Title:

Chronic pain among the hospitalized patients after the 22nd july-2011 terror attacks in Oslo and at Utøya Island.

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Abstract:

Background:

On July 22nd 2011, 48 people were hospitalized due to physical injuries from gun shots or explosion, following two terror attacks in the Oslo area, Norway. In this study we have investigated the occurrence of chronic pain, the severity and consequences of chronic pain in these patients, three to four years after the incidents.

Methods:

Totally 43 eligible terror trauma patients were invited to participate in the study, 30 patients were included. They underwent a consultation with a psychologist and a physician; containing psychological assessment, neuropsychological screening, a standardized clinical interview, medical examination and a pain protocol.

Results:

In 18 (60%) the injury was severe, as defined by New Injury Severity Score >15. Twenty-four patients (80%) reported injury-related chronic pain after the trauma, in 22 with consequences on daily life. Analgesics were used by 20 patients, including five in need of opioids. Ten patients had unmet needs of further specialist pain care.

In 12 patients the average pain score the preceeding week was above three on a 0-10 Numeric Rating Scale. In these patients, clinical signs of neuropathic pain were evident in 10, as tested by the Douleur Neuropathique score. There were significant correlations ($p<0.05$) between severity of chronic pain and presence of post-traumatic stress symptoms, reduced quality of life, reduced psychosocial and physical function; but no correlation with pre-injury patient characteristics or the degree of injury.

Conclusion: Chronic pain was frequent and significant, irrespective of injury severity, in these patients who obtained their physical injuries under extreme psychological conditions.

Introduction:

Whereas the initial focus and efforts after physical trauma are on patient survival and treatment of major physical injuries, the focus of the survivors will subsequently shift towards attention to pain and disabilities as well as physical and psychosocial functions. Both due to the physical injury and the frequent need of surgical interventions, trauma patients will experience acute pain. With healing of the wounds and injured structures, the patients are expected to recover to a pain-free state. Still, in 10-63% (1-4), the pain will continue into a state of chronic pain.

The transition from acute to chronic pain is a complex multi-factorial process involving biological, psychological and social-environmental factors (3, 5-9). A range of risk factors have been identified in this transition, in addition to the extent and characteristics of the physical trauma and surgeries. Previous or concurrent pain, female gender, young age, low education level, no pre-injury employment status, low social support, preoperative anxiety and a pain catastrophizing attitude are all factors which are associated with the development of chronic pain (5-7, 10).

Following exposure to a potentially life threatening situation with or without physical injury, a person may also develop symptoms of post-traumatic stress disorder (PTSD), anxiety and depression (11-13). Previous studies have indicated that PTSD and pain frequently co-occur following traumatic injury and may interact as to maintain and exacerbate dysfunction (14-17).

The two terror attacks July 22nd in 2011, a downtown bomb-explosion in Oslo, and a subsequent shooting on Utøya, an isolated island nearby, were the most severe terror attacks after the second World-war in Norway. A total of 77 persons were killed and another 152 persons were physically injured, of whom 48 were hospitalized (18-20). A major feature

of the victims at the island part of the attack was the intense exposure to the cruelty, prolonged anxiety and fear of death, caused by limited options of hiding or escape.

The focus of this report has been to assess the hospitalized patients extensively, three to four years after the attack. A primary concern was to do a thorough multi-disciplinary examination regarding physical and psychosocial symptoms. The primary aims of the study were to investigate: the occurrence of chronic pain, the severity of chronic pain, if a neuropathic component was present and analgesic treatment. Secondary aims were to look for: co-occurrence of post-traumatic stress symptoms, as well as consequences of pain for overall functioning and life satisfaction; physical and psychological health. Furthermore, we wanted to investigate if pain after three to four years was associated with some of the known risk factors for development of chronic pain, and if we could identify commonalities in a subgroup with clinical significant pain, defined according to the literature as moderate pain or more, with average pain last week at NRS > 3(2, 21-23) .

Methods

Study population and sample

In total, 48 patients were hospitalized after the terrorist attack July 22nd 2011, 13 from the bomb in the Oslo government district and 35 from the shooting at the Utøya Island. Five patients were excluded from the potential study population of 48 (fig 1).

The 43 eligible patients were identified from medical records at Oslo University Hospital (OUH) and Vestre Viken Hospital Trust (VV) and invited to participate in this cross-sectional study. Letters with informed consent forms were delivered by mail to all patients, except one who had no registered address, including one reminder letter. Contact by telephone was then attempted to non-responders. Written informed consent to participate was given by 31 patients; one of these withdrew consent after initial inclusion, but before assessment. A total of 30 patients participated in the study, corresponding to a 70% response rate.

An overview of the recruitment procedures, response rates and sample composition is shown in fig 1.

(Fig. 1 Flowchart here)

Medical data

Acute medical data from the initial hospital stay were extracted from the medical record. Anatomic injury was classified according to the Abbreviated Injury Scale 1998 (AIS) (24). The Injury Severity Score (ISS) (25) and New Injury Severity Score (NISS) (26) were calculated based on AIS. The calculation of ISS and NISS was completed by the trauma registry at OUH and VV. NISS score was chosen as the reference value, since this score has been claimed to be more predictive than ISS for outcome in trauma patients with penetrating injuries (26).

