OPIUM AND ITS DERIVATIVES: ADDICTIVE AND MEDICINAL PROPERTIES

Abstract

Opium, a highly addictive narcotic, is derived from the poppy plant. It has been used for millennia for its relaxing and pain-relieving properties. Opium, among other things, is a precursor of morphine, codeine, and heroin. Morphine, one of the most often used drugs in hospitals, is derived from opium. Codeine, another opiate, is commonly used as a cough suppressant. Opium is also used to manufacture heroin, one of the most dangerous drugs. Even while opium and its derivatives offer medicinal benefits, they are highly addictive and can cause serious health problems as well as addiction.

Keywords: Medical sciences, neurochemistry, opium.

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I. INTRODUCTION

Opium is a crude substance derived from the plant Papaver somniferum that is beneficial in the treatment of acute and chronic pain, but it can also lead to opium use disorder (1). Opioid names have evolved throughout time. Other sleep-inducing medications have been branded as narcotics, narcoanalgesics, and hypnoanalgesics, all of which are insufficient terms. They were also known as opiates, a general word that was eventually limited to natural opium compounds. The word opioid was developed by Acheson to describe drugs that act similarly to morphine but have a distinct chemical structure(2). Opiates are opioids that include opium, morphine, and heroin, which are all derived from the opium poppy plant. For millennia, opium has been used to relieve pain, and it is still used as an analgesic after surgery (3). Opium and its derivatives are often used to alleviate pain, particularly cancer pain; nevertheless, reverse causality is a major issue in these studies. Because many opium users are also strong tobacco smokers, confounding by tobacco use and other socioeconomic variables may exist and be under-adjusted for in previous research (4). Risk factors such as hypertension, dyslipidemia, diabetes, smoking, and a family history of early coronary artery disease were all documented(5). Drug addiction, both legal and illegal, is a serious health and socioeconomic problem in many nations across the world. Abuse of authorised opiate medications may cause serious morbidity in wide sectors of a population, affecting both health and the economy(6).

II. CHEMISTRY AND PHARMACOLOGY

Morphine is said to be the first alkaloid to be discovered. The second most prevalent opium alkaloid, codeine, accounts for around 0.5% of total opium content. The baine is the least prevalent of the hydrophenanthrene alkaloids in opium (0.1-2.5%). Major alkaloids include the narcotic and analgesic morphine and codeine, the moderate analgesic and sedative thebaine, the antitussive and apoptotic inducer noscapine or narcotine, and the vasodilator papaverine. Morphine and codeine, for example, bind to and function as agonists at opioid receptors, causing analgesia, euphoria, respiratory depression, reduced gastrointestinal motility, and physical and psychological dependency. According to the European Pharmacopoeia (10th Edition), opium contains at least 10% morphine and 2% codeine. Opium, sometimes known as raw opium, is the primary ingredient in opium therapies such as tinctures and standardised dry extracts.Opioids have an effect on the three types of mu, kappa, and delta receptors found in myocytes. The aforementioned alkaloids' pharmacological and toxic effects, abuse potential, and dependency risks are qualitatively identical to those of other Schedule II opioid analgesics (such as oxycodone, hydrocodone, and oxymorphone, among others)(7).

Although heroin may be inhaled, it is usually injected into a vein. Analysing the neurochemical underpinnings of behavioural changes in opiate addicts may aid in guiding psychopharmacological and psychological intervention choices, as well as providing insight into the underlying linkages that exist between various neurochemical systems. Opium is one of the world's oldest psychostimulants, including over 40 alkaloids (including morphine, thebaine, and codeine). Thebaine, unlike the other main opium alkaloids, has no therapeutic or medical uses. It is, nevertheless, a vital intermediary in the synthesis of several important opiate derivatives, and it is frequently utilised as a suitable precursor for industrial

semisynthetic compounds of significant medications such as oxycodone, oxymorphone, hydrocodone, buprenorphine and naloxone.

