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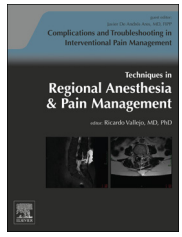

Contrast agents used in interventional pain: Management, complications, and troubleshooting

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ABSTRACT

Contrast agents (CAs) are one of the medications most used by interventional pain practitioners. They are used to confirm target, to distinguish different surrounding tissues, and to deliver adequate medication to specific areas of pathology. The high tolerance of modern CAs has been achieved through successive developments in chemical pharmacologic technology. Different CAs vary greatly in their chemical properties and toxic effects. Adverse reactions can occur while administering these substances and can be classified into acute and delayed. Acute reactions range from mild symptoms, such as urticaria and itching, to more severe reactions, such as cardiopulmonary arrest and death. Pain practitioners should be familiar with the clinical pharmacology of CAs, be aware of their potentially life-threatening reactions, and know how to prevent and treat them. All staff members should be able to recognize a potentially serious adverse reaction, as rapid response is critical.

Introduction

Without doubt, fluoroscopy and contrast media have made invasive pain treatment much safer. It is very important to correctly interpret fluoroscopic images and different contrast pattern flow, to perform safe and adequate interventional pain treatment techniques. Unfortunately, fluoroscopy can sometimes provide a false sense of security when fluoroscopic images are not properly interpreted. Contrast agents (CAs) are among the most used medications in interventional pain treatment along with local anesthetics and corticosteroids.[1] It is estimated that approximately 75 million doses of intravenous (iv) CAs are administered worldwide each year.[2] They serve no therapeutic purpose; their role is merely diagnostic by helping the practitioner to better distinguish different anatomical structures, visualize pain target, recognize vascular uptake, and interpret contrast pattern flow.[3] They also help avoid false-negative results in diagnostic blocks, making them more accurate.[4] Although they are used in smaller and, thus, safer doses than for radiological diagnostic purposes, severe allergic reactions may occur (Table 1).

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Table 1 – Importance of contrast agents in pain treatment.

Importance of contrast agents in pain treatment
(1) To confirm needle tip.
(2) To confirm intended target.
(3) To distinguish different anatomical structures.
(4) To recognize vascular uptake.
(5) To identify normal or abnormal contrast agent flow.
(6) To recognize epidural, subdural, or intrathecal space.

Mode of action of CAs

Different degrees of attenuation of x-ray beams by different body tissues are transformed into a black-and-white scale. The degree of attenuation is complex, but one of the major variables is the number of electrons with which the beam can interact in its path. Where there is a difference between densities of 2 structures, the outlines of the structures can be visualized with the help of CAs. The spinal cord and nerves cannot be seen using conventional x-rays, but they can be made visible by injecting CAs in the surrounding tissues, with a presumable pattern flow. It also helps to differentiate intrathecal, epidural, and subdural spaces (though this can sometimes be very challenging) and intravascular and intra-arterial flow and to perform discographies and arthrograms. It is very important to adequately interpret the CA flow and dispersal pattern.

See Figures 1-6 for different contrast flow patterns.