Medical examination and questionnaires

The patients met at the outpatient clinic at Sunnaas Rehabilitation Hospital in Norway. They were informed that unmet medical needs detected during the consultation would be addressed. All assessments were performed May 2014 to March 2015. The participants underwent comprehensive separate consultations with a physician and a psychologist. The consultations included a standardized clinical interview containing pre- per- and post –injury anamnestic information. Pre-injury pain, depression, anxiety, medication use and challenging life-events (defined as bullying, refugee status, serious illness or death in near family) were registered. Further, they all went through medical examination, pain consultation, psychological assessment and neuropsychological screening.

Pain consultation

The participants were asked whether or not they had pain related to the terror attacks. If positive answer, they went through a standardized pain protocol established for the study, based on The Norwegian Pain Association protocol(27).

The participants rated the clinical pain intensity by using a verbally administered numeric rating scale (NRS) (21, 28, 29). Pain intensity was specified on an 11-point numerical rating scale from 0 – 10 with 0 = “no pain” and 10 = “The most intense pain imaginable”. Questions from the Brief Pain Inventory (BPI) (30) were used to quantify maximum, minimum and average levels of pain the previous week and during the consultation, and the painful areas were marked on an illustrated body drawing (27, 30-33). The term “average” referred to the patients’ perception of pain in general the previous week.

Sensory abnormalities were clinically examined and identified by comparing the body areas where the participant addressed pain at the drawings, with assessment at a reference contralateral mirror area. The areas were tested with warm (40.0°C) and cold (20.0°C) metal

rolls (SBMEDIC Electronics, Sweden), brush (SENSELab Brush 05, Somedic, Sweeden), with a cotton wad and pinprick stimulation (256 mN vonFrey filament, VF7 Optihair, Marstock Nervtest, Germany). Symptoms of sensory loss (hypoesthesia or hypoalgesia) or gain (hyperalgesia or allodynia) were specified. The Norwegian version of the Douleur Neuropathique score (DN4) with a cut off value ≥4, was used to classify the pain as either "probable" or "unlikely" neuropathic pain (34-36). Physical function and life satisfaction were assessed by completing validated questionnaires. The participants were asked ten questions about physical function from the SF-36 subscale physical function scale (SF-36 PF) (37, 38). Sleep disturbances were assessed using the 5-item Insomnia Severity Index (ISI), with a cut off value ≥ 8 for sleep disturbance (39). Two questions were asked regarding physical and psychological health from the Life Satisfaction scale, (LiSat-11)(40, 41).

The Pain Catastrophizing scale (PCS) was used to assesses catastrophic thoughts or feelings accompanying the experience of pain (42). The total score range for the PCS is 0 to 52, with higher scores reflecting higher degrees of catastrophizing. A score of 20 was used as cut-off for a high level ofcatastrophizing. Post-traumatic stress reactions (PTS-R) were assessed using the University of California at Los Angeles PTSD Reaction Index (PTSD-RI) (43, 44). Clinically significant levels of posttraumatic stress symptoms were estimated using a cut off of 38 points (45).

Statistics:

The total patient material is presented by numbers and fractions (%). Correlations were analyzed with Pearson correlation, testing the primary outcomes and average pain (NRS) last week before examination, against relevant variables. The patients were further categorized into two groups depending upon whether they have had clinically significant pain, i. e. average pain NRS score last week of more than three (21, 22, 46). For further study of

patients with clinical significant pain versus those without, Mann-Whitney tests were used for comparisons, and for dichotomous variables Chi-square tests were performed. A p-value of <0.05 was used as level of statistical significance.

All analyses were conducted using SPSS v.22 software for Windows (IBM Corporation, Amonk, NY, USA)

Ethics considerations

The study was performed in collaboration between Oslo University Hospital and Sunnaas Rehabilitation Hospital. It was approved by the Regional Committee for Medical and Health Research Ethics, Region South-East, Norway, date: Feb 5th, 2014 , ref.no: 2013/2307 - 1.

Results

Demographic data, injury characteristics and acute hospital care

Thirty hospitalized patients participated in the study, 23 were injured at Utøya Island and seven at the Government district. The median age at the time of injury was 19 years, all were working or studying. At the time of consultation, three to four years after the terror attacks, five were not capable of studying or working. The demographic data and pre-injury characteristics of the patient sample are listed in table 1.

(Table 1 here: Demographic characteristics of the study sample)

As to the details of the type of injury and acute hospital care (table 2), all except two patients were fully conscious, i.e. GCS = 15, and breathing spontaneously at hospital admission. There were a majority of injuries to the upper part of the body, and 23 patients had multiple injuries. In 18 of the participants, the injury was classified as severe, as defined by NISS>15.

(Table 2 here: Injury characteristics and acute hospital care)

Pain characteristics

At the time of the study examination 24 (80%) of the participating patients, reported injury-related pain (table 3). They reported a NRS score of average pain last week of 3.0 (median). In 12 patients the average NRS score was more than three last week, and classified per protocol as clinically significant. The pain was mainly localized in parts of the body with traumatic injuries, except that five out of the nine patients with headache had no head injury. The pain started within 24 hours after the injury in 16 patients, whereas in four patients the pain started more than four weeks after the injury. Two of these were headaches. In 16 patients clinical signs of neuropathic pain were evident, categorized as

"probable" neuropathic pain as defined by a DN4 score of more than three. The neuropathic pain score (i.e. Sum DN4) was correlated with the severity of pain last week. (p=0.006)

(Table 3 here: Pain characteristics)

Pain Treatment

During the primary hospital stay the more severely injured patients had daily rounds of professional specialized teams for surgical, psychosocial, and pain care and were treated with multimodal analgesia (table 2).

