

THE STRESS RESPONSE TO SURGERY & ENHANCED RECOVERY

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CONTENTS

The stress response to surgery:

- Trauma
- Tissue injury
- Endocrinology
- Maladaptation

Mechanisms to obtund the stress response to surgery

Enhanced recovery: evidence, protocols and recurrent themes

WHY?

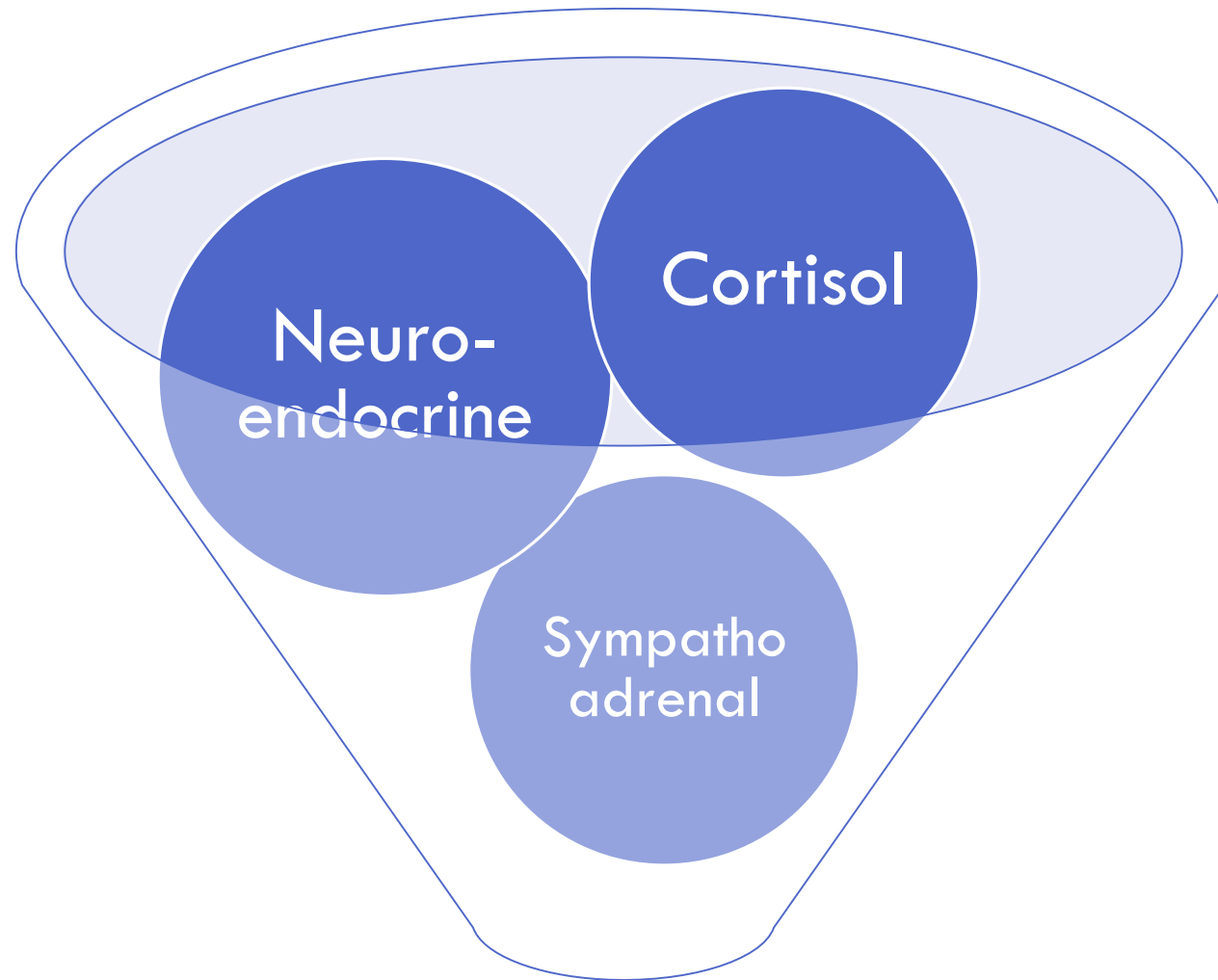
Remnant of evolution

Beneficial to the injured animal

Fluid, lipid and protein retention in a state of being unable to eat and drink

Modern surgery and post operative care (hopefully) attenuates these responses

Outcome : improved recovery times, improved time to recovery of normal function and work



Stress response

THE STRESS RESPONSE

“A series of hormonal, inflammatory, metabolic and psychological changes which occur in response to trauma or surgery”

Not isolated to surgery

Net effects of:

Substrate mobilisation

Muscle protein loss

Water retention

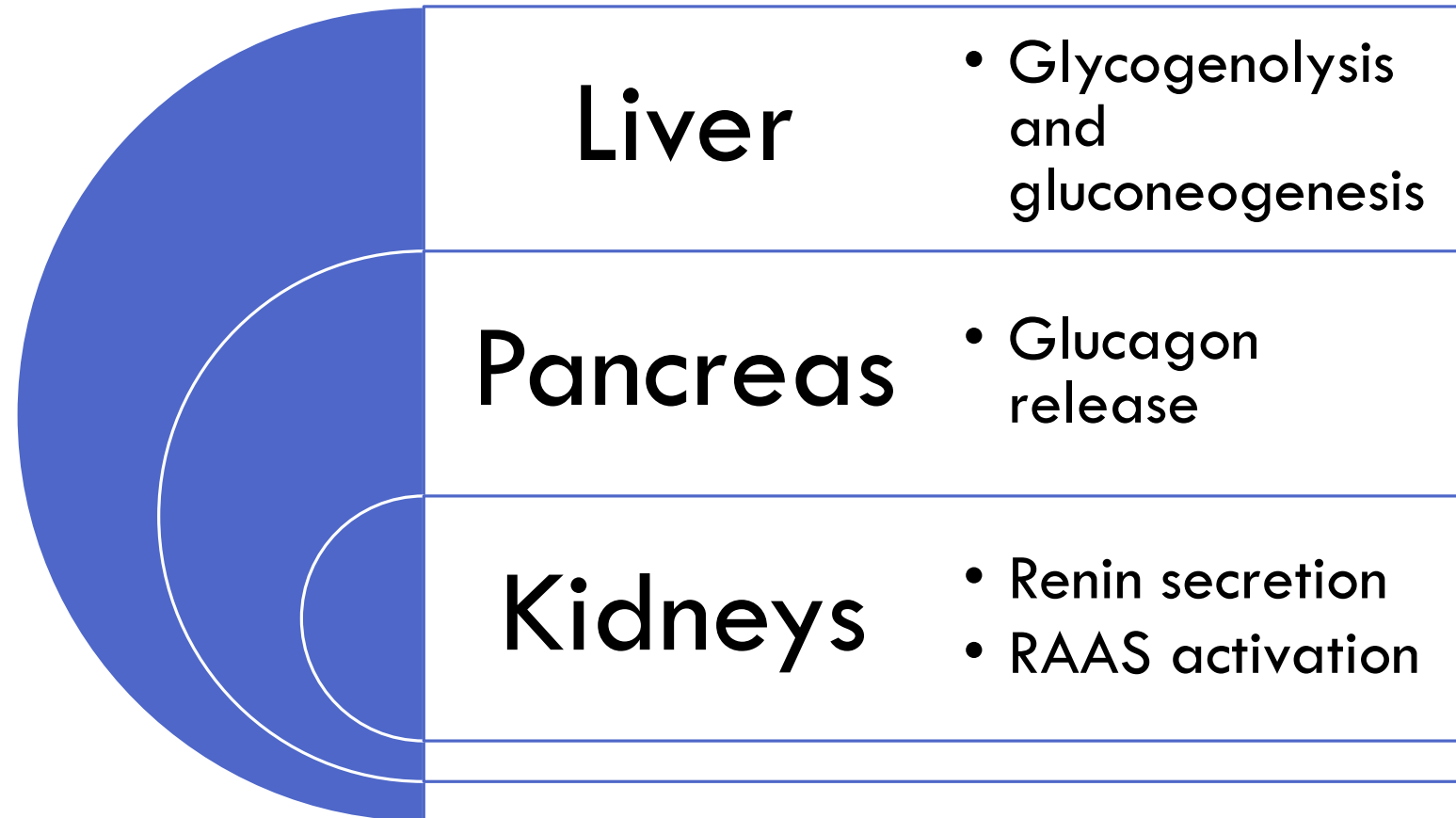
Sodium retention

SYMAPATHOADRENAL RESPONSE

Secretion of
Noradrenaline and
Adrenaline

Characteristic
response of
tachycardia,
hypertension

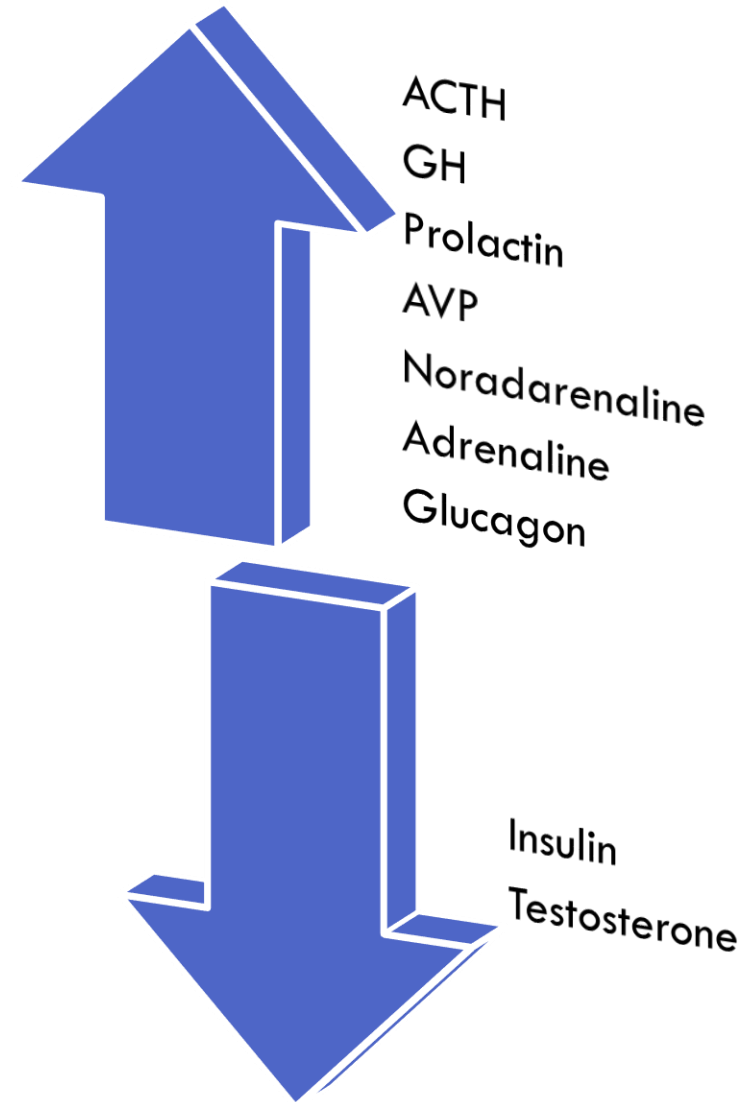
Many end organ
effects



HORMONAL RESPONSE

