REVIEW ARTICLE

CONTENTS

Peculiarities of prevention of chronic pain associated with combat trauma

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ABSTRACT

Aim: To analyze international experience in solving the problems of preventing chronic pain associated with combat trauma.

Materials and Methods: bibliosemantic and analytical methods were used in the study. The materials were international scientific sources that covered the experience of providing medical care in military conflicts for the period 2014-2024.

Conclusions: The best practices for preventing chronic pain associated with combat trauma are the effectiveness of pain relief immediately after injury, the timeliness of pain relief at all stages of evacuation, including the hospital and post-hospital period or the so-called stepped care model. In order to overcome the problem of opioid addiction in patients with combat trauma, the use of local and regional pain relief, as well as the use of a complex of non-drug methods, is recommended. The biopsychosocial model of chronic pain prevention (synonymously multidisciplinary, interdisciplinary, multicomponent) has the primary goal of restoring physical, psychological, and social functioning, involving a core team of multidisciplinary health care professionals (physicians, physiotherapists, occupational therapists, psychologists, and nurses) working as an integrated team as a response to the complex suffering of patients with chronic pain worldwide.

KEY WORDS: chronic pain, prevention, combat trauma, strategy, multidisciplinary approach

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INTRODUCTION

A feature of combat trauma is that it often leads to extensive tissue damage and limb loss, which in turn causes chronic neuropathy and phantom limb pain (PLP) and residual limb pain (RLP) [1, 2]. The military population differs in both demographic and social characteristics of the injury compared to other amputation and trauma cohorts. According to the results of a systematic review of the Embase and MEDLINE databases, the frequency of chronic and neuropathic pain associated with combat trauma was 57%, which indicates a high prevalence of post-amputation and chronic neuropathic pain after combat trauma [3-5].

Chronic pain is considered a disease model worldwide [6]. Acute pain initially occurs as an unpleasant, dynamic psychophysiological process, usually in response to tissue injury and associated with inflammatory processes. Acute pain is often life-threatening issue and plays a major role in the outcome of treatment. Once the acute phase has passed, pain becomes a disease in its own right. Acute pain becomes chronic when it persists beyond the expected healing period of 3 months according to the International Classification of Diseases, 11th revision criteria [7].

Acute and chronic pain are very common among veterans who participated in Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn (OEF/OIF/OND). Chronic pain is often accompanied by psychiatric disorders such as posttraumatic stress disorder (PTSD) or depression, as well as traumatic brain injury, which complicates pain management and recovery in this population. In the military health care system, the incidence of chronic pain diagnoses among service members quadrupled from 2007 to 2014, reaching 68.7 per 10,000 person-years [8]. Numerous factors have contributed to the dramatic increase in chronic pain, including improved survival rates from combat injuries, increased re-entry into combat, and rigorous physical training requirements [8].

AIM

To analyze international experience in solving the problems of preventing chronic pain associated with combat trauma.

MATERIALS AND METHODS

Bibliosemantic and analytical methods were used. The materials were international scientific sources that covered the experience of providing medical care in military conflicts for the period 2014-2024.

REVIEW AND DISCUSSION

The best practices for the prevention of chronic pain in the world are considered to be pain management throughout the treatment cycle. From the effectiveness of primary analgesic therapy, namely its components: the choice and dosage of the drug, the timeliness of pain relief and the subsequent effective staging of the analgesic effect. One of the effective methods for the prevention of chronic pain is its timely treatment using updated approaches.

In 2019, the issue of timely and effective pain relief following combat injuries has been of increasing significance in military medicine. Historically, the medical triage has been the priority, followed by pain relief. However, as highlighted by D. J. Aldington et al., this is not so anymore, with modern military pain relief being centered on early intervention to prevent both short-term complications and the long-term risk of chronic pain [9]. Evidence presented by S. P. Cohen et al. show that effective analgesia is not merely significant in preventing medical complications in the form of cardiovascular instability and respiratory distress, but is also critical in preventing PTSD, which is common in combat casualties where pain is not well managed [5-6, 10]. R.D. Treede et al. also underline that chronic pain should not be regarded simply as a symptom, but as a distinct disease entity, requiring specific preventive measures to provide improved long-term outcomes [7].