The current treatment of pain, three to four years after the incident, is listed in table 4; showing that 20 patients were using analgesics, including five who used opioids. We found that 10 out of the 24 patients with chronic pain (42%) were in need of subsequent specialist pain care as supplement to already ongoing care. These were all discussed with or referred to a specialist centre after the study assessment.

Physical and psychological health

Four subjects reported clinical post-traumatic stress symptoms, above the recommended cut-off value (i.e. PTSD-RI score≥38), and there was a statistically significant positive correlation between average pain last week and presence of post-traumatic stress symptoms ($p<0.01$).

In 22 of the 24 patients with pain related to the terror attacks, the pain was stated to result in one or more consequences on daily life and functions. Presence of pain negatively affected sleep quality in ten patients, daily activities or work abilities in 12 patients, and quality of life in 15 patients (table 4). When asked for whether the symptoms or disabilities resulted in significant impact on everyday activities, 12 patients confirmed such an association. There were statistically significant negative correlations between average pain

previous week before examination and present life satisfaction, regarding both psychological ($p<0.05$) and physical health ($p<0.05$).

(Table 4 here: Pain interference with daily living)

Predictors of chronic pain:

Looking at potential pre-injury risk factors of chronic pain (table 1), nine of the 24 patients with pain had experienced a persistent pain condition of 3-6 months duration, prior to the time of injury. Four patients specified a longer episode of persistent pre-injury pain. Paracetamol or NSAIDs were used by four patients at the time of injury. None of these pre-injury characteristics were statistically significantly associated with the occurrence, severity or neuropathic component of chronic pain at the consultation three to four years later. No statistical significant correlations were found for pre-injury characteristics such as age, gender, level of education or previous challenging life events. Further, the severity of injury (ISS, NISS), number of days in hospital, days spent in intensive care, hours spent in surgery or/and number of operations, were not statistically significantly correlated with current occurrence or severity of pain.

Patient with clinical significant pain

When looking at the 12 patients with clinical significant average pain level (i.e. NRS>3) last week as a subgroup, compared with the other 12 patients with pain; the two groups were similar in demographics and pre-injury characteristics. There were no significant differences in recorded pre-injury pain, anxiety, depression, injury characteristics, injury severity (ISS, NISS), and initial acute medical treatment. However, many aspects of test variables and function at the time of examination were significantly worse in the patients with average pain last week at NRS>3. They had significantly more insomnia problems ($p<0.03$) (table 5) and the six patients with a score above the cut-off level of 20 on the Pain Catastrophizing

Scale were all in this group ($p<0.01$). Patients with clinically significant pain reported the pain to have more impact on their work ($p<0.05$), social life ($p<0.05$) and physical abilities ($p<0.05$) compared to the other patients. Neuropathic pain was present in 83% of the patients in this group, versus 50% in the patents with less pain (ns, $p=0.07$).

(Table 5 here. Pain and symptoms when divided into last week average NRS > 3 vs NRS ≤ 3)

Discussion:

Main findings

The main finding of this three to four year follow-up study of 30 hospitalized victims from the terrorist attacks in Norway on July 22nd 2011 is an 80% prevalence of chronic injury related pain. In 12 patients (40%) the average pain last week was classified as clinically significant with NRS > 3. Ten patients (83%) in this group had signs of neuropathic pain and six of them had pain-related catastrophizing. Reduced sleep quality, reduced life quality (i.e. life satisfaction psychological-/physical health and physical function) and occurrence of post-traumatic stress symptoms were correlated with the strength of chronic pain. Five persons were using opioids and 10 were referred to specialist pain care after the assessment for the study.

Chronic pain

Our 80% prevalence of chronic pain is higher than the prevalence after trauma due to major surgery or serious injury reported in the literature (2, 3, 9, 47). Two relevant studies examining military veterans, who are supposed to have a stronger impact of terror and on-going fear in a trauma situation, have reported a similar prevalence of 80-82% with chronic pain (48, 49). The majority of our study population were young and healthy persons who were exposed to life-threatening terrorism and cruelty over a period of time, somewhat similar to veterans. Although 37% had experienced previous challenging life events, they were all in a full-time work or study situation at the time of trauma.

The high occurrence of patients with neuropathic pain, 67% of those 24 hospitalized with injury related pain, may be a significant contributor for the high prevalence and severity of chronic pain. Presence of neuropathic pain is known to correlate with chronic pain and severity of pain experience from several studies of patients after surgical trauma (3, 5, 7, 34,

50). A systematic review has reported a wide variation of the prevalence of neuropathic pain depending upon the various types of surgery, with the highest prevalence after thoracic and breast surgery (50). In our study, the high occurrence of traumatic injuries due to explosives, bullets and fragmenting rifle ammunition (51), and subsequent surgery to thorax, abdomen and limbs with unavoidable nerve damage, may have been important risk factors of developing chronic neuropathic pain (5). Still, the high prevalenceof chronic neuropathic pain was somewhat disappointing since pharmacological treatment of suspected neuropathic pain, (52-54), was initiated early during hospitalization in most of the patients (5, 7, 53) .