Initial hypothalamic activation via
afferent neuronal input, cytokine release
and SNS activation

Magnitude of response proportional to
initial trauma

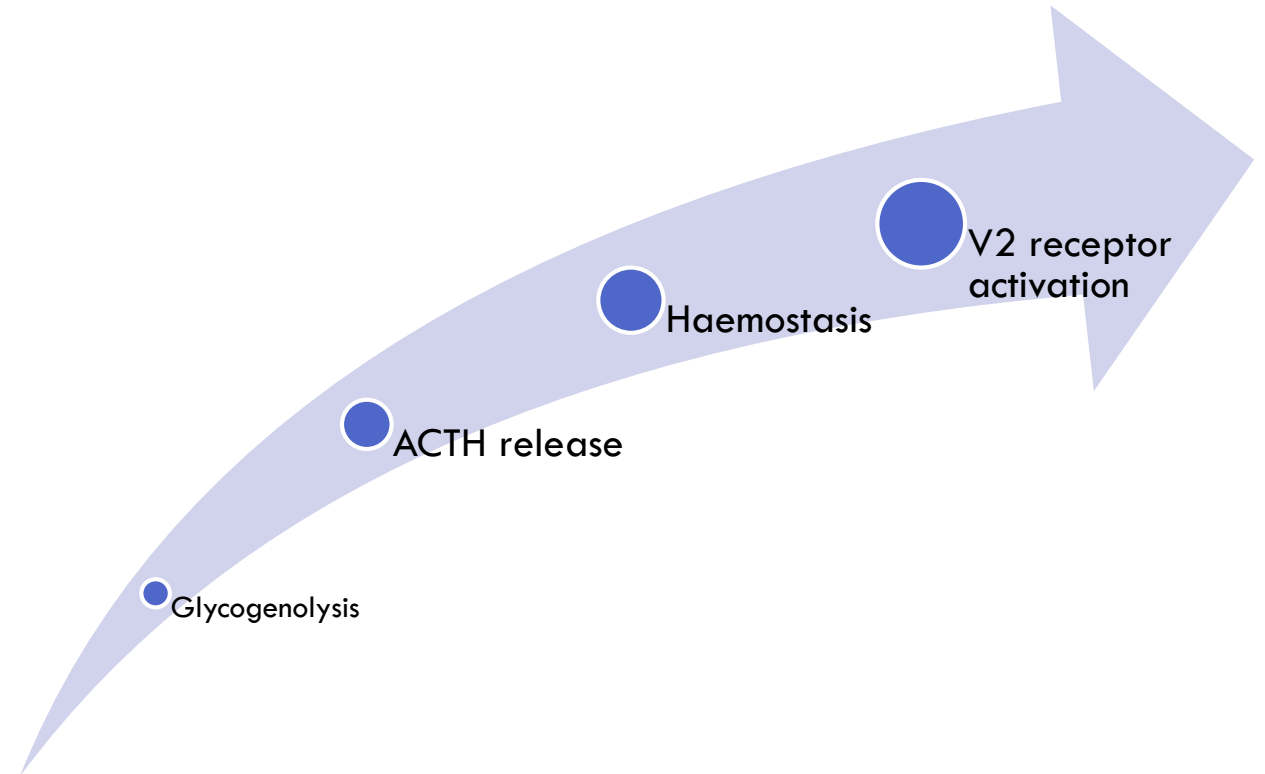


ADH

Released from the posterior pituitary

Released enhanced by cytokines and decreased in ECF (\uparrow Osmolality)