The British Defense Medical Service has adopted a tiered pain care system from the point of wounding to ultimate release from military service. The system is organized in a four-echelon structure, with ongoing care at each level of care. The first echelon is immediate on-scene care by the wounded soldier, comrades, or field medic staff. The second echelon is early stabilization at a forward medical station where pain is treated in addition to hemodynamic stabilization. The third echelon is field hospitals where limb- and lifesaving surgery is performed, and complex pain care strategies are implemented. The fourth echelon is specialist rehabilitation centers, e.g., the Royal Centre for Defence Medicine in Birmingham, where long-term pain care is implemented [8, 9]. Evidences by K. Bannister et al. and R. S. Adams et al. confirm the effectiveness of the tiered system, stating that organized, multimodal pain care reduces the number of persistent pain disorders in combat veterans [2, 8-10].

Proper pain assessment is a critical component of effective pain management. A.C.C. Williams and K.D. Craig (2016) state that pain is very subjective and that poor assessment is a contributing factor in the development of chronic pain [10]. Up until 2009, the British military employed the Numerical Rating Scale (NRS), 0-10 (no pain-severe pain), as the primary assessment. However, in acknowledgment of the necessity of a simpler, actionable tool for frontline medical personnel, a three-point scale (0-3) has been adopted. The new system is based on the World Health Organization's three-step analgesic ladder so that each one-point change is clinically significant. U. Kaiser et al., findings suggest that maintaining pain scores below 2 is very effective in the prevention of the development of chronic pain, further emphasizing the importance of standardized pain assessment procedures in military settings [11].

Prehospital pain relief is a critical component of combat casualty care. According to M.J. Buys et al., inadequate pain relief in the acute phase of injury is a strong predictor of chronic pain syndromes, particularly in military personnel who undergo severe trauma [12]. British military medic personnel now carry intramuscular auto-injectors of 10 mg of morphine. However, as M.D. Eckhoff et al., point out, this is comparable in analgesic potency to 1 g of paracetamol or 400 mg of ibuprofen, so in the event of major injuries, it may not be effective in reducing pain sufficiently [3, 13]. To address this limitation, the British Defense Medical Service introduced oral transmucosal fentanyl citrate (OTFC) as an adjunct to morphine. OTFC is said by A. Huang et al. and B.M. Ilfeld et al. to have a rapid onset of action and is very effective in combat scenarios where intravenous access is difficult [13, 14]. Moreover, S.P. Cohen et al., point out the necessity to include opioid alternatives and multimodal analgesic techniques to avoid the risks of long-term opioid administration [6, 14].

Multimodal pain relief is used in field hospitals, incorporating opioids, NSAIDs, regional anesthesia, and PCA. One of the innovations is the Baxter Infusor PCA device, which is mechanical and does not interfere with Royal Air Force navigation systems, thus appropriate for aeromedical evacuation purposes [9, 14-15]. One of the significant improvements in combat pain relief has been the expanded use of regional anesthesia techniques, including epidural, spinal, and peripheral nerve blocks. K. Bannister et al. (2020) note that regional anesthesia is critical in preventing chronic pain by blocking nociceptive transmission at the site of injury [2]. However, as D.J. Aldington et al. (2011) and L. Wang et al. (2020) noted that epidural anesthesia is risky in terms of infection, and peripheral nerve blocks have the risk of delaying acute compartment syndrome diagnosis, which may necessitate prophylactic fasciotomy in high-risk scenarios [9].