Papaverine is a benzylisoquinoline alkaloid found in the majority of opium species at 0.5-1% levels. In 1848, Merck isolated it as a minor product from opium for the first time. For over a century, papaverine has been used as a direct smooth muscle relaxant as well as an analgesic mixed with morphine to augment the analgesic properties of a less potent medicine like aspirin. Furthermore, the chemical is available as a topical gel for the therapy of sexual dysfunction in those who have suffered a spinal cord injury. Papaverine's pharmacological effect is associated with an increase in cerebral blood flow, which is assumed to be related to phosphodiesterase inhibition (8).After morphine, noscapine is the second most common opium alkaloid, accounting for 1-10% of opium's alkaloid makeup. Noscapine has been used to treat coughs in both humans and animals. Noscapine's anti-tumor effect and tubulin-binding property have previously been found. Noscapine slows the progression of melanoma, lymphoma, leukaemia, breast cancer, colon cancer, ovarian carcinoma, and glioblastoma. It did not induce kidney, heart, liver, bone marrow, spleen, or small intestine damage, but it did cause lung and prostate cancer. Hydromorphone, oxymorphone, hydrocodone, and oxycodone are the most common naturally derived opiates and semisynthetic derivatives of the opiate diacetylmorphine (heroin). Synthetic opioids include hydrocodone (Vicodin), hydromorphone (Dilaudid), oxycodone (OxyContin, Percodan), and heroin (diacetylmorphine). Synthetic opiates or opioids with different chemical structures but equivalent effects on the body and brain include propoxyphene (Darvon), meperidine (Demerol), and methadone(9). Naloxone, having a molecular weight of 327.38 g/mol, functions by competing with opioids for the -receptor in the central nervous system. It has also been discovered to be an antagonist for additional opioid receptors such as and, albeit it has a larger affinity for the receptor. Naloxone is a regularly used antidote for opioid overdose and can be delivered by parenteral, intranasal, pulmonary, or orotracheal intubation(10).

III. APPROACHES TO THERAPY

Human birth generates extensive and excruciating agony. Opium and its derivatives are the oldest and most powerful pain relievers, and they have been used in childbirth for thousands of years, along with a range of traditional medicines and cures(11). Opium tinctures are widely used to prevent and treat chronic diarrhoea in people with disorders such as Crohn's disease and short bowel syndrome. Opium tinctures can also be used to treat opiate withdrawal symptoms (12). Opium is a highly addictive narcotic opioid that has been used for centuries for both medicinal and recreational purposes. Tincture of Opium (TOP), which is used in numerous Asian countries to treat opiate withdrawal and, less frequently, as a maintenance drug. This is a pharmaceutically standardized opium combination in alcohol and water containing 1% morphine. TOP is regarded as a traditional medicine in some parts of South-East Asia and hence appears to be culturally acceptable, with the added bonus of being less expensive than methadone(13).

Naloxone is a 327.38 g/mol molecular weight substance that competes with opioids for the brain's -receptors. Despite having a higher affinity for the receptor, it has also been proven to be an antagonist for other opioid receptors such as and. Naloxone is commonly used as an antidote for opiate overdose. It is administered by parenteral, intranasal,

pulmonary, or orotracheal intubation. The euphoric and analgesic properties of opium are the most common reasons for its usage. Opioids are essential in the treatment of myocardial infarction, severe pain after surgical procedures, late-stage cancer, and other agonising diseases and conditions. Noscapine also works as an adulterant in illicit heroin samples. Opiates relieve pain, reduce anxiety, and, at high enough dosages, induce euphoria. The majority may be smoked, snorted, or eaten, but addicts prefer intravenous injection since it offers the strongest and quickest enjoyment.

IV. ADVERSE EFFECTS

Numerous further studies have found a link between opium usage and an increased risk of esophageal, stomach, bladder, throat, and lung cancer. According to previous research, opium and its pyrolyzed derivatives include a variety of mutagenic chemicals. It's unclear whether opium causes cancer directly by creating mutagenic compounds during pyrolysis or indirectly by influencing gastrointestinal peristalsis with alkaloids like morphine(10). Furthermore, when the digestive system is relaxed, tiredness, nausea, and a prolonged drop in arterial blood pressure ensue. Despite the fact that opioids have heart-protective characteristics and are essential in the treatment of ischemia episodes, long-term usage may complicate their effects. Constipation is a well-defined GI side effect of opium alkaloid because opiates impair colon motility (14). According to current study, opioid-induced analgesia is generated by OR signalling via the G protein Gi, while OR signalling via the -arrestin pathway can have a variety of negative repercussions, including constipation and respiratory depression. OR-specific antagonists biassed towards the Gi signalling pathway are being pursued as therapeutic methods as well as molecular probes to better understand OR signalling. Pregnancy-related drug addiction is one of the most sensitive kinds of drug misuse since it can impair a mother's cognitive and social functioning, increase sensitivity to pain and anxiety, alter the child's vulnerability to pain and drugs, and change behaviour. Maternal behaviour is complex and multifaceted, making it difficult to assess even in healthy adults (15). Reduced long term potentiation and synaptic plasticity in the hippocampus are two additional memory-impairing consequences of parental and paternal morphine addiction. Previous research has demonstrated that addictive chemicals have an effect on dopaminergic and glutamatergic circuits, which in turn influence memory (16).

