Session: Pharmacist Session: Amino Acids
Evolution of Different Amino Acid Solutions: Present and Future Concepts

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a piece of history ...

Amino acids

Proteins
Introduction

Amino acid solutions

Quantity

Quality

Synthesis

Proteins
Hormones
Neurotransmitters

Optimal AA solutions

Nitrogen retention
Allergic reactions
Metabolic complications
Correct plasma aminogram

1. Protein hydrolysates
2. Racemic crystalline amino acids
3. Crystalline L amino acids
Crystalline L amino acids

Specific diseases

Age groups

AA deficiencies / antagonisms / imbalances

conditionally essential

Standard Modified

Amino acids solutions

Essential / Semi-essential / Non-essential

Glycine
Leucine
Phenylalanine
Threonine

Histidine
Lysine
Serine
Valine

Cysteine
Glutamine
Taurine
Tyrosine

Nitrogen concentration

Electrolytes

Osmolarity

pH
Amino acids solutions

Modified

- Renal failure
- Hepatic failure
- High stress
- With Glutamine
- Paediatrics

Cost - effectiveness ??

Amino acids solutions - modified

for renal failure

Essential AA

non-essential physiologically recycled from urea

but
recycling is often incomplete
Amino acids solutions - *modified*

- **for hepatic failure / encephalopathy**
  - BCAA
  - AAA

- BCAA-enriched
  - Isoleucine
  - Leucine
  - Valine

- **for high stress**
  - Molar ratios
  - Muscle proteolysis
  - Urea production
  - Protein synthesis

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Amino acids solutions - modified

Glutamine-enriched

- Glycyl-L-glutamine
- L-alanyl-L-glutamine

Essential
- protein synthesis
- gut mucosal repair
- immunity

When
Dose
Administration
Side effects

Amino acids solutions - modified

Paediatric Patients
- Heterogeneous population
- Age
- Body composition
- Enzymatic / organ maturity
- Underlying disease

Tyrosine
Cysteine
Taurine
BCAA
Phenylalanine
Methionine
Tryptophan
Glycine
Histidine
Arginine
Glutamine

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Amino acids solutions - Key points

Efficacy
- Optimise nitrogen retention
- Stabilise physiologic functions

Safety
- Physico-chemical stability and compatibility

Key points - Aminogram

Proteins with high biological value

Plasma amino acids kinetic analysis

Disease

Age

Human breast milk

Umbilical cord blood
Key points - Amino acids pattern

Protein metabolism

Essential
Non essential

Right proportion

Oversupply
Arginine / Lysine
competition for cellular uptake / renal reabsorption

Key points - Amino acids pattern

Stability

Photolysis
Complexation

Methionine
Histidine
Tryptophan
Tyrosin

Cysteine
Histidine
Copper, iron, zinc

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Key points - **AA vs Salts vs Dipeptides**

- Pure AA preferred
- Hydrochloride salts → metabolic acidosis
- Acetate salts → better tolerated
- Acetylation → urinary excretion of AA
- Dipeptides → more soluble
  - require hydrolysis
  - peptides design ??
  - ↑ Maillard reaction

**Ketoacid analogues**

Ornithine → [keto glutarate] → Arginine + Glutamine

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Key points - **Nitrogen concentration**

- Nitrogen concentrations
- Facilitate PN preparations
- Individual patient nitrogen needs
- Fluid requirements
Key points - **Electrolytes and carbohydrates**

- Flexibility in tailoring regimens to individual needs
- **Maillard reaction**
  - Carbohydrates + Amino acids → Degraded products
  - Glycine
  - Proline
  - Tryptophan
  - Arginine
  - Lysine
  - Histidine

- Degraded products

- Acidic AA
  - Proline/ histidine degradation ↑ at pH < 4
  - Cysteine ↔ H₂S (acidic pH)

- Neutral AA
  - Ca and P solubility
  - In parallel with acidic pH

- Basic AA
  - Precipitation
  - Cysteine + copper

Key points - **pH**

- AA integrity
- Lipid emulsions stability
  - Buffer capacity
  - Enhance mechanical barrier
Key points - **Antioxidants**

- **Bisulphites**
  - Hepatotoxicity
  - Degradation of tryptophan/thiamine/niacin

- **EDTA**
  - Trace elements deficiencies during long-term parenteral nutrition

- **Citric acid**
  - Valid option

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**Key points - Container package**

**AA solutions**

**STORAGE**

- Resilient
- Transparent
- Flexible
- Impermeable to oxygen/water
- Steam sterilisable 121°C
- Safe
- Environment friendly

**Glass versus Plastic**

- EVA
- Polyolefins
- Laminated structures

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Key points - Others

- Aluminium
- Osmolarity
- Pyrogen free
- Sterility
- Toxicity

Conclusion

- Individual substrates
  - tissue/organ specific single nutrients
- Intravenous amino acids requirements
- Ratio essential to non-essential
- Utilisation of intravenously amino acids

Ideal amino acids solutions

Research
References


References