

CLINICAL USE OF PARACETAMOL

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ABSTRACT

Paracetamol, also known as acetaminophen, is a commonly used pain reliever and fever reducer. One of its main advantages is that it can be taken in different ways – orally (by mouth), intravenously (through a vein), or rectally (via the rectum). When taken orally or intravenously, it's absorbed relatively quickly, but when taken rectally, absorption is slower and less predictable.

The good thing about paracetamol is that its effects are consistent and predictable, regardless of the dose or how often it's taken. This means that whether you take a small or large dose, or if you take it regularly, its effectiveness remains the same.

Paracetamol has been shown to work well for various types of pain, whether it's acute (like a headache or toothache) or chronic (lasting a long time). For adults, the recommended dose is usually 1 gram (1000 milligrams), and the maximum amount you can take in a day is 4 grams. Its pain-relieving effects typically last around 6 hours.

Effervescent tablets, which dissolve in water, can be absorbed faster than regular tablets, leading to quicker pain relief. However, it's important to note that the level of paracetamol in the blood doesn't directly correlate with its pain-relieving or fever-reducing effects.

Paracetamol is often the preferred pain reliever for elderly people or those with kidney problems, as well as pregnant or breastfeeding women. It's generally safe to use in these groups, and usually, there's no need to adjust the dosage, even though their bodies might clear it more slowly.

Paracetamol is metabolized mainly in the liver and doesn't bind strongly to proteins in the blood. This means it's less likely to interact with other drugs, making it a safer option in combination with other medications, including some NSAIDs (nonsteroidal anti-inflammatory drugs).

When given alongside traditional NSAIDs, paracetamol can enhance pain relief or allow for lower doses of NSAIDs to be used.

For children, determining the right dose of paracetamol can be trickier because it depends on their age and how their body processes the drug. A common guideline is to give 15 milligrams of paracetamol per kilogram of body weight every 4 hours, up to a maximum of 60 milligrams per kilogram per day, to achieve the desired pain relief or fever reduction.

1. INTRODUCTION

Paracetamol (acetaminophen) is derived from substances like acetanilide and phenacetin. These substances used to be used as pain relievers and fever reducers too, but they're not used much anymore because they could cause a dangerous condition called methemoglobinemia, which reduces the amount of oxygen carried in the blood.

Paracetamol, on the other hand, shares the same pain-relieving and fever-reducing effects as acetanilide and phenacetin, but it doesn't cause methemoglobinemia. This is why paracetamol has become the most popular pain reliever and fever reducer worldwide. It has a very good balance between its benefits and risks, and it's less likely to cause harmful interactions with other drugs when taken at standard doses.

So, while older drugs like acetanilide and phenacetin have largely been abandoned due to safety concerns, paracetamol has emerged as the preferred choice for pain relief and fever reduction because it's effective and safer to use.

Pharmaceutical formulations & pharmacokinetics characteristic

Paracetamol (acetaminophen) can be taken in different ways: orally (by mouth), rectally (via the rectum), or intravenously (through a vein). When it's in your bloodstream at therapeutic levels (which means the right amount to be effective but not harmful), it doesn't bind much to proteins in your blood.

Most of the paracetamol you take gets broken down in your liver and then removed from your body through your kidneys. About 80% of it gets turned into different forms that your body can easily get rid of. A small amount, less than 10%, gets changed into a substance that's quickly neutralized by your body's defenses before being eliminated.

1. ****Oral Route****: Paracetamol taken by mouth gets absorbed quickly, usually reaching its highest level in your blood within 30 minutes to 1.5 hours after taking it on an empty stomach. The amount that gets into your bloodstream can vary

depending on whether you took a 500mg or 1g dose, but after several doses, it's about the same. It stays in your body for about 2 to 2.5 hours before it's cleared out.

2. **Rectal Route**: When you take paracetamol as a suppository (a solid medicine you put into your rectum), it's absorbed more slowly and less predictably than when taken orally. The level of paracetamol in your blood peaks around 4 hours after inserting the suppository. It's similar to taking a slow-release tablet.

3. **Intravenous Route**: Paracetamol can also be given directly into your bloodstream through an IV. This method can quickly raise the level of paracetamol in your blood, with the highest level reached at the end of a 15-minute infusion. The amount of paracetamol in your blood after an IV infusion is about twice as much as when taking it in tablet form. After the first hour, the levels in your blood from IV and oral forms become similar.

