Diagnosis and Management of Acute Pain in the Hospitalized Patient

Adam D. Marks, MD, MPH[a,*], Phillip E. Rodgers, MD[a,b]

KEYWORDS

• Acute pain • Opioids • Patient-controlled analgesia • Patient satisfaction
• Hospital readmission

HOSPITAL MEDICINE CLINICS CHECKLIST

1. Acute pain is defined as the neurophysiologic response to a noxious stimulus and is a common cause of patient hospitalization and readmission after surgery.
2. A careful patient history is the cornerstone of the evaluation of acute pain and should include the severity, duration, location, timing, and alleviating/exacerbating factors. Further diagnostic testing should be tailored to the location, pattern, and type of pain described.
3. Treatment of acute pain should be tailored to the severity of the pain as well as the comorbidities of the patient and can include
   a. Opioids
   b. Nonsteroidal antiinflammatory drugs
   c. Acetaminophen
   d. Nonpharmacologic interventions
4. Inadequate pain control is closely correlated to hospital readmission and patient satisfaction and can contribute to in-hospital morbidity.

DEFINITIONS

How is acute pain defined and classified?

[a] Division of Geriatrics and Palliative Medicine, Department of Internal Medicine, University of Michigan Medical School, Ann Arbor, MI 48109, USA; [b] Department of Family Medicine, University of Michigan Medical School, Ann Arbor, MI 48109, USA
* Corresponding author.
E-mail address: adamarks@med.umich.edu

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Acute pain is defined as the neurophysiologic response to a noxious stimulus, a response that is expected to resolve when the stimulus is removed.[1] This type of pain is in contrast to chronic pain, in which the sensation of pain persists beyond the expected time course of an acute injury and its repair process. Acute pain can be classified in multiple domains. Practically, acute pain is most often classified based on its location (eg, acute chest pain, acute abdominal pain), which helps the clinician formulate a differential diagnosis as well as an approach for evaluation and management. Acute pain can further be classified as either somatic (referring to a well-localized sensation related to skin, bone, or muscle) or visceral (referring to a poorly localized sensation related to distention, compression, or inflammation of internal organs).[2]

Physiologically, acute pain can be classified based on the underlying cause of the pain, which can further guide the development of treatment strategies (see later discussion). Nociceptive pain, which includes most acute pain, refers to the direct injury of tissue from a noxious stimulus, such as an acute traumatic injury or surgical incision. Inflammatory pain refers to pain mediated by inflammatory pathways. Neuropathic pain refers to altered sensory transmission by damaged nerves.[3] Although these types of pain are often described as discrete, they most often represent a continuum of the same inciting event.

EPIDEMIOLOGY

What is the incidence of acute pain among hospitalized patients?

The reported incidence of acute pain among hospitalized patients varies based on population and diagnosis. In hospitalized patients who had recently undergone surgery, 80% reported moderate to severe pain in the days after their operation.[4] In the emergency department, pain remains the most common chief complaint among patients seeking care, and in the intensive care unit, up to 64% of patients assessed have been found to have evidence of severe pain.[5,6]

How does the presence of acute pain affect clinical outcomes?

Acute pain in the inpatient setting has been associated with a variety of unwanted clinical outcomes and can contribute to impaired immunity and an increased risk of venous thromboembolic disease.[7] Furthermore, inadequately treated acute pain can increase the risk for the development of delirium, extended hospital stay, and is strongly associated with decreased patient satisfaction.[8,9] Readmissions for uncontrolled pain have recently been the focus of much attention, and despite efforts to standardize the management of acute postsurgical pain, uncontrolled pain remains the most common reason for readmission in the first week after surgery.[10]

PATHOPHYSIOLOGY

What is the pathophysiology of acute pain?

Nociceptive pain, the most common type of acute pain, involves the normal neural signaling that occurs when nerve endings (primarily small-diameter A-δ and the unmyelinated C-fiber axons) are activated by inflammation or other tissue damage.[11] Tissue damage causes the release of chemical mediators, including prostaglandins, bradykinin, serotonin, histamine, and substance P, which, in turn, activate nociceptors that

result in transduction or the generation of an action potential. This action potential is transmitted along afferent fibers to nociceptors in the spinal cord, which then carry the action potential along the spinothalamic tract, which is located in the dorsal horn of the spinal cord. From here, the signal reaches the thalamus and the midbrain, which send the nociceptive action potential to the higher structures of the brain where perception of pain occurs, namely the somatosensory cortex, frontal lobe, parietal lobe, and limbic system.[1]

How does acute pain differ from chronic pain?