Works via GCPR



CORTISOL

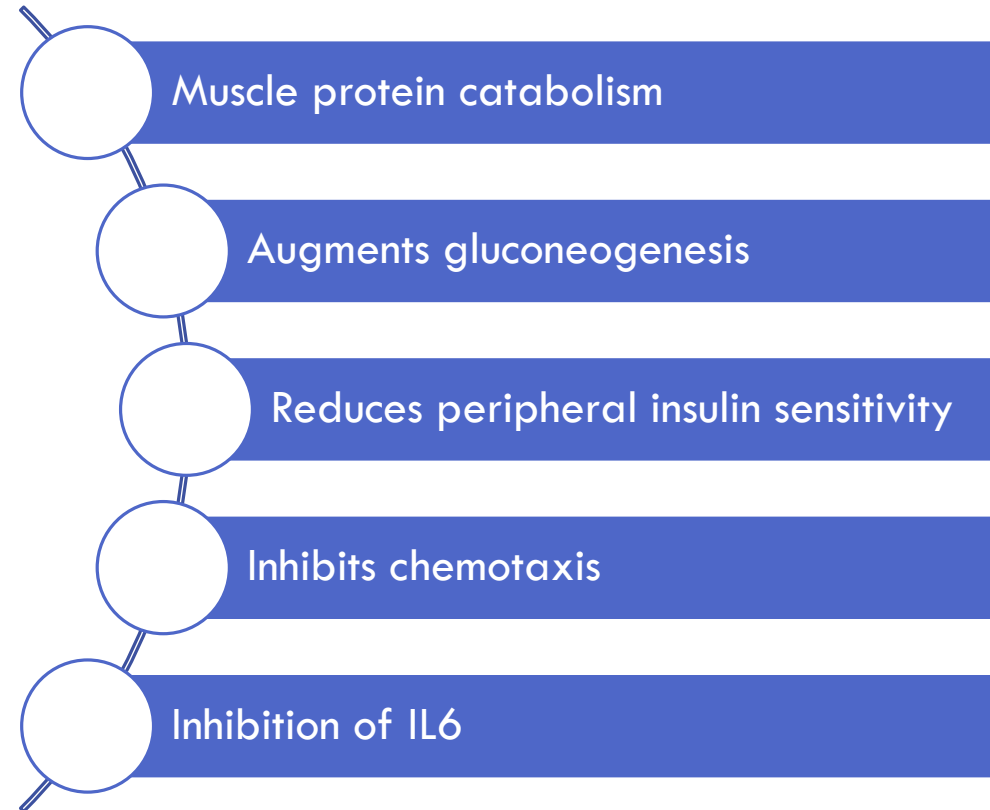
Normal cortisol production = 25-30mg/day (adult). Major surgery = 150mg/day

$T_{1/2} = 90\text{min}$

Peak values are achieved 4-6h after surgery

May persist for up to 72h : magnitude and duration dependent on degree of trauma

Loss of normal physiological response : ACTH no longer inhibits cortisol response



GROWTH HORMONE & INSULIN LIKE GROWTH FACTOR

Growth hormone normally stimulates intermediary production in the liver and muscle

These are the *insulin like growth factors* (aka *somatomedins*)