A 20% prevalence (n=5) of headache, not related to head injuries, was noted. This is in accordance with other studies on terrorism and trauma showing a consistent relationship with increased risk of persistent headache after exposure (49, 55, 56). Headache may be an unspecific result of psychological distress, not related to head injury specifically (57) .

In our study we chose a cut-off point of average pain last week at NRS > 3 for clinical significant pain, corresponding to moderate or more pain in the literature (2, 21, 22), (47) . This cut-off of NRS > 3 seems clinically relevant. Ten patients in this group, had symptoms of neuropathic pain, compared to six in the other group. All the 12 (i.e. NRS> 3) patients reported strongest pain last week above five on the NRS scale. These patients also had significantly more pain-related catastrophizing and insomnia problems. Sleep disturbances are a frequent complaint in the general population, but even more frequent among people suffering from chronic pain (58) , post-traumatic stress reactions and veterans (59-61). Sleep disturbances contribute to poor clinical outcome and decreased physical and psychological health (60-62).

We found a statistically significant positive correlation between strength of average pain last week and presence of post-traumatic stress symptoms, but not a correlation of post-traumatic stress symptoms to injury severity. These findings replicate earlier results. Chronic pain and post- traumatic stress symptoms are known and related comorbidities following traumatic injury (16, 63-65) (14, 15), and both may have a negative impact upon outcome from treatment of the other disorder (15, 16).

Significant pain is reported being associated with reduced movement, sleep, mood and satisfaction in other studies (46, 66, 67). There were significant negative correlations between average pain previous week before examination and life satisfaction, both on psychological and physical health. Earlier reports have described the same findings and pointed out the severe multidimensional impact of chronic pain resulting in low life satisfaction (41, 68) and low quality of life, among the lowest observed for any medical condition (69, 70).

Chronic pain predictors

The physical injury severity varied considerably in our sample with a NISS score of 1-59 (range), including some with minor physical trauma and no subsequent surgery. There was no significant correlation between NISS and chronic pain. This result may have to do with a lower number of patients, but also the potential differences in the sensitivity and specificity of the NISS in predicting later pain problems (9). NISS is basically designed to determine risk of mortality rather than tissue damage.

In spite of the established risk factors associated with the development of chronic pain (6, 7, 10), none of the potential pre-injury predictors came out as significant in this study; nor injury severity, hospital stay, surgery or treatment.

Pain treatment

The patients were subjected to updated multimodal analgesia (71) and follow-up in interdisciplinary teams during hospitalization at OUH.

At consultation three to four years after the injury, 20 (66%) of the 30 patients included in the study used analgesics. Five patients (17%) used opioids. In a previous study, 2.9% in a Norwegian population had persistent opioid use and 12% used opioids occasionally because of chronic nonmalignant pain (72). In a European study, Breivik et al reported that 4% of the general population used opioids for chronic pain (1). The relatively high occurrence of opioid use in our study-population three to four years after trauma may be of concern, although the sample size is small. Epidemiological data indicate that patients who use opioids for chronic pain still have high pain intensity, poor functioning and quality of life. With concomitant psychological co-morbidity there is also an increased potential of opioid abuse (73-75).

In 10 of the patients with pain, there was a need for further referral to a pain specialist after the assessment, suggesting that specialist follow-up needs are prolonged and often unmet in patients with physical injury following trauma and terror.

Study limitations and strengths

The major limitation of this cross-sectional retrospective study is the rather small sample size, providing mostly descriptive analyses. Further, health related selection bias may represent a limitation when reporting the prevalence of chronic pain in patients invited to participate in a study. Also, in the present study exposed unmet medical needs during the consultation had to be addressed, according to health legislation. By giving information of this prior to the consultation, it may have created a selection bias. Patients with perceived problems may be more prone to participate. We were not allowed to investigate the medical

records of the patients not willing to participate in the study, in order to check out such potential bias.

To obtain information of pre-injury risk factors and retrospective anamnestic data including medical history and personal experiences with impact on their lives, the patients underwent a semi-structured clinical interview. The answers given could have been biased by the relation to the physician during the consultation and examination. Validated and standardized measures might have improved the precision on these data.

A strength of our report is the acceptable response rate and the sample homogeneity in all patients being highly exposed to the terror incidents. The registration of injury characteristics and initial treatment was highly structured and well documented in The Trauma Registry at OUH and VV. A further strength of this study is the multidisciplinary approach with design of an extensive patient documentation-, interview-, tests- and status-protocol and the very thorough clinical examination of each patient individually by a physician and a psychologist; making a large dataset on most relevant aspects concomitantly in each patient.

Conclusions

Despite optimization of trauma care, psychosocial support and highly specialized initial treatment and eventually rehabilitation, we found an 80% prevalence of chronic pain, related to the injury in this three to four year follow-up study of 30 hospitalized victims from the July 22nd 2011 terror attacks in Norway. In 60% the pain was judged to be of everyday clinical significance. Of those with pain, 42 were in need of subsequent specialist pain care. There was a correlation between severity of chronic pain and presence of post-traumatic

stress symptoms, reduced quality of life and reduced life satisfaction and reduced physical function.

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References

1. Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. Eur J Pain. 2006;10(4):287-333.