Thebaine stands out as the most perilous among opium alkaloids due to its potential to induce convulsions when consumed in high doses.In contrast, papaverine, another opium alkaloid, boasts a history of medical application spanning more than a century.Reported side effects of papaverine, such as nausea, vomiting, and severe headaches, have been generally considered minor and not of significant concern.Carfentanil, derived from fentanyl, a synthetic opioid already about 100 times more potent than morphine, takes the danger to a new level.It is commonly blended with illegal substances like heroin and cocaine, effectively magnifying their euphoric effects.This super-potent opioid, along with various fentanyl derivatives, has triggered a surge in fatal overdoses due to their extreme potency and their frequent presence in illicit drugs.As a response to the challenges of opioid addiction and withdrawal, pharmaceutical interventions have emerged, including buprenorphine and methadone.

These medications function as neurotransmitter agonists, effectively managing the distressing symptoms associated with withdrawal.An additional advantage is that these

replacement drugs can also dampen the cravings for opioids, aiding in the recovery process. Notably, buprenorphine and methadone possess the ability to block the effects of other opioids, mitigating the potential for misuse and the euphoria that comes with it.The delicate balance between potent pain relief and the risk of misuse underscores the complexity of managing opioid medications. Thebaine's capacity to induce convulsions serves as a stark reminder of the potential dangers associated with powerful substances derived from nature. Papaverine's lengthy history in medicine highlights the ongoing exploration of natural compounds for therapeutic use. Carfentanil's extreme strength underscores the escalating risks of illicit drug adulteration and the need for vigilant monitoring and control measures. The synergy between carfentanil and other illicit substances illustrates the constant evolution of drug combinations to intensify their effects. The opioid crisis serves as a stark reminder of the far-reaching consequences of drug abuse and the need for comprehensive prevention and treatment strategies.

The use of buprenorphine and methadone as opioid substitutes is a step forward in harm reduction and rehabilitation. These drugs treat not only the physical symptoms of withdrawal, but also the psychological aspects of addiction. However, their potential for abuse and the requirement for strict supervision underline the complexities of addressing opiate addiction. The continual search for safer and more effective pain management solutions continues to be an important endeavour in medical research. The differing degrees of hazard associated with various opium alkaloids highlight the need of understanding each compound's particular features. Scientific advances in the analysis and characterization of these chemicals allow in a better understanding of their possible hazards and advantages. The introduction of carfentanil into the illegal drug market demonstrates the persistent ingenuity of those aiming to maximise the appeal of addictive compounds. The devastating impact of opioid overdoses on public health and society highlights the critical need for preventive measures.

The combination effect of buprenorphine and methadone in lowering withdrawal symptoms while also decreasing the motivation for usage is a step towards more complete addiction therapy. The possibility of serious adverse effects from medicines such as thebaine emphasises the significance of proper medical prescribing and use. The delicate balance between properly controlling pain and minimising injury remains a major issue in medical practise. The progression of opium-derived compounds from ancient treatments to current medicinal therapies exemplifies humanity's persistent obsession with harnessing nature's therapeutic power. The growing incidence of opioid-related mortality serves as a sombre reminder of the necessity for multifaceted approaches to combat addiction. In the complicated opioid environment, there is an ongoing search for treatments that provide effective pain management while reducing the danger of abuse and its disastrous effects (17).

V. BENEFITS

Opium and its derivatives provide significant medicinal benefits due to their potent analgesic properties. For ages, these compounds have been used to treat many types of pain, ranging from post-operative discomfort to the misery associated with fatal diseases such as cancer. Their ability to provide relief from acute pain is a critical benefit, making them frequently important instruments in the medical industry. Opium and its derivatives have historically played an important part in traditional medicinal practises throughout

civilizations. This historical use illustrates their time-tested efficacy in relieving pain and enhancing patients' well-being. However, it is critical to recognise that these chemicals have significant dangers and possible downsides. Their addictive nature is a major worry, frequently leading to the development of opium use disorder or other types of drug dependency.

This addictive propensity has played a role in the opioid crisis, a worldwide health problem with far-reaching repercussions. Furthermore, the usage and abuse of opium derivatives can lead to a variety of serious health concerns. These symptoms include respiratory depression, constipation, cognitive impairment, and an increased risk of lethal overdose. The euphoric properties of these medications contribute to their overuse, and those seeking pain treatment may accidentally become addicted. The difficulty is balancing the evident pain-relieving advantages of opium derivatives with the risk of side consequences. Responsible prescription, complete patient education, and good monitoring are critical components in reducing the dangers associated with its use.

Substance abuse treatment programmes have become critical in assisting persons in overcoming reliance on opium derivatives in order to address the possibility for addiction. The current research in the medical community strives to find alternative pain treatment techniques that harness the advantages of these substances without the same level of addiction risk. While opium and its derivatives have great benefits in pain treatment, their addictive nature and potential for health concerns highlight the need of using them with caution and knowledge. The continued efforts of the medical community to maximise benefits while minimising hazards will continue to influence the landscape of pain management and addiction therapy.