Recent technological improvements in portable ultrasound machines have significantly made better the accuracy and safety of regional anesthesia. J. Vollert et al. noted that ultrasound-guided nerve blocks allow

the direct visualization of anatomical structures, enabling improved accuracy in positioning the catheter and reducing complications of blind injections [15]. This technological advancement has been very helpful in military medicine, where efficient pain relief is paramount in austere environments. E. Dragioti et al. (2018) also recommend the use of multidisciplinary pain management programs, combining regional anesthesia with psychological and rehabilitation interventions to achieve the improved long-term outcomes [16]. Prevention of chronic pain in combat veterans requires an integrated approach through the combination of pharmacological, interventional, and psychological interventions. R.S. Adams et al., suggest expanding pain care programs after deployment to incorporate long-term monitoring and treatment of chronic pain disorders in military veterans [8]. A.C. Williams et al. (2012) also emphasize the importance of psychological interventions, i.e., cognitive-behavioral therapy (CBT) and mindfulness-based stress reduction (MBSR), in preventing the establishment of chronic pain [10, 17]. U. Kaiser et al. **(**2017) and J.S. Gewandter et al. (2015) suggest that prevention of pain should not be addressed merely at acute pain relief but also at the detection of patients at risk of developing chronic pain at an early phase so that intervention is done on time [11, 18-19].

The improvements in multimodal analgesia, regional anesthesia, and methods of early intervention have significantly improved pain outcomes in military medicine. However, additional researches are still needed to further advance pain prevention strategies, particularly in the area of reducing opioid dependence and integrating rehabilitation-focused methods. Implementation of evidence-based pain care practices, as proposed by S.P. Cohen et al. (2021), will be critical in decreasing the long-term burden of chronic pain in combat casualties [6, 7, 20]. With further advancement of existing methods and the integration of new pain care strategies, military medicine will be better positioned to further enhance the quality of life of wounded soldiers, ultimately reducing the burden of chronic pain on the military and veterans.

The next stage of care for the casualty is repatriation. The main principle of this stage is to provide analgesia before the evacuation begins, as attempting to do so during the evacuation is always very difficult. RAF air medical teams can now manage epidurals and continuous peripheral nerve blocks in flight. The next stage is the hospital phase of care, which involves ensuring the safe use of techniques such as epidurals and local anaesthetic infusions. These approaches have provided a combined moderate to severe pain score of 10%, and 90% of patients had pain scores of 0 or 1 or less. Special attention is paid to local anesthetic techniques for two reasons. Firstly, continuous peripheral nerve block results in lower pain scores. Secondly, for patients undergoing multiple surgeries in a short period of time, as in the military persons, an analgesic that does not have systemic side effects is intuitively more beneficial than alternative (opiate-based) analgesia. Catheter cultures for analgesia and identification of any microorganisms are performed to prevent infectious complications. It is also not uncommon for oral opiates and continuous peripheral nerve block to be used concurrently in the same patient. Continuous epidural infusions significantly increase patient safety and drug efficacy while reducing side effects [20]. Treatment of neuropathic pain begins at a relatively early stage, which has a positive effect on the prevention of chronic pain. Antineuropathic analgesics reduce the perioperative need for opiates [9, 21], since opioid use is an important problem for the socialization of war wounded in the future.

For example, in the USA, according to the Department of Veterans Affairs, about 26.2% (5.2 million) of veterans of the Vietnam War, Iraq, and some other conflicts had mental illnesses or substance abuse (SA) [21, 22]. At the same time, the central place in the policy on drug addicts in the army is occupied by mandatory screening for the use of SA. It took the USA about 35 years to introduce such a procedure. It was a set of successive steps: the introduction of testing of a person before enlistment in the service, random testing during its passage and participation in combat operations, etc. At the same time, the US Army practiced the controlled use of SA (only in certain doses under the supervision of a doctor). Another, no less important component of the policy on drug addicts in the US Army was the introduction of social adaptation and rehabilitation programs for military personnel at the state level. For example, according to the information presented on the official website of the US Department of Veterans Affairs, assistance to drug-addicted military personnel is provided both in local medical centers, including under the patronage of public organizations, and in specialized clinics subordinate to the department. At the same time, the provision of such assistance is based on evidence-based methods (cognitive-behavioral therapy, motivational interviewing with a veteran, during which specialists try to help him to discover his personal motivation for change, etc.). In the USA, it is possible to use substitution therapy and undergo rehabilitation in a hospital [21].

