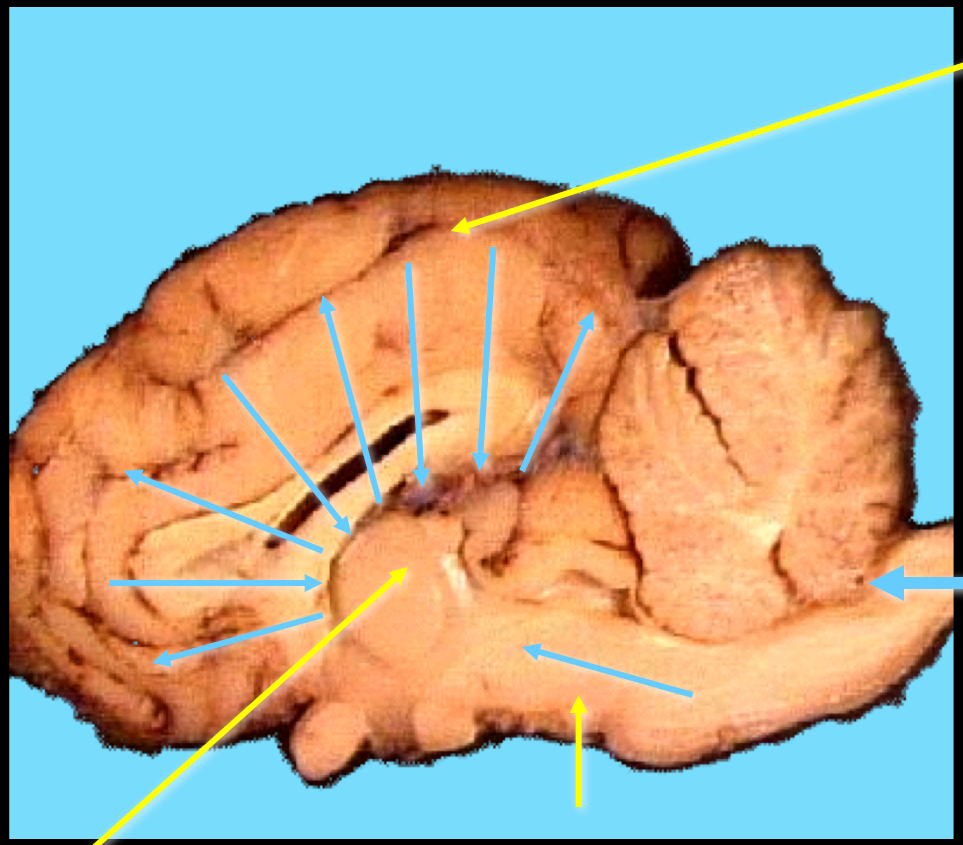
# Transfer of information to the CNS

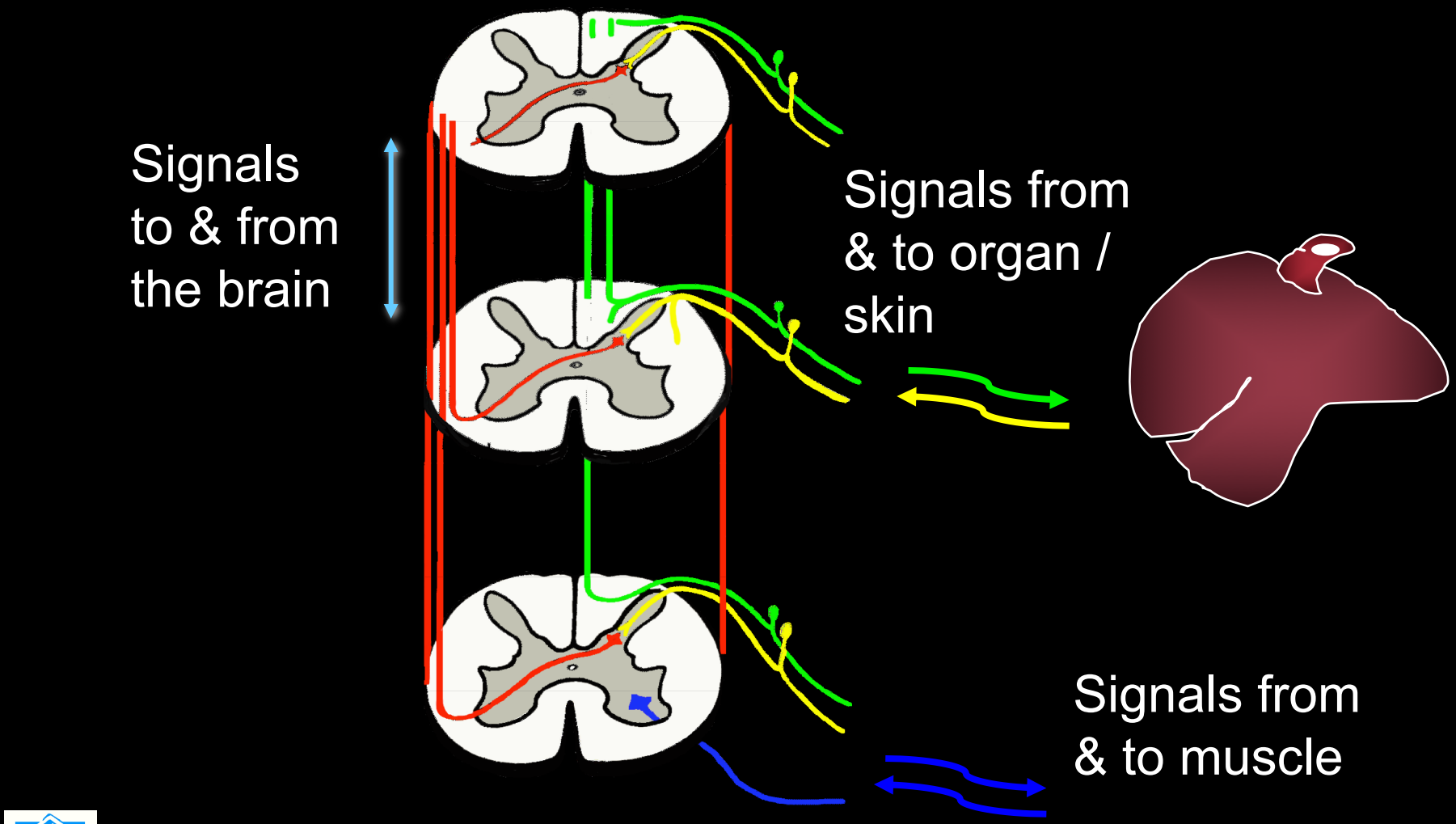
Sensation = Conscious experience
Somatosensory (including pain), vision, hearing

Unconscious experience (physiological)
Evoked responses (somatosensory, visual, auditory)

# Transfer of information between viscera and CNS



# Transfer of information between viscera and CNS