VI. TECHNIQUES USE FOR DETECTION OF OPIUM

Forensic toxicology is extremely important in its search of discovering various marker substances within urine samples in order to distinguish between legitimate and illegal opiate use. Notably, the opium component thebaine appears to be a useful marker for distinguishing poppy seed intake from illegal heroin usage. Thebaine detection using gas chromatography-mass spectrometry (GC-MS) appears as a critical technology. Thebaine's key position inside opium, paired with its potential as a marker, makes it an appropriate candidate as a urine marker to indicate opium ingestion in current research endeavours. Surprisingly, despite the absence of a typical functional group, thebaine has been demonstrated to produce a trimethylsilyl derivative, a change critical for successful detection. This novel method allows for the simultaneous detection of thebaine, codeine, and morphine in a single urine sample, expediting the analytical procedure while optimising resource utilisation.

In compared to the non-derivatized substance, completely automated trimethylsilyl derivatization significantly improves thebaine's stability and chromatographic properties. Surprisingly, this strategy significantly improves detection sensitivity, essentially raising it by over 50 times. Thebaine was examined in real urine samples produced from opium, illegal codeine, or heroin formulations using the recognised methods for experimental validation.

The results repeatedly demonstrated thebaine's efficacy as a precise measure of opium use, especially when supplied orally (18).

Toxicologists, on the other hand, have begun a thorough investigation of opium's acute and chronic harmful effects on many human organs. These experts rigorously assess the concentration and potential adulteration of opium-derived substances within the human body using a diverse array of analytical techniques such as gas chromatography-mass spectrometry (GC-MS),thin-layer chromatography (TLC), Gas Chromatography and high-performance liquid chromatography (HPLC)(13). The forensic toxicology domain's concentrated efforts generate significant advances in identifying opium intake using marker chemicals, as shown starkly by thebaine. These advances not only improve chemical detection procedures, but also provide light on the physiological effects of opium on human health, contributing to both scientific knowledge and public safety.

VII. SUMMARY

Opium, which is produced from the plant Papaver somniferum, has both useful and possibly hazardous characteristics. It has traditionally been used to relieve pain, but it also carries the danger of opium use disorder. Opioid nomenclature has expanded from opiates to opioids to include a larger variety of drugs that operate similarly to morphine. Opioids include natural chemicals such as opium, morphine, and heroin, with opium being used for pain management and even post-surgery rehabilitation since ancient times. While opium and its derivatives provide pain relief, its use in research might lead to reverse causality concerns owing to factors such as cigarette smoking. Complication risk factors include hypertension, diabetes, and a family history of coronary artery disease.

Morphine, thebaine, and codeineare opium alkaloids with chemistry and pharmacology. These substances bind to opioid receptors, causing analgesia, euphoria, and addiction. Opium is usually made up of at least 10% morphine and 2% codeine. Alkaloids like thebaine are necessary intermediates in the synthesis of powerful medicines like oxycodone and hydrocodone. Another opium alkaloid, papaverine, functions as a smooth muscle relaxant and has been employed in a variety of medicinal purposes.Opium has historically been used in delivery and to treat chronic illnesses such as diarrhoea. While it provides efficient pain relief, it has the potential to develop to addiction. Naloxone is used to treat opioid overdoses. Opium abuse has been related to a variety of malignancies, and pyrolyzed derivatives may contribute to the formation of mutagenic chemicals. Opium usage has been linked to gastrointestinal difficulties, constipation, and possibly cognitive deficits.
Because of its ability to cause convulsions, thebaine stands out as a deadly opium alkaloid. Carfentanil, a fentanyl derivative, offers a serious risk due to its strength and role in illicit drug mixing, while papaverine has a long history of medicinal usage. opiate replacement medications, such as buprenorphine and methadone, relieve withdrawal symptoms and reduce opiate cravings. While opium and its derivatives provide essential pain relief, their addictive nature and possible side effects underline the importance of careful use and thorough addiction therapy. Through the use of marker chemicals in urine, forensic toxicology may distinguish between legitimate and illicit opiate use. Thebaine is a potential marker for opium intake that may be identified using gas chromatography-mass spectrometry (GC-MS). This approach detects thebaine, codeine, and morphine at the same time, simplifying processing and enhancing detection sensitivity. To assess the effects of opium on the body, toxicologists use a variety of analytical procedures. Ultimately, the medical advantages of opium for pain treatment are offset by its addictive potential and related health hazards. Understanding the chemistry, pharmacology, and side effects of opium is critical for ethical medical usage.

Forensic toxicology advances help distinguish between legal and illegal opiate use, while opioid replacement medications provide a way to manage addiction.

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