Stimulates protein synthesis and inhibits breakdown

Stimulates lipolysis

Enhances glycogenolysis

Peripheral insulin resistance

INSULIN

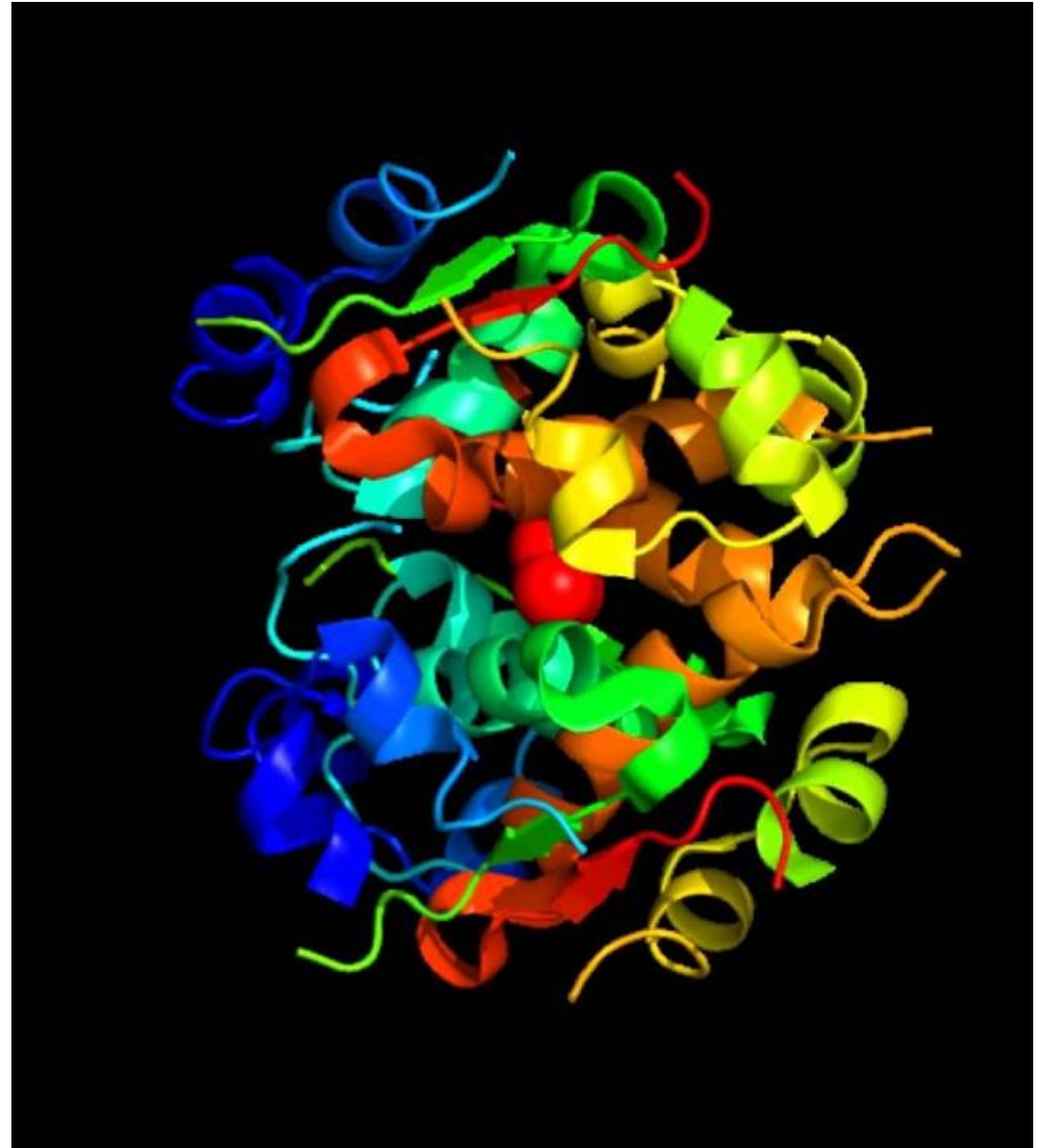
Secreted by beta cells of the pancreas

The key hormone of anabolism : released in response to increased blood glucose and amino acids

Promotes uptake of glucose and fatty acids into muscle liver and adipose tissue

Inhibits glycogen breakdown and the formation of new glucose

Implicated as a major component of the maladaptation to the stress response



INSULIN

During stress response:

- failure of secretion in response to circulating glucose
- α_2 adrenergic inhibition of secretion
- Suppression by volatile agents (all)

Resultant hyperglycaemia : not as simple as peripheral insulin resistance

THYROID HORMONES

Innately linked to the sympathoadrenal response

Increased sympathoadrenal activity = increased secretion

Increased sensitisation of tissues to effects of thyroid hormone

However

This increase is very limited

Suppressed by cortisol

?limit metabolic rate in time of stress

CYTOKINES

Low molecular weight glycoproteins

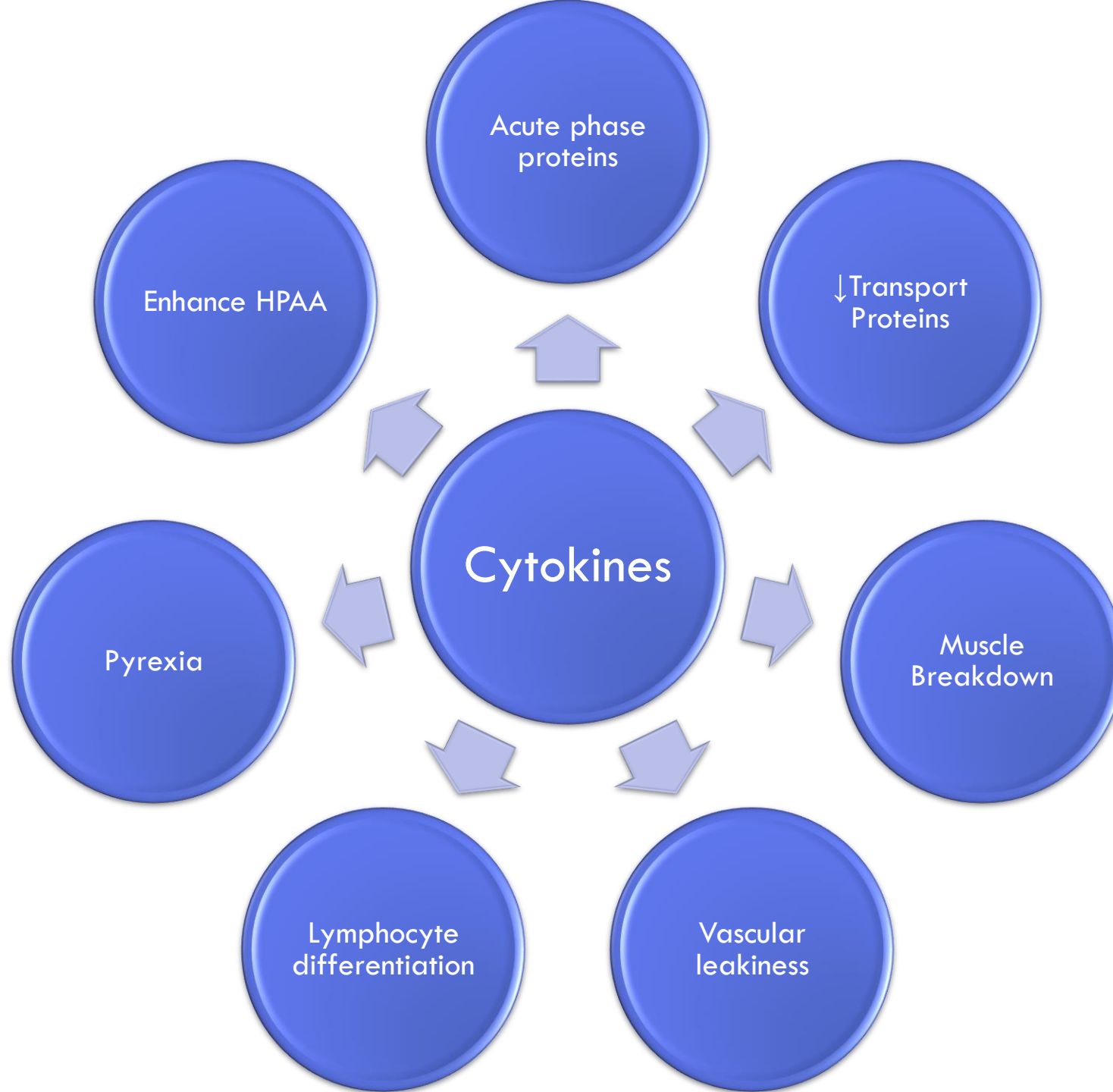
Made by immunocompetent cells in response to trauma