Contracting or mobilization in the USA occurs only after the screening for signs of drug or psychotropic substance use according to a certain procedure, volume and responsible units. Accordingly, at the time of

service, cases of substance use are rare, when a person either starts using for the first time or returns to use that was not diagnosed by screening during contracting/mobilization [21-23]. The above mentioned confirms that rehabilitation is a significant component of the prevention of chronic pain which is associated with combat trauma. Morphine remains one of the most widely used analgesics in military medicine, but it has a high potential for addiction. Historical evidence, as evidenced in the American Civil War, mentions "soldier's disease," a term used to describe opioid addiction in wounded soldiers. While the historical accuracy of this name is doubtful, opioid addiction is still a significant issue in military medicine [9]. S.P. Cohen et al. and M.J. Buys et al. indicated that, while opioids are a critical component of acute pain relief, opioid dependence over the long term needs to be closely monitored and treated through formal rehabilitation processes [6, 12, 22]. During rehabilitation, military personnel undergo tapering of the drug over time, so opioid administration is stopped in a controlled manner. Military pain specialists also carry out regular assessment and maintain open communication channels to enable long-term recovery and prevent dependency [14].

The final level of pain care is at the level of the primary care, where specialists in military rehabilitation may not have the experience. U. Kaiser et al. (2021) state that transitioning to civilian healthcare facilities is normally challenging for veterans with chronic pain disorders [11, 19, 23]. To address this, some military garrisons have established special pain relief units, where senior pain medicine consultants collaborate with rehabilitation specialists, sports medicine specialists, and general practitioners. The units not just provide direct care to patients but also serve as training centers for primary care professionals, offering a standardized approach to treating chronic pain [8, 23].

Management of pain within the military is a multidisciplinary process in which the anesthetists, surgeons, physicians, psychiatrists, primary care doctors, nurses, physiotherapists, occupational therapists, and psychologists are involved [23]. The British military healthcare system is a mixed system with both military and civilian professionals, increasing the scope of interventions that can be accessed [7, 22]. Training is also a part of this system, with specialist medical courses having pain management as a core competency. The Battlefield Advanced Trauma Life Support (BATLS) course, which is attended by medical personnel of the UK and coalition forces, has an updated section on pain management. Additionally, pre-deployment training of field hospital staff consists of special lectures on pain management techniques [2, 22]. The Postgraduate Medical Officer (PGMO) course also provides military doctors with appropriate training in pain management before posting [22-23].

One of the persistent challenges in pain management is the relative paucity of knowledge on pain mechanisms. L. Wang et al. (2020) note that even when mechanism-based pain treatment models have been described, it remains difficult to make a clear distinction between the treatment of nociceptive and neuropathic pain in the clinic [5]. Much of current pain management remains empirical despite advances, underlining the necessity of ongoing research on pain perception and treatment outcomes [18]. Multidisciplinary care, comprising pharmacological, interventional, and psychological interventions, has been shown to reduce some of the uncertainty and deliver improved outcomes in patients [16, 21].

The US military has made significant improvements in pain management through evidence-based care and multimodal, interdisciplinary interventions [22, 23]. Evidences by C.M. Brummett et al. suggest that the implementation of military pain management guidelines has led to increased pain monitoring, better patient education, and better overall outcomes of care [6, 24-25]. The US military has also taken steps to prevent opioid abuse so that opioids remain an essential part of acute and chronic pain relief without perpetuating long-term dependence [26]. Inefficient pain management is still a widespread issue in both military and civilian populations, particularly in chronic pain. Evidence by U. Kaiser et al. (2017) suggests that the integration of military pain management practices into civilian healthcare systems could significantly improve pain relief outcomes and reduce the societal burden of chronic pain [19, 27-29].

