

# Catheter tip granuloma

## General information

**Catheter**-associated inflammatory masses (CIMs), AKA catheter tip **granulomas**, are a recognized **complication** that may be associated with a number of **intrathecal devices**. An inflammatory reaction at the tip of the catheter produces a **mass** arising from the **arachnoid** layer of the **meninges** composed of **macrophages**, **plasma** cells, **eosinophils** and **lymphocytes**. CIMs are usually **intradural** and extramedullary, but may rarely be extradural or intramedullary.

Intrathecal drug delivery systems (IDDS) utilizing **opioids**, especially **morphine**, but also other agents including hydromorphone, fentanyl, tramadol, sufentanil, methadone, baclofen, clonidine, and ziconotide have been associated with granulation tissue. Non drug delivery devices have also been implicated, including: lumbar shunts, ventricular shunts, and spinal cord stimulators.

## Etiology

The exact mechanism remains unknown. **Granuloma** formation is thought to be related to the migration of inflammatory cells from the meningeal vasculature and not dependent on **opioid receptor** activation. Although the mass is typically sterile, bacterial infections have been implicated, suggesting CIMs be evaluated for the presence of aerobic and anaerobic bacteria. Factors such as drug concentration, CSF flow rate, drug distribution, drug flow rate (with low flow rates thought to be more likely to increase risk), anatomic variance that disrupts CSF flow, prior history of granuloma, and duration of infusion have all been noted to predispose a patient to granuloma formation.

The association between drug dose and concentration delivered is considered the most contributory to granuloma formation.

No relation between catheter tip location or catheter material and CIM formation has been identified to date.

## Clinical features

For patients receiving intrathecal opioids, the most common presentation is an increase in pain, possibly related to decreased opioid release due to granuloma obstruction. This is often misinterpreted as **opioid tolerance**; a yearly increase in opioid dose should be regarded as a warning sign.

New radicular pain in the dermatomal level corresponding to the catheter tip also warrants investigation. Other signs and symptoms reflective of spinal cord dysfunction include myelopathy, paraesthesias, bowel and bladder dysfunction, radicular pain, paralysis, paraplegia, paresis, and generalized weakness or lower extremity muscle weakness.

## Prevention

Preclinical evidence suggests adding clonidine to opioid infusions decreases the risk of granuloma formation. However, case reports have challenged translation to humans. Evidence for nonopioid alternatives, such as ziconotide have been indeterminate, with some case reports demonstrating regression and others showing persistence of inflammation after substitution.

According to the PACC, decreasing the dose and concentration may be among the most effective ways to prevent or delay onset of granuloma formation. One study demonstrated almost 50% reduction in relative risk of CIM formation by reducing the dose and concentration of morphine from the recommended maximum of 15 mg/day and 20 mg/mL to 10 mg/day and 15 mg/mL. Bolus dosing instead of continuous infusion may further limit continuous exposure and reduce the risk. Previous recommendations to place the catheter tip below the conus have not proven to be clinically significant. However, consensus is to place the tip as close to the pain level as possible to minimize dilution of the drug by diffusion to achieve similar concentration of drug at the target with lower doses. Experts have anecdotally recommended dorsal placement of catheters given a larger CSF space and because granuloma formation would be easier to treat surgically.

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