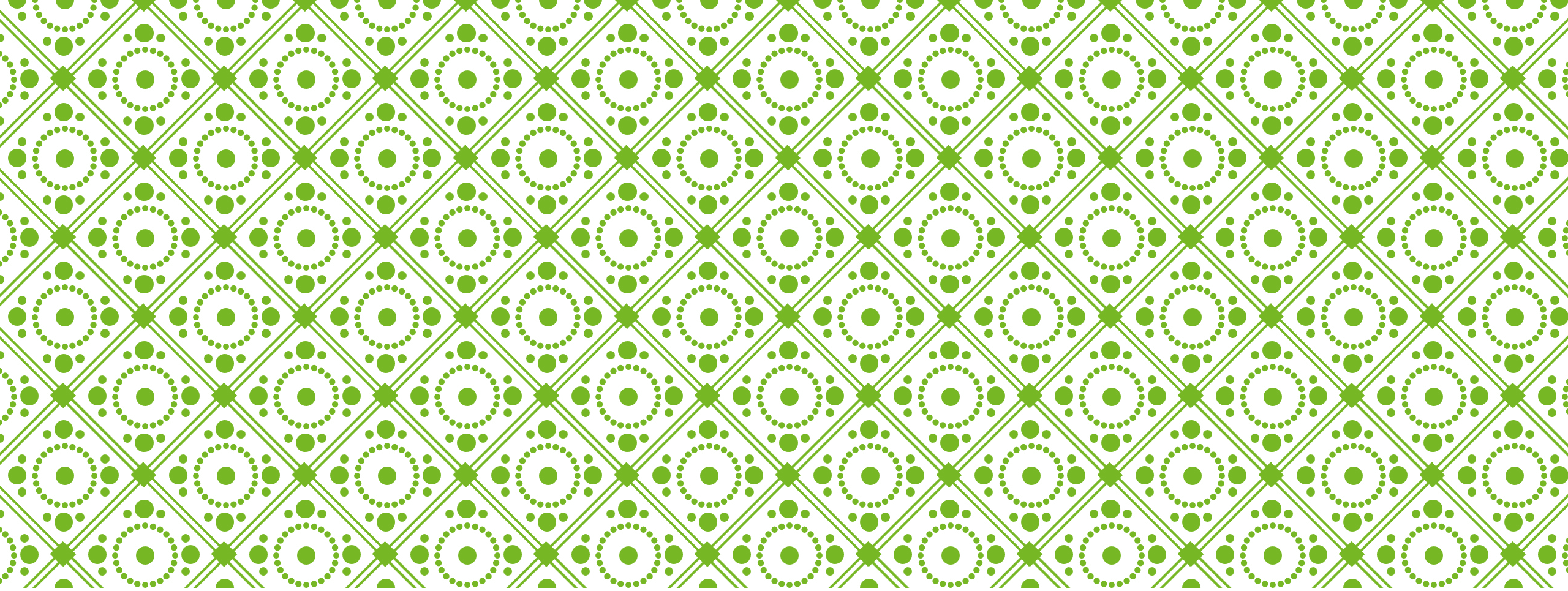
Purpose : isolate and destroy organisms. Enhance immunocompetent activity. Activate healing. Mark cells for death.

Activation of acute phase response

IL6 considered most important cytokine : release α trauma

Cytokines co-ordinate the neuroendocrine response to trauma





CONSEQUENCES





Hyperglycaemia

Protein catabolism

Water retention and urinary concentration

Fatigue & Malaise

ATTENUATION

IV induction agents

Etomidate : inhibits 11β hydroxylase.
May last 8-12h after dose.

Vogue for use in ill patients?

How much cortisol do you really need?

RCT anyone?