In contrast to acute pain, in which the experience of pain is expected to resolve with completion of wound healing, chronic pain persists beyond the expected time course of an acute injury and its repair process. Although several definitions suggest that the diagnosis of chronic pain requires that a given time interval has passed, more accurately such a diagnosis implies a remodeling of the organization of the central nervous system (CNS) such that the normal balance between signals generated by the nociceptive afferent fibers and inhibitory mechanisms is restored. The resulting chronic pain is not related to an ongoing injury, but rather a dysregulation of neural pathways, and thus, by definition, can be considered neuropathic in nature.[1]

EVALUATION AND DIAGNOSIS

Which elements of a patient history are important in the evaluation of pain?

By definition, pain is a subjective phenomenon, and thus, a careful history is critical both to the identification of the underlying cause and to the development of an effective pain management plan. A complete and comprehensive pain history includes pain location, intensity, and quality; duration and temporal pattern; aggravating and alleviating factors; effects on functionality; past therapies and their effectiveness or lack thereof; and pain relief goals.[12] Whenever possible, a self-report from the patient should be obtained. This strategy is not always possible in the acute care setting, when a patient may be intubated, sedated, delirious, or otherwise cognitively impaired.

Which tools are recommended for pain assessment?

The subjectivity and multidimensionality of pain can make accurate assessment challenging. Despite this, several pain assessment tools have been developed and validated in certain populations. The Joint Commission recommends that pain needs be assessed at the time of admission to the hospital, and at regular intervals. In addition, there is a requirement that pain intensity be reassessed after a patient receives medication for pain to determine its effectiveness.

Common tools for pain assessment include the unidimensional pain intensity scales, which include the Numerical Rating Scale (NRS), the Verbal Descriptor Scale (VDS), and the Faces Pain Scale -Revised (FPS-R) (**Fig. 1**). The NRS is perhaps the most commonly used and consists of asking a patient to rate (orally or in writing) the intensity of their pain on a scale of 0 to 10, with 0 being no pain and 10 indicating the worst pain imaginable. The VDS asks the patient to pick the words that best describe their pain, from no pain, mild pain, moderate pain, severe pain, very severe pain, and the worst possible pain.[13]

The FPS-R has been validated for use in older adults and can be particularly useful for those with mild to moderate cognitive impairment.[14] This tool involves presenting a patient

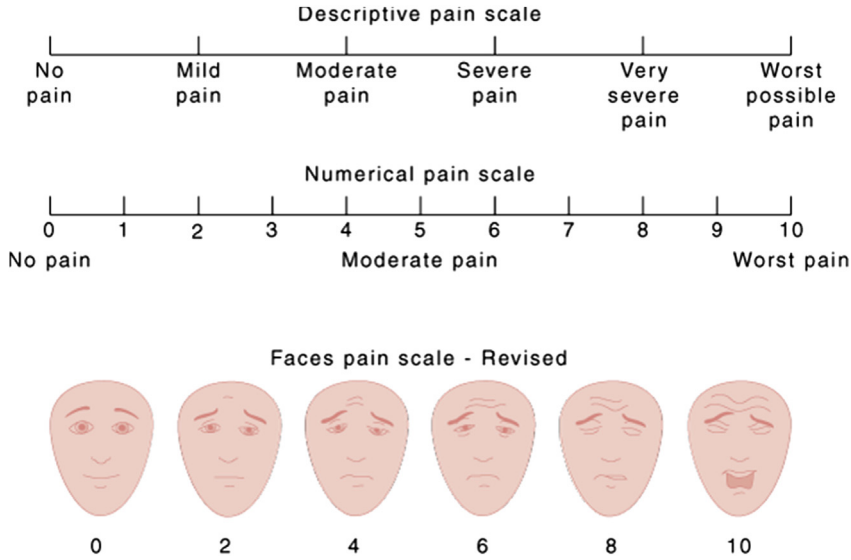

Fig. 1. Pain scales. (This Faces Pain Scale-Revised has been reproduced with permission of the International Association for the Study of Pain® (IASP®). The figure may not be reproduced for any other purpose without permission.)

with a graphic depiction of faces in pain with corresponding numbers. The patient is then asked to point to the face that best represents their current level of pain. This scale has likewise been validated in patients who are unable to read or who speak limited English.