2. Johansen A, Romundstad L, Nielsen CS, Schirmer H, Stubhaug A. Persistent postsurgical pain in a general population: prevalence and predictors in the Tromso study. Pain. 2012;153(7):1390-6.

3. Rivara FP, Mackenzie EJ, Jurkovich GJ, Nathens AB, Wang J, Scharfstein DO. Prevalence of pain in patients 1 year after major trauma. Arch Surg. 2008;143(3):282-7; discussion 8.

4. Kehlet H, Bay-Nielsen M, Kingsnorth A. Chronic postherniorrhaphy pain--a call for uniform assessment. Hernia. 2002;6(4):178-81.

5. Kehlet H, Jensen TS, Woolf CJ. Persistent postsurgical pain: risk factors and prevention. Lancet. 2006;367(9522):1618-25.

6. Neil MJ, Macrae WA. Post Surgical Pain- The Transition from Acute to Chronic Pain. Reviews in pain. 2009;3(2):6-9.

7. Katz J, Seltzer Z. Transition from acute to chronic postsurgical pain: risk factors and protective factors. Expert Rev Neurother. 2009;9(5):723-44.

8. George E, Elman I, Becerra L, Berg S, Borsook D. Pain in an era of armed conflicts: Prevention and treatment for warfighters and civilian casualties. Prog Neurobiol. 2016;141:25-44.

9. Holmes A, Williamson O, Hogg M, Arnold C, Prosser A, Clements J, et al. Predictors of pain 12 months after serious injury. Pain Med. 2010;11(11):1599-611.

10. Kalkman CJ, Visser K, Moen J, Bonsel GJ, Grobbee DE, Moons KG. Preoperative prediction of severe postoperative pain. Pain. 2003;105(3):415-23.

11. Bonanno GA, Galea S, Bucciarelli A, Vlahov D. Psychological resilience after disaster: New York City in the aftermath of the September 11th terrorist attack. Psychol Sci. 2006;17(3):181-6.

12. Bugge I, Dyb G, Stensland SO, Ekeberg O, Wentzel-Larsen T, Diseth TH. Physical injury and posttraumatic stress reactions. A study of the survivors of the 2011 shooting massacre on Utoya Island, Norway. J Psychosom Res. 2015;79(5):384-90.

13. Neria Y, DiGrande L, Adams BG. Posttraumatic stress disorder following the September 11, 2001, terrorist attacks: a review of the literature among highly exposed populations. Am Psychol. 2011;66(6):429-46.

14. Clapp JD, Masci J, Bennett SA, Beck JG. Physical and psychosocial functioning following motor vehicle trauma: relationships with chronic pain, posttraumatic stress, and medication use. Eur J Pain. 2010;14(4):418-25.

15. Asmundson GJ, Coons MJ, Taylor S, Katz J. PTSD and the experience of pain: research and clinical implications of shared vulnerability and mutual maintenance models. Can J Psychiatry. 2002;47(10):930-7.

16. Otis JD, Keane TM, Kerns RD. An examination of the relationship between chronic pain and post-traumatic stress disorder. J Rehabil Res Dev. 2003;40(5):397-405.

17. Defrin R, Ginzburg K, Solomon Z, Polad E, Bloch M, Govezensky M, et al. Quantitative testing of pain perception in subjects with PTSD--implications for the mechanism of the coexistence between PTSD and chronic pain. Pain. 2008;138(2):450-9.

18. Sollid SJ, Rimstad R, Rehn M, Nakstad AR, Tomlinson AE, Strand T, et al. Oslo government district bombing and Utoya island shooting July 22, 2011: the immediate prehospital emergency medical service response. Scand J Trauma Resusc Emerg Med. 2012;20:3.

19. Gaarder C, Jorgensen J, Kolstadbraaten KM, Isaksen KS, Skattum J, Rimstad R, et al. The twin terrorist attacks in Norway on July 22, 2011: the trauma center response. The journal of trauma and acute care surgery. 2012;73(1):269-75.

20. Waage S, Poole JC, Thorgersen EB. Rural hospital mass casualty response to a terrorist shooting spree. Br J Surg. 2013;100(9):1198-204.

21. Breivik H, Borchgrevink PC, Allen SM, Rosseland LA, Romundstad L, Hals EK, et al. Assessment of pain. Br J Anaesth. 2008;101(1):17-24.

22. Gerbershagen HJ, Rothaug J, Kalkman CJ, Meissner W. Determination of moderate-to-severe postoperative pain on the numeric rating scale: a cut-off point analysis applying four different methods. Br J Anaesth. 2011;107(4):619-26.

23. Johansen A, Schirmer H, Stubhaug A, Nielsen CS. Persistent post-surgical pain and experimental pain sensitivity in the Tromso study: comorbid pain matters. Pain. 2014;155(2):341-8.

24. AIS. The Abbreviated Injury Scale 1990 Revision-Update 98. Des Plains, IL: Association for the Advancement of Automotive Medicine; 1998.

25. Baker SP, O'Neill B, Haddon W, Jr., Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma. 1974;14(3):187-96.

26. Osler T, Baker SP, Long W. A Modification of the Injury Severity Score That Both Improves Accuracy and Simplifies Scoring. Journal of Trauma and Acute Care Surgery. 1997;43(6):922-6.

