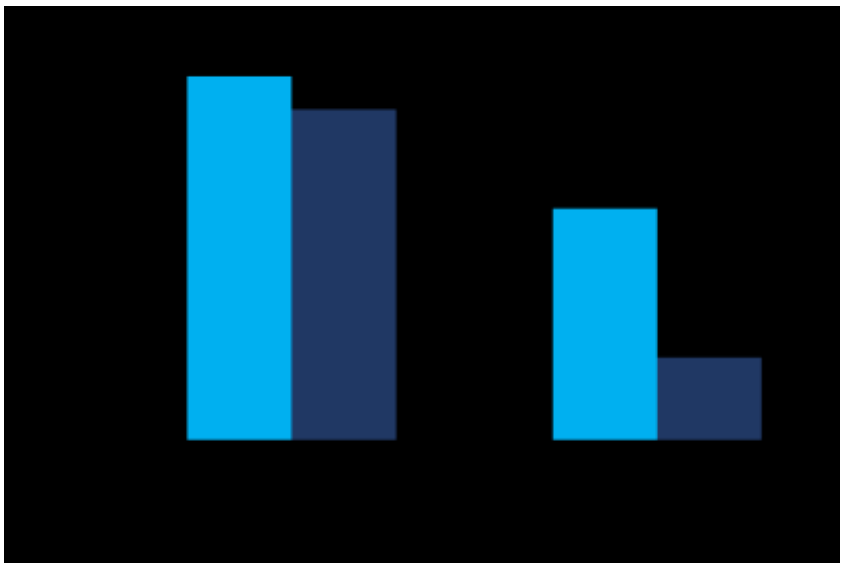
Figure 1:



Absolute number of participants with significant anxiety (■) or depression (■) at six months. Significant anxiety or depression is defined as scores ≥8 on the relevant scale of the HADS questionnaire.

Table 1:

Recruitment to the CHIPS study from Plymouth, Bristol and Exeter centres.

Participants recruited to PASTIES	294
Participants excluded from CHIPS	8
Participants contacted	286
Usable questionnaires returned	141
Total questionnaires sent	492
Returned after initial post	85
Returned after first chase	59
Total phone calls made	57
Returned after phone calls	0

Table 2:

Diagnostic categories of CHIPS participants.

Number of participants	Abdominal pain diagnosis
15	gall bladder pathology
13	renal pathology (stone passed)
12	bowel pathology
12	abdominal pain (NOS)
6	pancreatic pathology
6	other abdominal pain
5	appendix pathology
4	gynaecological pathology
2	oesophagitis / gastritis
2	renal pathology (NOS)

Number of participants	Trauma diagnosis
29	lower limb fracture
9	multiple injuries
7	pelvic bony injury
6	spinal injury
5	chest wall injury
4	upper limb fracture
4	other trauma

Appendix:

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