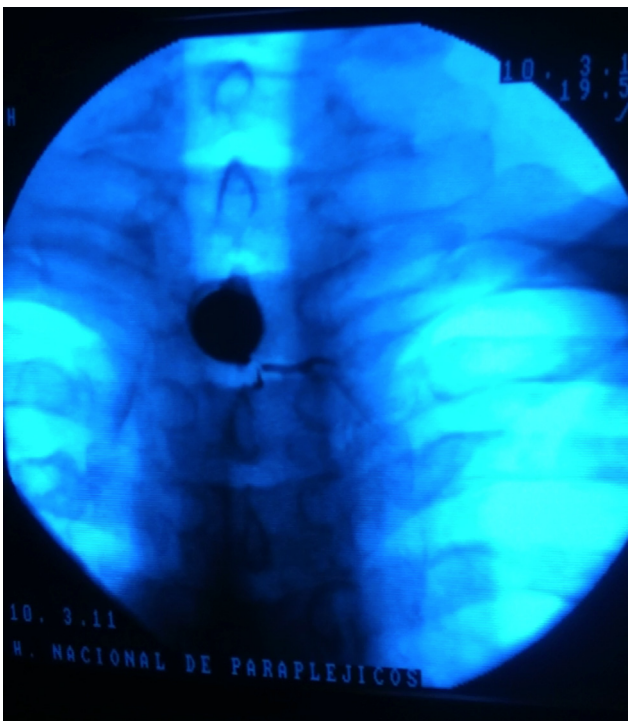

Fig. 1 – Interlaminar epidural with vascular uptake. The procedure was performed using the loss-of-resistance technique, but intravascular (intravenous) uptake was observed. The venous uptake and the characteristic lateral flow pattern should be noticed. (Color version of figure is available online.)

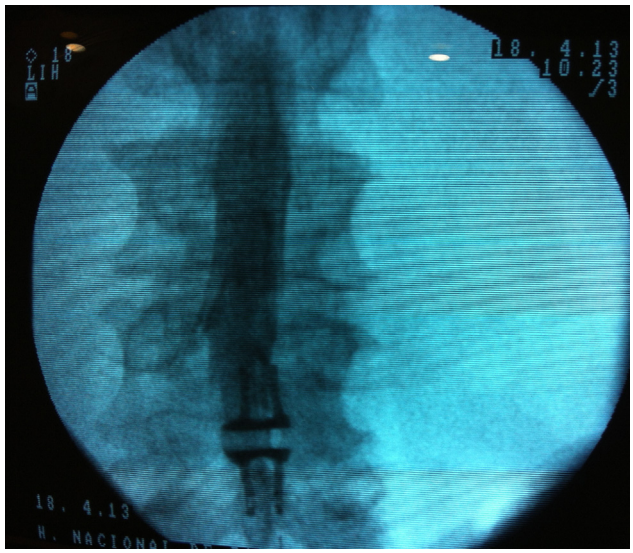

Fig. 2 – Intrathecal contrast agent flow. Caudal epidural with inadvertent dural puncture. The contrast shows intrathecal flow. (Color version of figure is available online.)

Clinical pharmacology

All CAs have a similar chemical structure, with a tri-iodinated benzene ring. There are mainly 2 kinds of CAs: iodinated and gadolinium-based. The former are the most broadly used CAs, whereas gadolinium-based CAs are used for iodinated allergic patients.[5] Iodinated CAs can be divided into ionic and non-ionic[6] based on water solubility (ionic CAs dissociate into ions and cations in blood) and charge of the iodinated molecule. They can be monomers or dimers depending on their molecular structure. They can also be classified based on osmolality compared with blood serum into low osmolal, iso-osmolal,

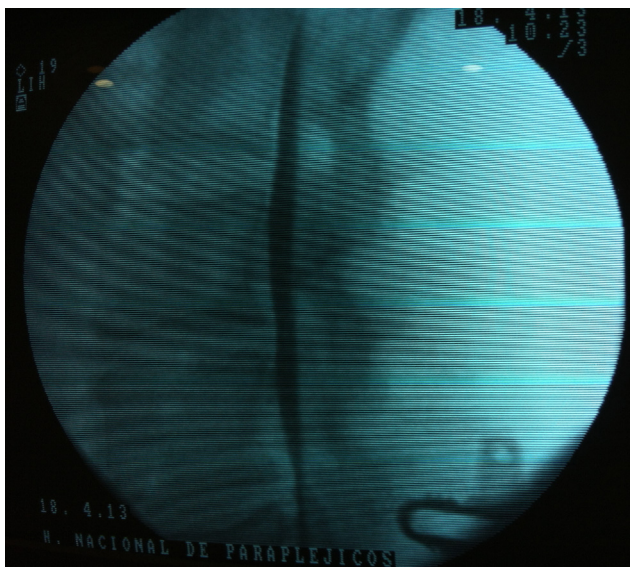

Fig. 3 – Intrathecal contrast agent flow. Caudal epidural with inadvertent dural puncture. The contrast shows intrathecal flow. Lateral view. (Color version of figure is available online.)