27. Fredheim OM, Borchgrevink PC, Landmark T, Schjodt B, Breivik H. [A new schedule for the inventory of pain]. Tidsskr Nor Laegeforen. 2008;128(18):2082-4.

28. Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: a comparison of six methods. Pain. 1986;27(1):117-26.

29. Bijur PE, Latimer CT, Gallagher EJ. Validation of a verbally administered numerical rating scale of acute pain for use in the emergency department. Acad Emerg Med. 2003;10(4):390-2.

30. Daut RL, Cleeland CS, Flanery RC. Development of the Wisconsin Brief Pain Questionnaire to assess pain in cancer and other diseases. Pain. 1983;17(2):197-210.

31. Klepstad P, Loge JH, Borchgrevink PC, Mendoza TR, Cleeland CS, Kaasa S. The Norwegian brief pain inventory questionnaire: translation and validation in cancer pain patients. J Pain Symptom Manage. 2002;24(5):517-25.

32. Keller S, Bann CM, Dodd SL, Schein J, Mendoza TR, Cleeland CS. Validity of the brief pain inventory for use in documenting the outcomes of patients with noncancer pain. Clin J Pain. 2004;20(5):309-18.

33. Caraceni A, Cherny N, Fainsinger R, Kaasa S, Poulain P, Radbruch L, et al. Pain measurement tools and methods in clinical research in palliative care: recommendations of an Expert Working Group of the European Association of Palliative Care. J Pain Symptom Manage. 2002;23(3):239-55.

34. Treede RD, Jensen TS, Campbell JN, Cruccu G, Dostrovsky JO, Griffin JW, et al. Neuropathic pain: redefinition and a grading system for clinical and research purposes. Neurology. 2008;70(18):1630-5.

35. Bouhassira D, Attal N, Alchaar H, Boureau F, Brochet B, Bruxelle J, et al. Comparison of pain syndromes associated with nervous or somatic lesions and development of a new neuropathic pain diagnostic questionnaire (DN4). Pain. 2005;114(1-2):29-36.

36. Finnerup NB, Haroutounian S, Kamerman P, Baron R, Bennett DL, Bouhassira D, et al. Neuropathic pain: an updated grading system for research and clinical practice. Pain. 2016;157(8):1599-606.

37. Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992;30(6):473-83.

38. Loge JH, Kaasa S. Short form 36 (SF-36) health survey: normative data from the general Norwegian population. Scand J Soc Med. 1998;26(4):250-8.

39. Bastien CH, Vallieres A, Morin CM. Validation of the Insomnia Severity Index as an outcome measure for insomnia research. Sleep Med. 2001;2(4):297-307.

40. Fugl-Meyer AR, Bränholm I-B, Fugl-Meyer KS. Happiness and domain-specific life satisfaction in adult northern Swedes. Clin Rehabil. 1991;5(1):25-33.

41. Silvemark AJ, Kallmen H, Portala K, Molander C. Life satisfaction in patients with long-term non-malignant pain - relating LiSat-11 to the Multidimensional Pain Inventory (MPI). Health and quality of life outcomes. 2008;6:70.

42. Sullivan MJ, Bishop SR, Pivik J. The pain catastrophizing scale: development and validation. Psychol Assess. 1995;7(4):524.

43. Santiago PN, Ursano RJ, Gray CL, Pynoos RS, Spiegel D, Lewis-Fernandez R, et al. A systematic review of PTSD prevalence and trajectories in DSM-5 defined trauma exposed populations: intentional and non-intentional traumatic events. PLoS One. 2013;8(4):e59236.

44. Steinberg AM, Brymer MJ, Decker KB, Pynoos RS. The University of California at Los Angeles Post-traumatic Stress Disorder Reaction Index. Current psychiatry reports. 2004;6(2):96-100.

45. Rodriguez N, Steinberg A, Saltzman W, Pynoos R, editors. PTSD Index: Psychometric analyses of the adolescent version. Symposium conducted at the annual meeting of the International Society for Traumatic Stress Studies, New Orleans, LA; 2001.

46. van Dijk JF, Kappen TH, Schuurmans MJ, van Wijck AJ. The Relation Between Patients' NRS Pain Scores and Their Desire for Additional Opioids after Surgery. Pain practice : the official journal of World Institute of Pain. 2015;15(7):604-9.

47. Holmes A, Williamson O, Hogg M, Arnold C, O'Donnell ML. Determinants of chronic pain 3 years after moderate or serious injury. Pain Med. 2013;14(3):336-44.

48. Lew HL, Otis JD, Tun C, Kerns RD, Clark ME, Cifu DX. Prevalence of chronic pain, posttraumatic stress disorder, and persistent postconcussive symptoms in OIF/OEF veterans: polytrauma clinical triad. J Rehabil Res Dev. 2009;46(6):697-702.

49. Beckham JC, Crawford AL, Feldman ME, Kirby AC, Hertzberg MA, Davidson JR, et al. Chronic posttraumatic stress disorder and chronic pain in Vietnam combat veterans. J Psychosom Res. 1997;43(4):379-89.

50. Haroutiunian S, Nikolajsen L, Finnerup NB, Jensen TS. The neuropathic component in persistent postsurgical pain: a systematic literature review. Pain. 2013;154(1):95-102.