Prevention of chronic pain is aligned with the recommendations of the International Association for the Study of Pain (IASP, 2020), which focus on secondary and tertiary prevention [30]. Prevention of pain chronicity not just relieves the pain of the sufferer but also the long-term burden on the healthcare system. Secondary prevention aims at detecting pain conditions at an earlier stage to avoid progression, and tertiary prevention aims at preventing complications, disability, and functional impairment in patients with already established chronic pain [19, 27]. Literature data indicate that effective secondary prevention requires a well-identified set of risk factors of pain chronicity, as well as the development of validated assessment tools to identify high-risk patients [28].

Classification of risk factors into biological (red flags), psychosocial (yellow flags), occupational (blue flags), compensatory (black flags), and sociocultural (white

flags) provides a structure to create targeted interventions [27]. Based on the study by A. Sarmanova et al. (2018), some risk factors – i.e., age, sex, heredity, pre-existing pain disorders, and psychological factors – are accountable for the development of chronic pain, particularly following surgical procedures [28, 30]. Subdivision of patients on the grounds of risk of pain chronicity and the respective adjustment of the treatment approach has been proved to be an effective way of optimizing outcomes both in the short and medium terms [29, 30-32]. In addition to risk stratification, theoretical models such as the avoidance and coping model have provided insight into pain prevention strategies specific to individuals [23]. For tertiary prevention, interventions seek to alleviate secondary consequences of chronic pain, i.e., impairment of function, loss of work, psychological distress, and social isolation [29]. The fear-avoidance model and the avoidance and coping model both highlight the manner in which psychosocial impairments impact the quality of life in patients with chronic pain [30-33].

The biopsychosocial perspective of pain, initially conceptualized in the 1980s and later defined by the IASP task force in 2017, has played a central role in the modern pain care approach [9]. It has led to the common practice of a multidisciplinary, interdisciplinary, and multicomponent pain treatment method involving physical, psychological, and social rehabilitation. It is primarily intended to restore maximum functional potential through a core team of healthcare professionals, including physicians, physiotherapists, occupational therapists, psychologists, and nurses, working within an integrated system [16, 34].

Interdisciplinary pain care has been recognized internationally as a central method of chronic pain treatment. However, ongoing research shows that chronic pain remains a significant and unsolved issue in both military and civilian healthcare settings [20, 35-37]. Recent research suggests that combining psychological therapies, physical rehabilitation, and opioid-sparing strategies into multimodal pain care regimens is very effective in promoting long-term outcomes in patients [25, 38, 39]. As chronic pain is increasingly being recognized as a major public health issue, future research should be targeted at optimizing prevention strategies, expanding access to multidisciplinary pain care programs, and advancing knowledge on pain mechanisms. With the integration of personalized, evidence-based interventions, healthcare systems have the potential to reduce the burden of chronic pain and enhance the well-being of individuals affected by it [20, 40-41].

CONCLUSIONS

Thus, the best practices for the prevention of chronic pain associated with combat trauma are the effectiveness of pain relief immediately after injury, the timeliness of pain relief at all stages of evacuation, including the hospital and post-hospital period, or the so-called stepped care model. In order to overcome the problem of opioid dependence in patients with combat trauma, there is the use of local and regional analgesia, as well as the use of a complex of non-drug methods. The biopsychosocial model of chronic pain prevention (synonymously multidisciplinary, interdisciplinary, multicomponent) has the main goal of restoring physical, psychological and social functioning, involving a core team of multidisciplinary health professionals (physicians, physiotherapists, occupational therapists, psychologists and nurses) working in an integrated team as a response to the complex suffering of patients with chronic pain worldwide.

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CONFLICT OF INTEREST
The Authors declare no conflict of interest

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