What physical examination finding may be present in patients with acute pain?

Evolutionarily, acute pain plays a vital role in providing a warning signal to the organism, and significantly activates the fight or flight response of the sympathetic nervous system. From this signal, a variety of responses are activated, including hypertension, tachycardia, pallor, pupil dilation, restlessness, and diaphoresis.[15] However, these physiologic responses are extremely variable and should not be used to either confirm or disprove the presence of pain.

Which diagnostic measures are appropriate for evaluation of acute pain?

Pain is a subjective experience, and there exists no laboratory or imaging study that can detect pain. Laboratory tests or imaging may show the presence of a pain generator (eg, fracture, acute myocardial infarction, appendicitis) but say little about the symptomatic experience of the patient. A condition that can cause severe pain in one patient may be only mildly distressing in another patient, and vice versa.

Broadly speaking, the pain history elicited from the patient should guide the diagnostic measures undertaken in the evaluation of acute pain, and clinicians should be familiar with common pain patterns, which can indicate specific conditions.

TREATMENT

What are the options for acute pain control?

Table 1
Opioid side effects by system

System	Effect Seen
Immunologic/allergy	Suppression of humoral immunity Inhibition of T-cell proliferation Decrease in natural killer cell activity Pruritus
Endocrine	Decrease in testosterone, estrogen, which may result in decreased libido and energy Reduced bone mineral density
CNS	Delirium Sedation Centrally mediated hyperalgesia Sleep disturbance
Gastrointestinal	Constipation Nausea
Urinary system	Urinary retention
Cardiovascular	Hypotension Bradycardia QT prolongation (methadone)
Respiratory	Dry mouth Respiratory depression

Data from Meuser T, Pietruck C, Radbruch L, et al. Symptoms during cancer pain treatment following WHO guidelines: a longitudinal follow-up study of symptom prevalence, severity and etiology. Pain 2001;93:247–57.

Opioids

Opioid medications remain the most common treatment of acute pain and have many potential routes of administration including intravenous (IV), intramuscular, subcutaneous, transdermal, and by mouth (**Table 1**). Opioid medications activate the μ receptor throughout the CNS and thereby modulate the transmission and perception of painful stimuli.[16] The main difference in commercially available opioids involves potency, duration of action, speed of onset, and optimal route of administration. Opioids are not limited by a ceiling effect; even at high doses, increasing the amount theoretically results in increasing analgesia. However, functionally, opioids are limited by their side effects, which include constipation, sedation, nausea, vomiting, and respiratory depression.

Opioids are the preferred medications to treat acute, moderate to severe static nociceptive pain, such as postsurgical pain and are less effective against movement-related pain (such as osteoarthritis) or neuropathic pain. Furthermore, increasing evidence of the long-term effects of narcotics on pain perception as well as the risk of addiction and overdose are leading many advisory groups to recommend against the routine use of opioid medications for chronic pain.[17–19]

Nonsteroidal Antiinflammatory Drugs

Nonsteroidal antiinflammatory drugs (NSAIDs) provide their analgesic effect by attenuating the inflammatory response via their inhibition of prostaglandin synthesis by the cyclooxygenase (COX) enzymes.[1] This class of medication is thus especially useful for pain related to inflammation, including surgery, infection, or trauma. Although opioid sparing, NSAIDs do have a ceiling effect beyond which increasing doses do not result in improved analgesia.[20]

Traditionally, NSAIDs have been nonspecific for the 2 main forms of COX enzymes, COX-1 and COX-2. As a result of COX-1 inhibition, nonspecific NSAIDs can cause platelet inhibition, gastric mucosal irritation, and renal blood flow compromise.[20] In contrast, selective COX-2 inhibitors more specifically affect prostaglandin production at the sites of inflammation, and thus are less likely to cause gastric irritation or platelet inhibition; however, COX-2 agents are no safer than nonspecific NSAIDs in regard to renal function and may cause a prothrombotic state, resulting in an increased risk for myocardial infarction.[18]