51. Jorgensen JJ, Naess PA, Gaarder C. Injuries caused by fragmenting rifle ammunition. Injury. 2016;47(9):1951-4.

52. Finnerup NB, Attal N. Pharmacotherapy of neuropathic pain: time to rewrite the rulebook? Pain management. 2016;6(1):1-3.

53. Romundstad L, Breivik H, Roald H, Skolleborg K, Romundstad PR, Stubhaug A. Chronic pain and sensory changes after augmentation mammoplasty: long term effects of preincisional administration of methylprednisolone. Pain. 2006;124(1-2):92-9.

54. Attal N, Bouhassira D. Pharmacotherapy of neuropathic pain: which drugs, which treatment algorithms? Pain. 2015;156 Suppl 1:S104-14.

55. Bugge I, Dyb G, Stensland SO, Ekeberg O, Wentzel-Larsen T, Diseth TH. Physical Injury and Somatic Complaints: The Mediating Role of Posttraumatic Stress Symptoms in Young Survivors of a Terror Attack. J Trauma Stress. 2017;30(3):229-36.

56. Stensland SO, Zwart JA, Wentzel-Larsen T, Dyb G. The headache of terror: A matched cohort study of adolescents from the Utoya and the HUNT Study. Neurology. 2018;90(2):e111-e8.

57. Stensland SO, Dyb G, Thoresen S, Wentzel-Larsen T, Zwart JA. Potentially traumatic interpersonal events, psychological distress and recurrent headache in a population-based cohort of adolescents: the HUNT study. BMJ open. 2013;3(7).

58. Karaman S, Karaman T, Dogru S, Onder Y, Citil R, Bulut YE, et al. Prevalence of sleep disturbance in chronic pain. Eur Rev Med Pharmacol Sci. 2014;18(17):2475-81.

59. Khazaie H, Ghadami MR, Masoudi M. Sleep disturbances in veterans with chronic war-induced PTSD. Journal of injury & violence research. 2016;8(2):99-107.

60. Germain A, Buysse DJ, Nofzinger E. Sleep-specific mechanisms underlying posttraumatic stress disorder: integrative review and neurobiological hypotheses. Sleep Med Rev. 2008;12(3):185-95.

61. Leskin GA, Woodward SH, Young HE, Sheikh JI. Effects of comorbid diagnoses on sleep disturbance in PTSD. J Psychiatr Res. 2002;36(6):449-52.

62. Germain A, Nielsen TA. Sleep pathophysiology in posttraumatic stress disorder and idiopathic nightmare sufferers. Biol Psychiatry. 2003;54(10):1092-8.

63. Holmes AC, O'Donnell ML, Williamson O, Hogg M, Arnold C. Persistent disability is a risk factor for late-onset mental disorder after serious injury. Aust N Z J Psychiatry. 2014;48(12):1143-9.

64. Quale AJ, Schanke AK, Froslie KF, Roise O. Severity of injury does not have any impact on posttraumatic stress symptoms in severely injured patients. Injury. 2009;40(5):498-505.

65. Geisser ME, Roth RS, Bachman JE, Eckert TA. The relationship between symptoms of post-traumatic stress disorder and pain, affective disturbance and disability among patients with accident and non-accident related pain. Pain. 1996;66(2-3):207-14.

66. Serlin RC, Mendoza TR, Nakamura Y, Edwards KR, Cleeland CS. When is cancer pain mild, moderate or severe? Grading pain severity by its interference with function. Pain. 1995;61(2):277-84.

67. Maier C, Nestler N, Richter H, Hardinghaus W, Pogatzki-Zahn E, Zenz M, et al. The quality of pain management in German hospitals. Deutsches Arzteblatt international. 2010;107(36):607-14.

68. Silvemark AJ, Kallmen H, Portala K, Molander C. Life satisfaction in patients with long-term non-malignant pain-relation to demographic factors and pain intensity. Disabil Rehabil. 2008;30(25):1929 - 37.

69. Becker N, Bondegaard Thomsen A, Olsen AK, Sjogren P, Bech P, Eriksen J. Pain epidemiology and health related quality of life in chronic non-malignant pain patients referred to a Danish multidisciplinary pain center. Pain. 1997;73(3):393-400.

70. Katz N. The impact of pain management on quality of life. J Pain Symptom Manage. 2002;24(1 Suppl):S38-47.

71. Burke S, Shorten GD. When pain after surgery doesn't go away. Biochem Soc Trans. 2009;37(Pt 1):318-22.

72. Fredheim OM, Mahic M, Skurtveit S, Dale O, Romundstad P, Borchgrevink PC. Chronic pain and use of opioids: a population-based pharmacoepidemiological study from the Norwegian prescription database and the Nord-Trondelag health study. Pain. 2014;155(7):1213-21.

73. Eriksen J, Sjogren P, Bruera E, Ekholm O, Rasmussen NK. Critical issues on opioids in chronic non-cancer pain: an epidemiological study. Pain. 2006;125(1-2):172-9.

74. Wu SM, Compton P, Bolus R, Schieffer B, Pham Q, Baria A, et al. The Addiction Behaviors Checklist: Validation of a New Clinician-Based Measure of Inappropriate Opioid Use in Chronic Pain. J Pain Symptom Manage. 2006;32(4):342-51.

75. Feingold D, Brill S, Goor-Aryeh I, Delayahu Y, Lev-Ran S. Misuse of prescription opioids among chronic pain patients suffering from anxiety: A cross-sectional analysis. Gen Hosp Psychiatry. 2017;47:36-42.