# Parameters used in assessment of stress

Stress = Response to a stressor

## Behavioural responses:

- Escape
- Restlessness
- Aggression
- Fighting
- Stereotypic behaviour
- Tonic Immobility

## Physiological responses:

Cardiovascular

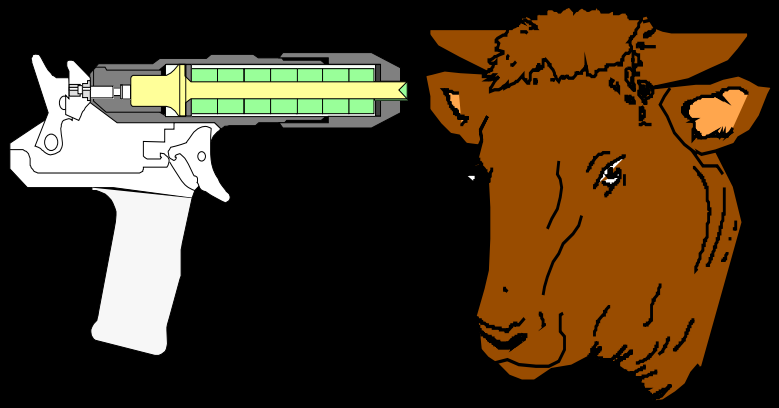
- Heart rate, BP

Indicators in blood

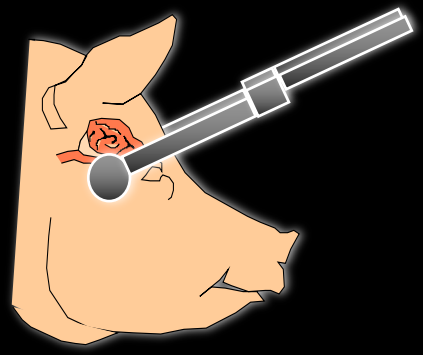
- PCV (packed cells vo
- Cortisol
- ß-endorphin