There's a special form of paracetamol called propacetamol, which is a prodrug of paracetamol. It's converted into paracetamol in your body. However, it's unstable and can cause skin irritation, so a ready-to-use IV solution of paracetamol has been developed to avoid these issues. This solution has the same effects as propacetamol but with better local tolerance and without causing skin sensitization in healthcare workers who handle it.

Paracetamol is effective in treating various types of pain, both short-term and long-term. Some important aspects of its effectiveness:

1. **Dose-Effect Relationship**: Researchers have studied how different doses of paracetamol affect pain relief, especially in situations like postoperative pain. They found that a single oral dose of 600-650mg provided relief for about half the patients, and a dose of 1g provided relief for even more patients. However, beyond 1g, the pain relief didn't increase significantly. So, the standard adult dose for paracetamol is 1g, and it's generally effective for most people. Taking more than 1g in a single dose doesn't increase its pain-relieving effects.

2. **Maximum Daily Dosage**: It's important not to exceed 4g of paracetamol in a day, even if you need to take it more frequently. This is because its pain-relieving effect typically wears off after about 6 hours, so taking more won't provide additional benefit and could be harmful.

3. **Concentration-Effect Relationship**: Interestingly, there isn't a direct relationship between the amount of paracetamol in your blood and its pain-relieving effects. The level of paracetamol in the cerebrospinal fluid, which surrounds the brain and spinal cord, follows a similar pattern to its concentration in the blood but with a delay. This makes it difficult to pinpoint the exact level of paracetamol needed for pain relief. However, some studies suggest that a certain level of paracetamol in the blood, around 10 mg/L, can provide satisfactory pain relief for some individuals.

4. **Importance of Route of Administration**: How you take paracetamol can affect its effectiveness. Studies have shown that the intravenous route (directly into the bloodstream) is more effective than taking it orally, which is in turn more effective than using suppositories (rectal route). This is because the body absorbs paracetamol differently depending on the route of administration. For example, the intravenous route leads to higher and quicker peak levels of paracetamol in the blood compared to oral or rectal routes. Therefore, the choice of administration route can impact how well paracetamol works for pain relief.

In summary, paracetamol is an effective pain reliever when taken at the right dose and through the appropriate route of administration. However, it's important to follow dosage recommendations and not exceed the maximum daily limit to avoid potential harm.

Paracetamol in different scenarios:

1. **Elderly Individuals**: As people age, their liver's ability to clear paracetamol from the body may decrease due to changes in liver volume and enzyme activity. However, this doesn't usually require a change in the standard dosage of paracetamol. Even in elderly individuals receiving multiple medications, no harmful buildup of paracetamol in the blood was observed with standard dosing. Therefore, for mild to moderate pain in elderly individuals without liver or kidney problems, paracetamol is often recommended as the first choice.

2. **Pregnancy and Lactation**: Paracetamol is considered safe to use during pregnancy as it doesn't have any proven harmful effects on the developing baby when used at therapeutic doses. While its elimination from the body may be slightly faster during pregnancy, there's no need to increase the dosage. Additionally, the amount of paracetamol that passes into breast milk is very low, so it's generally safe to use while breastfeeding.

3. **Renal Impairment**: Severe kidney problems don't usually affect how paracetamol is broken down in the body. However, there may be some changes in the levels of certain substances in the blood. Despite this, there's typically no need to adjust the dosage of paracetamol for patients with chronic kidney impairment. However, health authorities may recommend not exceeding certain doses or spacing out doses more for individuals with very poor kidney function. Long-term use of paracetamol in patients with kidney problems should be monitored by a healthcare professional, but there's no clear evidence linking regular paracetamol use with kidney damage.

4. ****Chronic Liver Disorders****: In mild liver disorders, such as fatty liver disease, paracetamol is generally safe to use because it doesn't significantly affect how the drug is absorbed or cleared from the body. However, in severe liver conditions like cirrhosis, there can be changes in how paracetamol is processed by the body. This can lead to a longer elimination half-life of the drug, meaning it stays in the body longer. The severity of these changes depends on the degree of liver damage. While some studies show that the liver's ability to detoxify paracetamol remains intact, long-term use of paracetamol is generally not recommended for individuals with documented liver impairment due to safety concerns.
5. ****Chronic Alcoholism****: Chronic alcohol consumption can affect the way the liver metabolizes paracetamol, potentially increasing its risk of causing liver damage. Some studies suggest that long-term alcohol abuse may increase the activity of certain enzymes in the liver, such as CYP2E1, which is involved in metabolizing paracetamol. However, it's not entirely clear whether this increase in enzyme activity directly leads to greater metabolism of paracetamol or greater susceptibility to liver toxicity. Different countries have varying recommendations regarding the use of paracetamol in chronic alcoholics. For example, the US FDA suggests limiting paracetamol intake to 2.5g per day for individuals consuming more than a certain amount of alcohol daily. In France, however, there are no specific dosage restrictions for chronic alcoholics.