Table 1.

Demographic and anamnestic characteristics of the study sample (n=30)

	Mean (SD) or n	Median (Q1,Q3)	Range
Gender: Female / Male	19/11		
Age at time of injury	23(11)	19(17,23)	15-67
Age at time of consultation	27(11)	23 (21,27)	19-71
Education (years) at consultation	14	13.5 (13,15)	11-19
Pre-injury symptoms/characteristics; n			
Pain with ≥3-6 months duration	9		
Persistent pain	4		
Depression ≥ 4 weeks duration	9		
Anxiety or Panic feeling ≥ 4 weeks	2		
Previous challenging life events	11		
Pre-injury medication; n			
Opioids	0		
Paracetamol / NSAIDS	4		
Sleep medication	1		
Sedative hypnotics	0		
Antidepressants	0		
Other	0		

Table 2.
Injury characteristics and acute hospital care (n=30)

	Mean (SD) or n	Median (Q1,Q3)	Range
Mechanism of trauma; n			
Explosion	7		
Shooting	19		
Other	4		
Main injury location; n			
Head	7		
Upper body	10		
Upper extremity	6		
Lower extremity	7		
Injury severity;			
NISS	23 (19)	25 (3.8-37)	1-59
NISS > 15; n	18		
NISS < 15; n	12		
ISS	18 (16)	15 (3.3-26)	
Primary hospital care;			
Acute hospitalization time (days)		15	1-81
Number of days in ICU		2.5	0-59
Respirator; days		0	0-41
Surgical procedures;		3.0	0-22
Number of surgeries; n			
1-5	17		
>5	9		
In hospital pain medication;n			
Paracetamol	26		
NSAID	8		
Strong opioids	15		
Week opioids	4		
Gabapentin	9		
Clonidin	5		
Steroids	4		
Ketamin	2		
Epidural – EDA	7		
Plexus regional anesthesia	4		
Antidepressants	6		

NISS: New Injury Severity Score ISS: Injury Severity Score

Table 3. Pain characteristics in the patients with chronic pain (n=24)

	Mean (SD) or n	Median (Q1,Q3)	Range
Pain related to the injury; n (%)			
No	5 (17)		
No, but pain of other reasons	1 (3)		
Yes	24 (80)		
Start of pain, n (%)			
Immediately after trauma	16 (67)		
Within the first week	3 (13)		
Within the first four weeks	1 (4)		
> Four weeks after trauma	4 (17)		
Pain location; n (%)			
Head	9 (38)		
Upper body	9 (38)		
Upper extremity	10 (42)		
Lower extremity	9 (38)		
Pain severity :			
Strongest pain last week; NRS		6.0 (3.0, 7.5)	0-10
Patients with NRS > 3;n	18		
Weakest pain last week; NRS		1.0 (0, 3.0)	0-6
Patient with NRS > 3;n	5		
Average pain last week		3.0 (1.5, 5.5)	0-8
Patients with NRS > 3;n	12		
Pain at consultation		2.0 (0, 5.0)	0-7
Patients with NRS > 3;n	9		
Presence of neuropathic pain			
DN4 $\geq$ 4; n (%)	16 (67)		
- Average pain last week in patients with neuropathic pain		4.5 (3, 6)	0-8
-Patients with neuropathic pain and average NRS > 3;n	12		

NRS: Numeric Rating Scale DN4: Douleur Neuropathique version 4

Table 4.
Pain interference with daily living in the patients with chronic pain (n=24)

	n	%
Pain occurrence		
All the time	13	54
Every day	17	71
Weekly	2	8
Monthly	3	13
Sometimes	2	8
During rest	17	71
During sleep	9	38
During work	16	67
During regular daily activity	20	83
Negative consequences of pain on		
Daily activities	12	50
Social activities	9	38
Work	12	50
Sleep	10	42
Psychological health	11	46
Quality of Life	15	63
Medication	7	30
Alcohol consumption	1	4
Other	6	25
Treatment of pain at time of consultation		
Any treatment	20	84
-Opiods	5	21
-Paracetamol / NSAIDS	19	79
-Sleep medication	8	33
-Sedative hypnotics	1	4
-Antidepressants	0	
-Other drugs	1	4
-Pain clinic	5	21
-Physiotherapy	15	63

Table 5:
Pain and symptoms when patients with pain (n=24) are divided into: last week average NRS > 3 or NRS ≤ 3

Median (Q1-Q3) or n (%)	Group NRS>3 n=12	Group NRS ≤ 3 n=12	p
Average NRS last week	5.5 (4-7.5)	2.5 (1-3)	<0.001
Worst NRS last week	7 (7-8.75)	3.5 (1.5-5)	< 0.002
Neuropathic pain (DN4≥ 4);n	10 (83 %)	6 (50%)	ns (p=0.07)
Present use of opioids;n	4	0	ns *
NISS score > 15;n	7 (58%)	9 (75 %)	ns
Insomnia problems (ISI score≥8);n	9 (75%)	4 (33 %)	<0.03
PCS score >20;n	6 (50%)	0	<0.01

MW test, *chi-square test)

NRS: Numeric Rating Scale DN4: Douleur Neuropathique version 4
ISI : Insomnia Severity Index PCS : Pain Catastrophizing Scale