Opioids

Opiates inhibit the HPA

Mediated by the hypothalamus

Dose of 50-100mcg/kg needed for effect

ATTENUATION

Regional

Afferent blockade reduces overall CNS input

Does not abolish cytokine input

Psychological improvement and patient wellbeing

NSAIDS

Part of multimodal analgesia strategy

Frequently overlooked

Very limited evidence (apparently) demonstrating benefit intra/post op

Most ideal as premed

ATTENUATION

Minimally invasive surgery

Reduces overall trauma burden

Biochemical reduction in IL6 and CRP :
less acute phase response

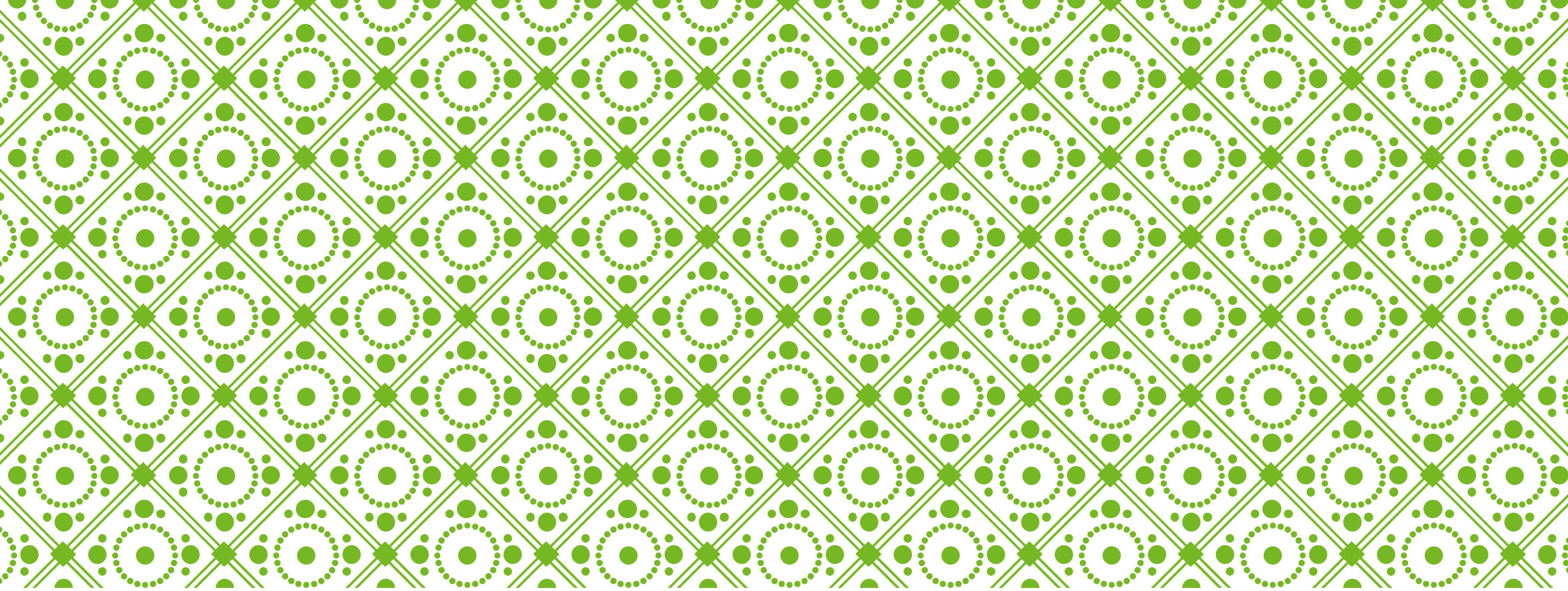
No change in cortisol and
catecholamines

Certain surgeries = survival benefit, e.g.
colectomy

Alpha 2 agonists

Act centrally and reduce sympathetic
outflow

Adverse effects re: hypotension and
sedation



ENHANCED RECOVERY



ENHANCED RECOVERY PROTOCOLS

“A combination of therapies, delivered by a multidisciplinary team to minimise physiological disturbance, permit earlier mobilisation and to promote discharge from hospital and return to normal function after inpatient elective surgery”