Interactions of paracetamol with other drugs:

1. ****Pharmacodynamic Interactions****: Paracetamol is often combined with opioids or NSAIDs to boost its pain-relieving effects. It generally doesn't interact much with other drugs in terms of how they work in the body. However, certain medications like anticholinergics or opioids may slow down the absorption of paracetamol from the intestine, delaying its effects.
2. ****Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)****: Combining paracetamol with traditional NSAIDs like ibuprofen can provide better pain relief compared to using paracetamol alone. This combination is especially effective for postoperative pain and can reduce the need for stronger painkillers like morphine. However, the effectiveness of combining paracetamol with selective NSAIDs like celecoxib is still under investigation. Some studies show benefits, while others are inconclusive.
3. ****Antivitamin K****: There have been some reports suggesting that paracetamol might increase the risk of bleeding in patients taking antivitamin K medications like warfarin. However, the evidence is conflicting. While some studies show a potential interaction, others don't. Generally, at therapeutic doses, paracetamol doesn't significantly affect the blood clotting levels monitored by the International Normalized Ratio (INR). Still, it's recommended to monitor INR levels when starting or stopping paracetamol treatment in patients taking antivitamin K medications to avoid potential complications.

In summary, paracetamol is usually safe to use with other drugs, but caution should be exercised when combining it with certain medications, especially antivitamin K drugs, to prevent potential interactions and adverse effects. It's always best to consult with a healthcare professional before starting or stopping any medication regimen.

Paracetamol in children

Paracetamol, is commonly used to relieve pain and reduce fever in children. It is recommended by organizations like the World Health Organization and the American Academy of Pediatrics as the first-choice medication for these symptoms. Unlike aspirin, it's safe to use in children and doesn't cause Reye's syndrome.

Pharmacokinetic Aspects:

- In infants, the way the body processes paracetamol differs significantly during the first year of life.
- The absorption of paracetamol in infants is slower compared to adults but reaches adult levels by 6-8 months of age.
- The volume of distribution (how the drug spreads throughout the body) decreases as the child grows, from birth to 2 weeks, and continues to change as the body composition changes.
- The clearance of paracetamol (how quickly the body removes the drug) increases rapidly until 6 months of age and then gradually until around 12 years when the liver's ability to process the drug matures

Dosage:

- Paracetamol dosages vary from country to country.
- In the UK, the recommended dose is 10 mg/kg every 4–6 hours, up to a maximum of 40 mg/kg per day.
- In the USA, the dose ranges from 10–15 mg/kg, not to exceed 50–70 mg/kg per day.
- French authorities recommend 15 mg/kg every 6 hours, up to 80 mg/kg per day if necessary.
- In Australia, it's recommended as 15 mg/kg every 4 hours, up to 60 mg/kg per day.

- These doses are based solely on the child's weight and don't consider age-related changes in how the body processes the drug.

Special Considerations for Suppositories:

- Suppositories of paracetamol may have erratic absorption and reduced effectiveness.
- The ideal dosage for rectal administration is more challenging to determine.
- Some suggestions include a loading dose followed by maintenance doses to achieve effective concentrations.

Important Points:

- Self-medication or family use should follow recommended dosages.
- While paracetamol has a wide safety margin in children, higher doses should only be given under a doctor's recommendation and close supervision.

Overall, it's crucial to follow dosing guidelines based on weight, consider the child's age, and use caution, especially with suppositories and higher doses. Always consult a healthcare professional for proper guidance.

2. CONCLUSION

In conclusion, paracetamol is a widely trusted and effective medication for pain relief and fever reduction. It is safe for most populations, including the elderly, pregnant women, and those with mild liver or kidney issues, though caution is needed in individuals with severe impairments or when combined with certain drugs. Paracetamol can be administered through various routes, with each having distinct absorption rates, and careful dosing, especially in children, is crucial for safety. When used appropriately, paracetamol remains a cornerstone in pain management with a strong safety profile and minimal risks.

3. REFERENCES

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