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Toxicology in Intensive Care Unit

Essay

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List of Abbreviations

Abb.	Full term
AC	Activated charcoal
ACS	Anticholinergic syndrome
ALT	Alanine aminotransferase
AT	Atrial tachycardia
CCB	Calcium channel blocker
CNS	central nervous system
COHb	Carboxyhemoglobin
COX	Cyclooxygenase
CroFab	Crotalidae Polyvalent Immune Fab (ovine)
CRRT	Continuous renal replacement therapy
D_5W	Dextrose in water
DNS	Delayed neurologic sequelae
ECG	Electrocardiogram
EETs	Extracorporeal elimination techniques
GABA	Gamma-aminobutyric acid
GI	Gastrointestinal
HBO	Hyperbaric oxygen therapy
HD	Hemodialysis
HIE	Hyperinsulinemic euglycemia
ICU	Intensive care unit
ILE	Toxicity, IV lipid emulsion
IV	Intravenous
MCPP	Mecoprop
MDAC	Multidose activated charcoal
NAPQI	N-acetyl-p-benzoquinoneimine
PT	Prothrombin time
SNRIs	Serotonin-norepinephrine reuptake inhibitors
SSRIs	Serotonin reuptake inhibitors
UDS	Urine drug screen
UDT	Urine drug testing
Vd	Volume of distribution
VPA	Valproic acid
WBI	Whole-bowel irrigation

Introduction

Poisonings, adverse drug effects, and envenomations continue to be commonly encountered. Patients often present critically ill and warrant intensive care unit (ICU) admission. Many other patients who are initially stable have the potential for rapid deterioration and require continuous cardiopulmonary and neurologic monitoring. Given the potential for rapid deterioration, and because patients need continuous monitoring, ICU admission is frequently required ***(Levine et al., 2011).***

Specific toxic syndromes (toxidromes) arise from similarities in the pharmacology of many poisons, permitting treatment to be started empirically, based on clinical presentation without definitive knowledge of the offending agent. The classic toxidromes include opioid, sedative-hypnotic, anticholinergic, cholinergic and sympathomimetic ***(Levine et al., 2011).***

Specific drug assays will not be useful or affect the management of every patient, however, and when interpreting results, the physician must always consider the limitations of the particular test and whether the results "make sense," considering the clinical findings ***(Hammett-Stabler et al., 2002).***

Historically, the initial treatment of patients with undifferentiated altered mental status included use of a "coma

cocktail," which refers to intravenous administration of dextrose, thiamine, and naloxone ***(Levine et al., 2011).***

Gastrointestinal decontamination refers to any measures undertaken to minimize absorption of the toxin from the GI tract. These measures have traditionally included activated charcoal (AC), syrup of ipecac, gastric lavage, and whole-bowel irrigation (WBI) ***(Vale et al., 2004).***

In this review we will focus on specific drugs that likely to be encountered in the ICU for example:acetaminophen toxicity, cardiac glycosides intoxication &carbon monoxide poisoning.

Also, we will focus on natural toxins such as heavy metals and those produced by plants, mushrooms, arthropods, and snakes.

Aim of the Work

The aim of this work is to discuss general and specific management of poisoned patients in the ICU.

Chapter 1

Generalized Care Of Poisoned Patients in Intensive Care Unit

Physicians frequently encounter critically ill patients who were poisoned under a variety of circumstances. The wide range of clinical syndromes that occur as a result of overdose or recreational use of an ever-increasing array of available prescription and illicit drugs provides a continuous challenge to the intensive care physician ***(Levine et al., 2011).***

Toxidromes

Toxidromes are Specific toxic syndromes that arise from similarities in the pharmacology of many poisons permitting treatment to be started empirically based on clinical presentation without definitive knowledge of the offending agent ***(Levine et al., 2011).***

The classic toxidromes include:

1) Classic opioid toxidrome:
2) Sedative-hypnotic toxidrome.
3) Sympathomimetic toxidrome.
4) Anticholinergic toxidrome.
5) Cholinergic toxidrome

1- Classic opioid toxidrome:

The classic opioid toxidrome results from the stimulation of opioid receptors by naturally occurring opiates, such as morphine and codeine, or by synthetic opioids, such as oxycodone, hydrocodone, hydromorphone, and fentanyl ***(Levine et al., 2011)***.