# Stunning methods

## Mechanical Stunning



## Electrical Stunning



## Gas Stunning

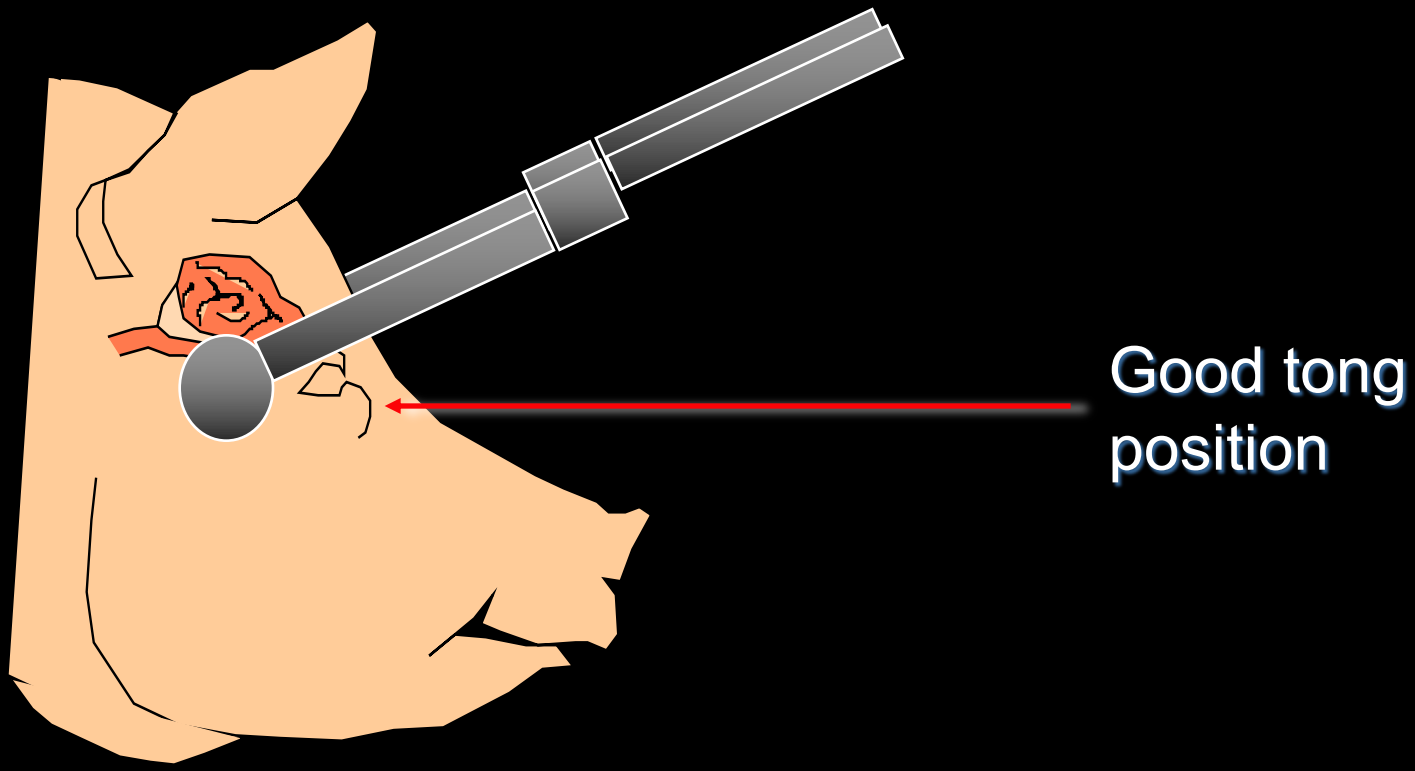
# The aim of stunning

"The purpose of any method of stunning is to render the animal immediately unconscious until it is dead"