Acetaminophen

The mechanism by which acetaminophen produces its analgesic effect is poorly understood, although recent data[21] have suggested that it inhibits the COX-3 enzyme, which is involved in prostaglandin formation. Acetaminophen remains the most common over-the-counter analgesic, and although it is typically well tolerated with a low side-effect profile, hepatic toxicity remains a concern. In general, acetaminophen is a first-line agent for mild to moderate pain and can be an important adjunct to opioids in patients with more severe pain.[22] Many preparations combine acetaminophen with an opioid (eg, hydrocodone/acetaminophen, oxycodone/acetaminophen), and the prescribing clinician should ensure that the patient does not exceed the recommended daily dose of 4000 mg.

Patient-Controlled Analgesia

Patient-controlled analgesia (PCA) remains an efficient and effective way for managing postoperative pain with IV opioids and is also used for short-term management for patients with persistent severe pain, such as metastatic cancer. Patients prefer PCA because of convenience and because it allows a measure of control over medication delivery.[23] The three most common medications used in PCAs are morphine, hydromorphone, and fentanyl. Typically, loading doses are used at initiation to allow for rapid achievement of analgesia, whereas a continuous dose is delivered via a microprocessor-controlled infusion device. The patient then controls preprogrammed additional doses of opioid to the optimal level. To prevent overdosing, PCA devices are programmed with a lockout interval after each demand dose is delivered (typically 6–15 minutes) and a limit to the total amount that can be delivered over a set period (1–4 hours) (**Table 2**).[18]

PCAs are not without their risk, and patient safety should be of utmost importance to the ordering clinician. Patients with renal failure, older adults, patients with respiratory diseases, or patients receiving other sedating medications (benzodiazepines, muscle relaxants, or antiemetics) warrant particular attention and consideration. Use of continuous pulse oximetry is recommended, and regular assessment of the patient on a PCA is critical, to ensure both safety and the successful management of the patient's pain.[19]

Nonpharmacologic Interventions

Substantial evidence exists regarding the usefulness of nonpharmacologic interventions in treating mild to moderate pain. Hot or cold packs and physical therapy have been shown to be effective for musculoskeletal pain.[24] Other studies have shown the usefulness of meditation and cognitive distraction for acute pain.[25] Although widely used, data regarding the effectiveness of massage in acute pain management are lacking; however, it seems to be most effective for pain related to muscle spasm.[25,26] Using a combination of pharmacologic and nonpharmacologic techniques can improve the management of acute pain in the inpatient setting.

Table 2
Patient-controlled analgesia dosing

	Drug		
	Morphine	**Dilaudid**	**Fentanyl**
General PCA Dosing[a]			
Standard concentration	1 mg/mL	1 mg/mL	10 μg/mL
PCA dose	1.5 mg	0.2 mg	20 μg
Lockout interval (min)	7	7	7
4-hour dose limit	30 mg	3 mg	300 μg
Typical PCA dose change	0.5 mg	0.1 g	5 μg
Rescue doses	3 mg IV every 5 min ×3	0.3 mg IV every 5 min ×3	25 μg IV every 5 min ×3
Notes		Preferred in renal dysfunction	Preferred in liver, renal dysfunction
High-Risk Patient PCA Dosing[a,b]			
Standard concentration	1 mg/mL	1 mg/mL	10 μg/mL
PCA dose	1 mg	0.1 mg	15 μg
Lockout interval (min)	7	7	7
4-hour dose limit	30 mg	3 mg	300 μg
Typical PCA dose change	0.5 mg	0.1 g	5 μg
Rescue doses	2 mg IV every 15 min, may repeat ×1	0.2 mg IV every 15 min, may repeat ×1	25 μg IV every 15 min, may repeat ×1
Notes		Preferred in renal dysfunction	Preferred in liver, renal dysfunction

[a] Continuous infusion dosing should be avoided.
[b] Indications for high risk include age >70 y, morbidly obese, history of sleep apnea or other moderate to severe pulmonary disease.

Reproduced from Pain management tables and guidelines. Dana Farber Cancer Institute/Brigham and Women's Hospital Pain and Palliative Care Program. Copyright © 2004. Available at: https://d12yjkfv4xzz5l.cloudfront.net/uploads/7a382cf7c80c3373d54449ea4ff28879/original/Pain_Management_Guidelines_2013_pink_book_.pdf. Accessed April 08, 2014.