The symptoms of an opiate toxidrome include the classic triad of coma, pinpoint pupils, and respiratory depression as well as altered mental states, shock, pulmonary edema and unresponsiveness. Complications include bradycardia, hypotension, and hypothermia ***(Stead et al., 2006).***

This classic toxidrome may be obscured in mixed overdoses. For example, miosis alone is insufficient to infer the diagnosis of opioid intoxication. Polysubstance ingestions may produce normally reactive or mydriatic pupils, as can poisoning from meperidine, propoxyphene, or tramadol ***(Zacny, 2005).***

Several opioids have unique clinical features of importance:

- Propoxyphene produces sodium channel blockade, which is associated with QRS prolongation and cardiovascular collapse.
- Whereas potassium efflux blockade and QT prolongation are commonly observed with methadone toxicity.

- Meperidine, propoxyphene, and tramadol can cause seizures.
- The rapid administration of highdose IV fentanyl can induce chest wall rigidity, which can complicate ventilation ***(Levine et al., 2011).***

2- Sedative-hypnotic toxidrome:

Agents that may produce this toxidrome include benzodiazepines, benzodiazepine-like agents (eg, zolpidem), barbiturates, carisoprodol, chloral hydrate, ethanol, and baclofen ***(Levine et al., 2011).***

All the sedative-hypnotics are general CNS depressants. Most stimulate the activity of GABA, the principal inhibitory neurotransmitter in the CNS. Benzodiazepines, which are one of the most frequently prescribed medications in the world, enhance the effect of the neurotransmitter gamma-aminobutyric acid (GABA) at the GABA receptors. Characteristic clinical effects are anxiolysis and, as mentioned earlier, CNS depression. Respiratory depression and hypothermia may also occur ***(Chen et al., 2015)***.

Most cases of severe sedative-hypnotic poisoning are deliberate (suicidal). These agents are also commonly abused as recreational drugs.

Death from sedative-hypnotics is caused by respiratory arrest. Alprazolam (Xanax) is relatively more toxic than other benzodiazepines in overdose ***(Buckley and Mcmanus, 2014).***

3- Sympathomimetic toxidrome:

The sympathomimetic toxidrome is often caused by stimulants such as cocaine and methamphetamine. Several over-the-counter and prescription medications,such as pseudoephedrine, caffeine, and agents used to treat attention deficit disorders (eg, methylphenidate), can also produce this toxidrome ***(Levine et al., 2011).***

The classic signs and symptoms (toxidrome) often seen with the sympathomimetic drugs include hyperactivity, mydriasis (dilated pupils), hypertension, tachycardia, and hyperthermia; some of these drugs also precipitate psychosis, hallucinations and seizures ***(Williams et al., 2000).***

N.B. Sedative-hypnotic withdrawal syndrome can appear similar to the sympathomimetic toxidrome, and occurs with abrupt discontinuation of a sedative-hypnotic agent following prolonged use ***(Levine et al., 2011).***

4- Anticholinergic toxidrome:

The anticholinergic toxidrome results from a multitude of different classes of drugs, including tricyclic antidepressants,

antihistamines, antipsychotics, and cyclobenzaprine ***(Levine et al., 2011).***

Anticholinergic syndrome (ACS) is produced by the inhibition of cholinergic neurotransmission at muscarinic receptor sites. It commonly follows the ingestion of a wide variety of prescription and over-the-counter medications ***(Bang et al., 2011).***

It is characterized by the combination of mydriasis, dry flushed skin, delirium, hyperthermia, tachycardia, urinary retention, and hypoactive bowel sounds ***(Frascogna, 2007).***

At low doses, dryness of the mouth and skin may be noted; moderate doses lead to worsening anhidrosis, mydriasis, and tachycardia. At higher doses, central anticholinergic effects will occur, including ataxia, agitation, delirium, hallucinations, and coma ***(Levine et al., 2011).***

5- Cholinergic toxidromes:

It is classically produced by organophosphate insecticide poisoning, but may also be produced by other medications that affect acetylcholine esterase such as edrophonium or physostigmine ***(Eddleston et al., 2004).***

The symptoms of a cholinergic toxidrome include bronchorrhea, confusion, defecation, diaphoresis, diarrhea, emesis, lacrimation, miosis, muscle fasciculations, salivation, seizures,