Benefits

Less inpatient hospitalisation

Earlier return to work

Increased financial tariff

Lower readmission rates

Reduced complication incidence

BACKGROUND

Not a new concept

“Fast track surgery” Kehlet 1990s

Pinnacle example : 23hour elective colorectal resections

Now has a worldwide society ERAS

Recently published (2019) guidelines for colorectal surgery - ?exam question

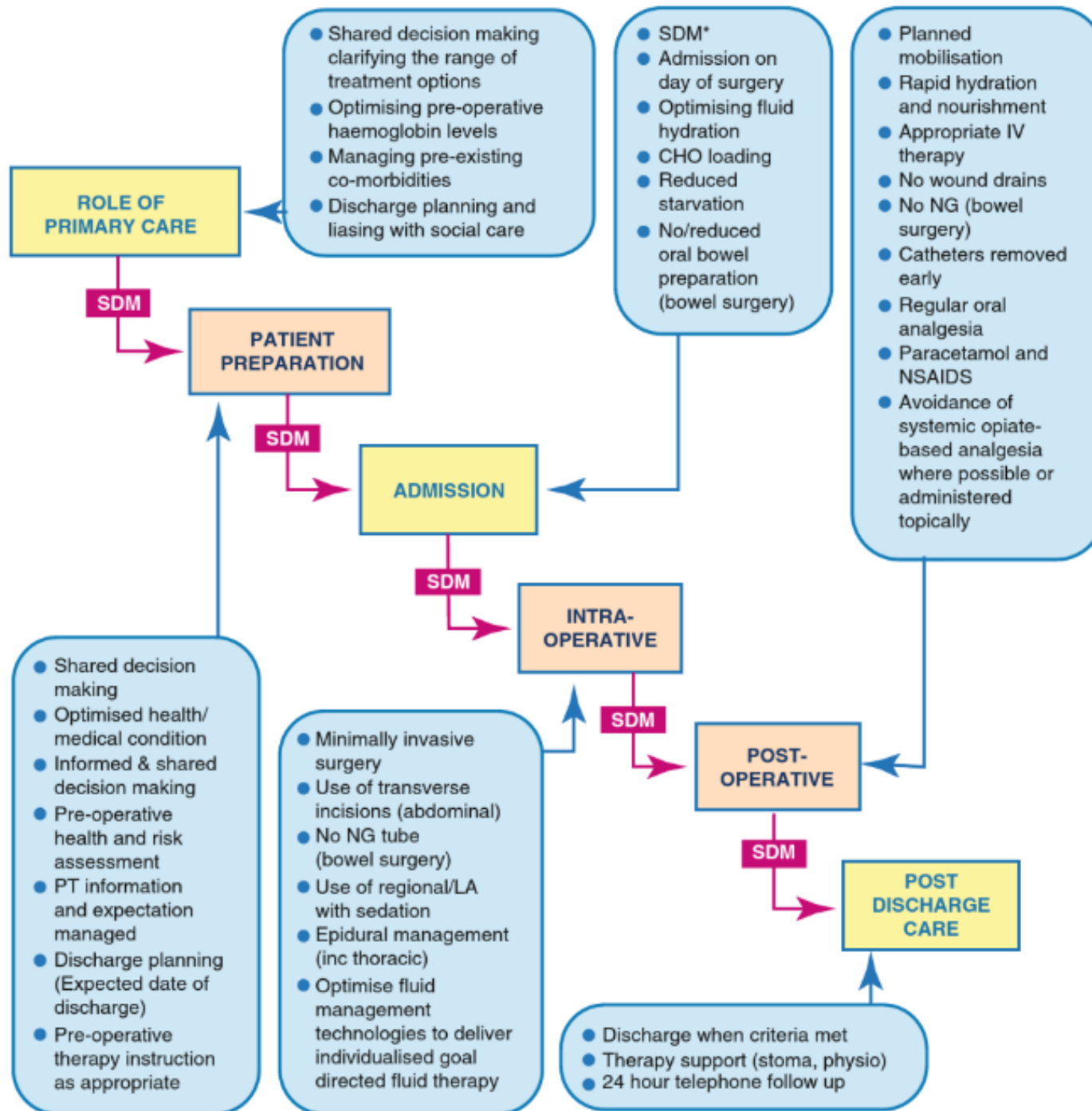
PRINCIPLES

Patient focussed protocol

Named anaesthetic / speciality lead

Usually a lengthy multistep process

Sum of individual parts



ANAESTHETIC CONSIDERATIONS

Quite variable depending on type of surgery

Recurrent (and pivotal) themes:

1. Fluid balance
2. Analgesia

FLUID BALANCE

Patients should receive balance crystalloid

Fluid therapy should be goal directed

- Evidence based benefit e.g. restrictive vs liberal fluid strategies

IVI should be discontinued ASAP

Oral intake should be encouraged early

ANALGESIA

Multimodal analgesia strategy

Avoidance of opiates

Use of regional techniques to facilitate opioid sparing

- “Bruges protocol”

Epidural analgesia debateable

1. Consider premedication: *Clonidine (Catapressan) 150 ug* or *Gabapentine (Lyrica) 150 – 300 mg po*

Before beginning of anesthesia prepare:

1. "The Dexdor load" - 5 cc syringe with 5 ml *Dexmedetomidine 4 ug/ml*

2. "The induction & maintenance mixture" - 50 cc syringe containing:

50 ug *Dexmedetomidine (Dexdor)* (0,5 cc of standard 100 ug/ml solution or 12,5 cc from 4ug/ml solution.)

50 mg *Ketamine (Ketalar)* (or 25 mg *S-Ketamine*)

500 mg *Lidocaine (Linisol)* (25 ml of standard 2% solution)

NaCl up to total 50 ml

2. Pre induction loading:

Start with "The Dexdor load" syringe direct after iv line is placed and patient has been connected to Standard monitoring latest 10 min before induction.

Give iv 0,25 ug/kg *Dexmedetomidine* (max 20 ug) (age dependent)

3. Induction:

Dexmedetomidine 0,1 ug/kg

Lidocaine 1 mg/kg

Ketamine 0,1 mg/kg

= 1ml/10kg of solution from "The induction & maintenance mixture" syringe

Continue induction with *Propofol*.

If NMB is needed give *Rocuronium* and measure TOF/PTC

Consider *Dexamethasone* 10 mg; *Droperidol* 0,625 – 1,25 mg, *Magnesium* 40 mg/kg (~2,5 g)

4. Continue maintenance of anesthesia with:

Dexmedetomidine 0,1 ug/kg/h

Lidocaine 1 mg/kg/h

Ketamine 0,1 mg/kg/h

= 1ml/10kg/h of solution from "The induction & maintenance mixture" syringe

+ *Sevoflurane* or *propofol* infusion as usual

About 15 min before the end of the operation reduce maintenance dose to 0,5 ml/kg/h.

5. Provide anti nociception in PACU:

Continue infusion at 0,5 ml/kg/h until it ends or until patient discharge from PACU

Dexmedetomidine 0,05 ug/kg/h

Lidocaine 0,5 mg/kg/h

Ketamine 0,05mg/kg/h

= 0,5 ml/10kg/h of solution from "The induction & maintenance mixture" syringe

6. Analgesia after PACU (intensive care, ward, day clinic, home)

Oral analgesics – iv analgesics – PCIA pumps

Paracetamol iv - po

NSAIDs iv - po

OFAMixture iv fixed pump rate 0,5 ml/10kg/h if needed patient controlled bolus of 1 ml (lockout 15 min)

Morphine iv – po - sl as rescue

OTHER BITS

Ideal anaesthetic technique to prevent prolonged neurological obtundation

Multimodal anti emesis (r/c Apfel score)

Maintenance of normothermia (r/c effects of GA on HPA temp regulation)

Normoxia

Normocarbida

“SSI bundle” including antibiotic prophylaxis

Regular audit

Responsible anaesthetic service lead

THE END

Almost certain that a component of this will come up in the written / SOE

Vogue for anything that will free up a bed

Day case surgery now encompasses 75% of all surgical work UK wide