What are the adverse effects of opioids for pain control?

Although effective for the management of acute pain, opioids carry significant risks; however, the severity of these risks is minimized with appropriate prescribing. Although opioid side effects are many (see **Table 1**), this article focuses on the three most common side effects: nausea, constipation, and sedation.

Nausea

Nausea can occur in 25% to 30% of patients on opioids and commonly occurs with opioid initiation or with dose increase.[27] Centrally, opioids may stimulate the chemoreceptor trigger zone via D_2 receptors or directly stimulate the vestibular apparatus, triggering vertigo in addition to nausea.[28] In addition, they induce a delay in gastric emptying and a delay in intestinal transit time, which can further worsen subjective nausea. Opioid-induced nausea is typically very responsive to standard antiemetic therapy (particularly D_2 receptor antagonists like metoclopramide and prochlorperazine) and often spontaneously resolves within 3 to 7 days of a stable opioid dose.[29] In those patients whose nausea persists, rotation to another opioid may be of benefit.

Constipation

Opioids cause constipation by reducing gastrointestinal motility and increasing intestinal fluid absorption.[30] Constipation is the most common opioid side effect and can occur in up to 90% of patients started on opioid.[27,31] Unlike sedation or nausea, tolerance to the constipating effects of opioids seems to occur slowly if at all, and most patients require laxative therapy for the duration of their opioid use. Although all narcotics cause constipation, there are some data to suggest that the more potent opioids (hydromorphone and fentanyl) are less constipating compared with morphine.[29] In general, any patient who is started on opioids should also be prescribed a scheduled laxative to prevent opioid-induced constipation.

Sedation

Sedation occurs in 20% to 60% of patients receiving opioids and commonly occurs after initiation or after significant dose increases.[27] In most patients, this sedating side effect should abate after several days of a stable opioid dose. In some patients with severe pain, apparent sedation after initiation of an opioid may reflect increased comfort after days of pain-induced insomnia rather than true opioid-induced somnolence. In those whose sedation persists, potential options for treatment include opioid rotation or opioid dose reduction, with increased use of adjuvant analgesics such as those described earlier. Clinicians should be alert for other potential causes of sedation, including polypharmacy, renal or hepatic dysfunction, infection, or dehydration.[32]

What adjustments in pain control should be made for special populations?

Geriatric Populations

Elderly patients are more likely to have multiple comorbidities, including altered kidney and hepatic function, which affect the metabolism and clearance of drugs. In addition, the presence of other drugs can further affect the likelihood of developing CNS side effects of pain medications. This situation makes older adults particularly sensitive to many of the pain medications commonly used. In general, acetaminophen is the recommended medication for geriatric patients suffering from mild to moderate pain. Around-the-clock dosing is preferred, particularly for those patients suffering from dementia who may have difficulty reporting pain, although it is recommended that the total daily dose not exceed 3000 mg compared with the 4000 mg maximum daily amount for other adults.[32–34] Opioids, when used, should be started at doses reduced by 25% to 50%, and frequent monitoring for adverse reactions is recommended.[14] Titration should be gradual. NSAIDs can be used for short periods and with careful attention paid to renal function and bleeding risk.

Renal Failure/Insufficiency

As the population ages, the number of people living with chronic or end-stage renal disease is increasing, and physicians need an understanding of the way that such patients respond to common pain medications. Most opioids are renally cleared, and patients with chronic kidney disease (CKD) are at higher risk for opioid accumulation and side effects, including sedation, nausea, delirium, and respiratory depression.[35] Morphine is the best studied, and the build-up of its metabolite morphine-3 glucoronide can have toxic effects, including neural irritability and myoclonus. In general, more potent narcotics such as hydromorphone and fentanyl show less build-up of metabolites compared with morphine with less toxicity and thus are the preferred medications for moderate to severe pain for patients with CKD.[36]

NSAIDs, with their propensity to worsen renal function and worsen bleeding, should generally be avoided in patients with CKD, although in some instances, they can be used for limited time spans with periodic monitoring of kidney function. Acetaminophen does not carry this risk and is recommended by the National Kidney Foundation as the nonnarcotic analgesic of choice for mild to moderate pain.[37]

Liver Failure

Hepatic disease can be associated with dysfunction in several pathways that impede pain control strategies. Advanced liver dysfunction can affect many drugs and increase the risk for side effects from even lower-risk medications. Acetaminophen, classically associated with hepatotoxicity, is still safe in advanced liver disease, although most experts recommend a lower maximum daily dose of 2 g.[38] Coagulation issues can preclude interventional management techniques, including regional anesthesia, nerve blocks, or other injections.