*- The Welfare of Animals (Slaughter or Killing) Regulations 1995*

# Primary aim of electrical stunning

Electrical stunning is aimed at producing..... EPILEPSY



# The physiology of epilepsy

## How and why do nerve cells communicate ?

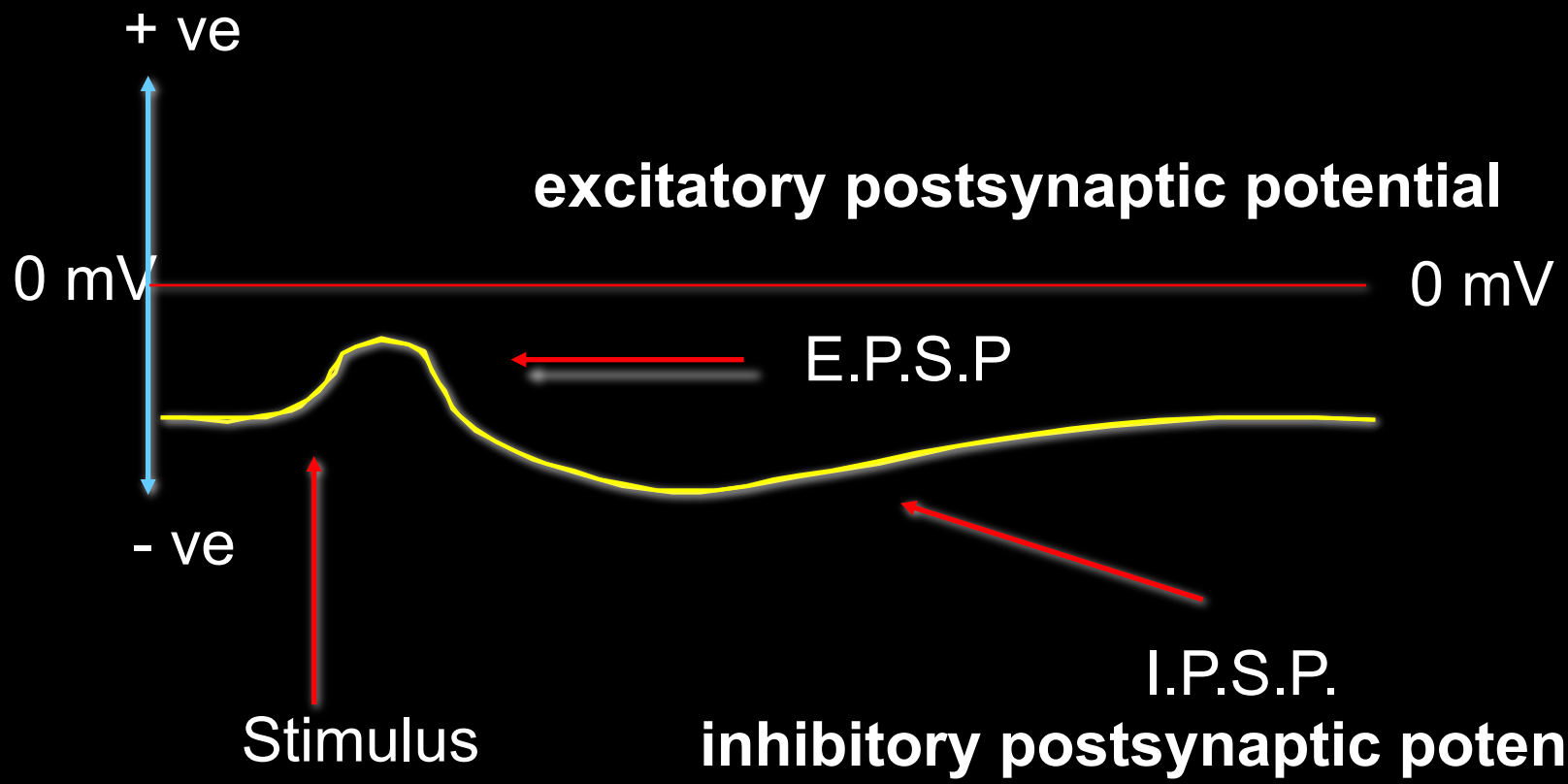
- Electrical stunning throws the brain into a state of confusion

- This ‘confused state’ is the condition in which the animal
  cannot feel pain, i.e. THE STUN HAS BEEN EFFECTIVE !