Opioid medications in particular can be significantly affected by hepatic insufficiency, characterized by decreased clearance and increased oral bioavailability. These drugs, then, should be used at a decreased dose or at longer intervals. The metabolism of hydromorphone, fentanyl, and its isomers (sufentanil, remifentanil) is relatively unaffected compared with other opioids, and thus, it is considered the drugs of choice for patients with acute pain and hepatic failure.[39]

Opioid-Tolerant Patients and Those with Addiction Risk

Achieving effective acute pain relief can be challenging in those who have developed a tolerance to opioids or who have a history of drug dependence. As mentioned earlier, unlike other medications, opioids have no ceiling dose and are limited only by the side effects that they cause. Thus, when titrating medications for a patient who is opioid tolerant, clinicians may find themselves using doses of opioids beyond their comfort zone. Consultation with an acute pain specialist may be helpful. Furthermore, in patients who are already tolerant to opioids, the use of adjuvant medications (eg, NSAIDs, acetaminophen) for pain control should be strongly considered.

For those patients with addiction risk or a history of substance abuse, an empirical evaluation of their history of drug use is essential. In addition to a careful history that focus on the types, quantity, and frequency of substances abused, urine studies should be sent to confirm the presence or absence of substances that could interact with analgesic medication or if withheld cause dangerous withdrawal symptoms.[40] A clear and consistent approach with the patient should be used, which emphasizes patient safety and appropriate medical care, and should incorporate input from nursing, pharmacy, social work, and any outpatient physicians involved in the pain management of the patient.[41]

PERFORMANCE IMPROVEMENT

How is high-quality pain control defined in the inpatient setting?

Like other aspects of patient care, the need to measure, compare, and improve the quality of pain management is being increasingly sought by consumers and payers alike. Integral to this strategy is a practical and reliable measure of adequate pain control. However, the definition and measurement of quality pain control are challenging because of the complex and subjective nature of pain and reliance on direct feedback from patients about their experiences.[42]

Although several tools have been developed in an attempt to standardize evaluation of pain control, the Revised American Pain Society Patient Outcome Questionnaire has emerged as one of the most widely used for hospitalized patients. This measure focuses on 6 aspects of quality: (1) pain severity and relief; (2) impact of pain on activity, sleep, and negative emotions; (3) side effects of treatment; (4) helpfulness of information about pain treatment; (5) ability to participate in pain treatment decisions; and (6) use of nonpharmacologic strategies.[43]

What strategies can improve the pain experience of patients admitted to the hospital?

There are several strategies for improving the quality of care for patients admitted to the hospital. These strategies include reducing variation of practice; measuring outcomes; encouraging continuous innovation; and using performance rewards. The reduction of variation can be achieved with the integration of guidelines and standardized process into patient care.[44] As mentioned earlier, measuring outcomes is key to quality improvement initiatives, and reporting of outcome measures can motivate employees to improve performance. Programs that encourage continuous innovation by supporting new ideas can lead to the development of novel solutions to existing problems. Performance rewards can be used to incentivize changes in behavior. Often, successful programs use different strategies to improve outcomes.[45]

How is pain control related to quality measures and hospital reimbursement?

Quality measures are increasingly tied to hospital performance reporting and reimbursement, and pain control is a core element of patient experience. The Centers for Medicare and Medicaid Services (CMS) now publicly report each US hospital's quarterly results from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey.[46] One of the 10 items published assesses the percentage of patients who report that their pain was always controlled during a recent hospital stay.

HCAHPS scores make up 30% of a hospital's Value-based Purchasing score, the cornerstone of CMS's pay-for-performance program. Many private payers are already engaged in pay-for-performance programs, which are expected to increase significantly as proportion of reimbursement. As a result, high-quality pain management will be key to the future success and viability of US hospitals.

CLINICAL GUIDELINES

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