- In time, the brain will ‘stabilise’ once more, at which point the
  animal is thought to be capable of feeling pain again.

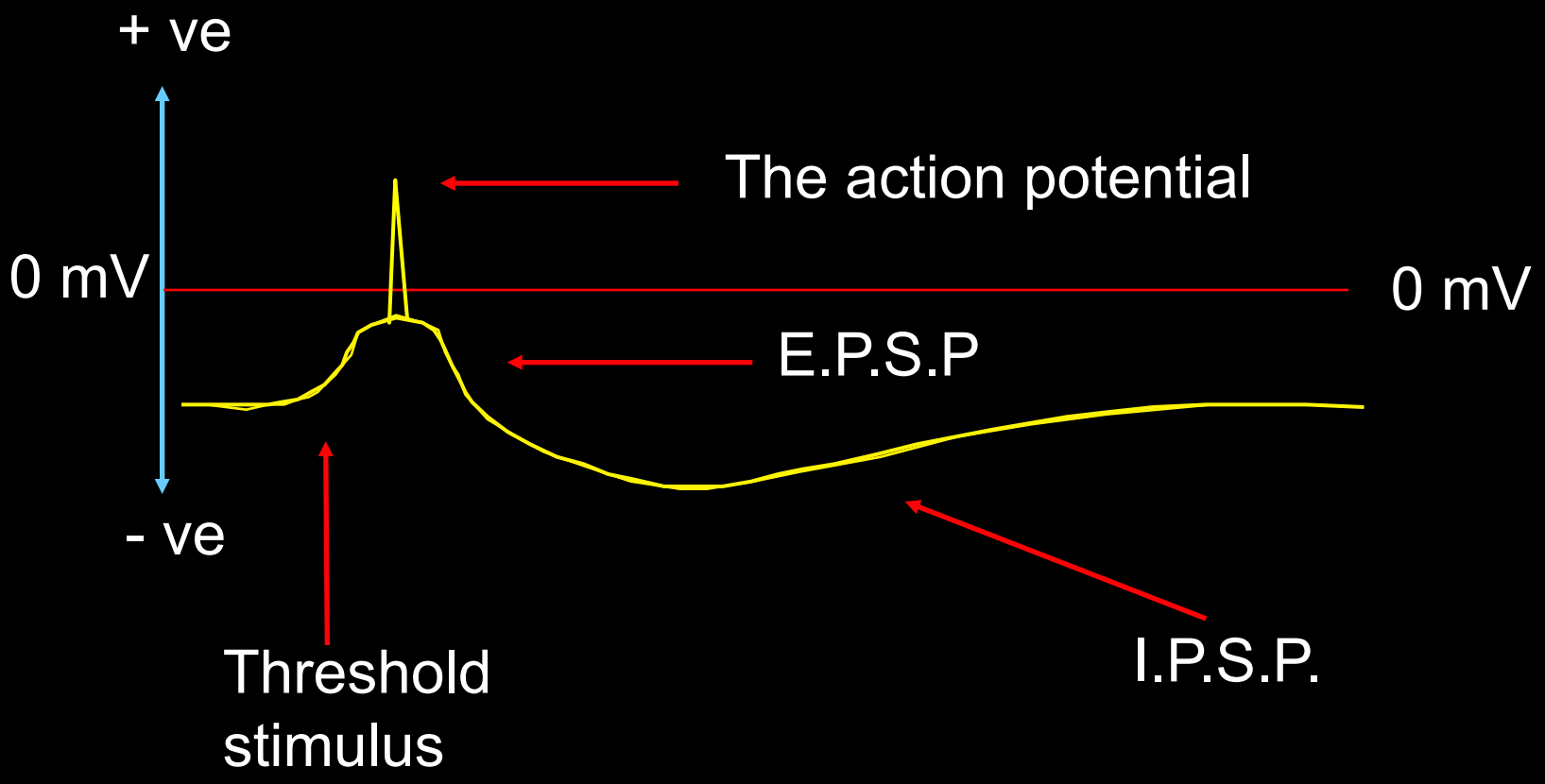
# The physiology of epilepsy

## The electrical activity of a neuron



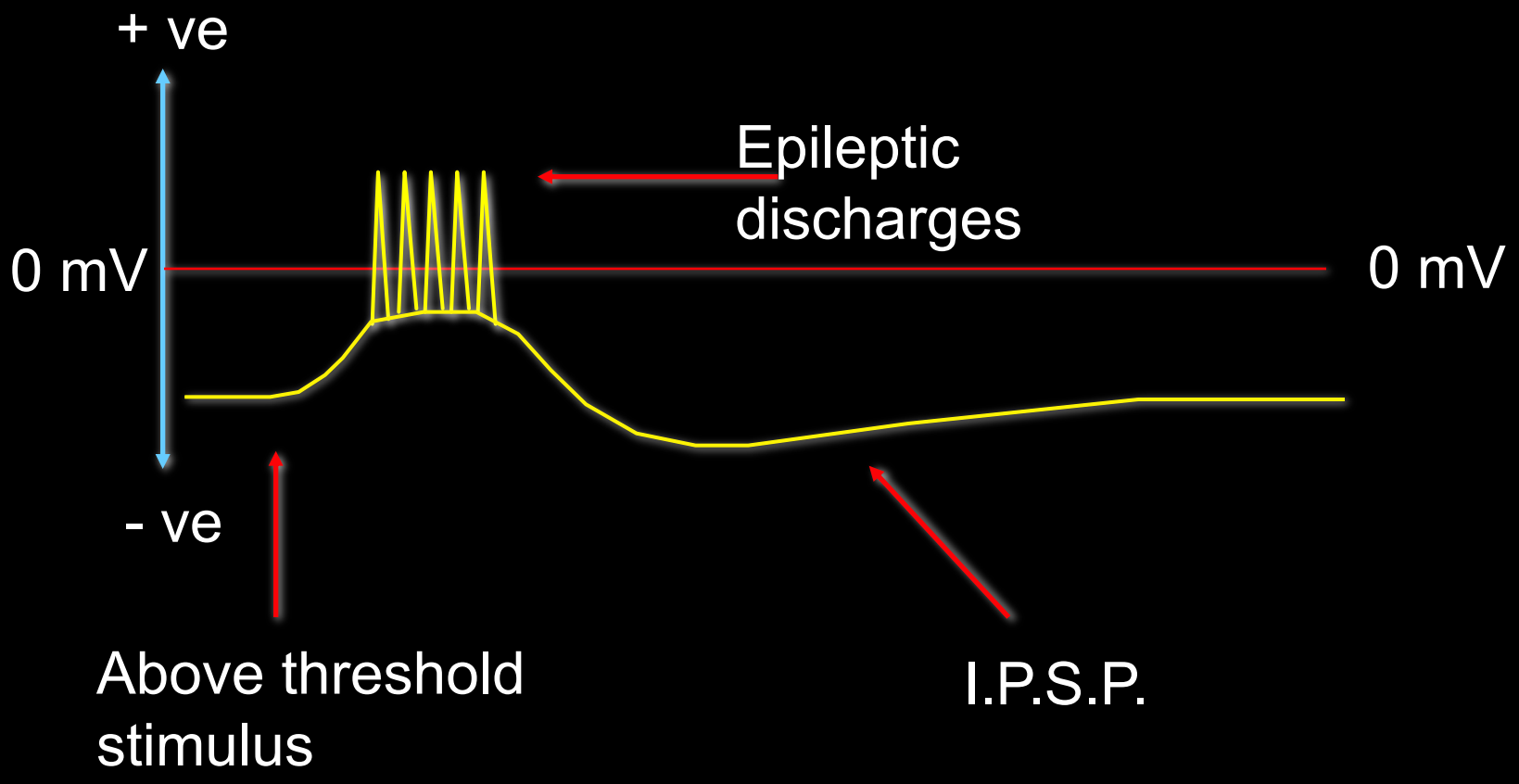
# The physiology of epilepsy

## The electrical activity of a neuron



# The physiology of epilepsy

## The electrical activity of a neuron



# 50 Hz stunning

## Phases

Tonic
( rigid )

Clonic
( kicking )

Quiescent
( relaxed )

Effects

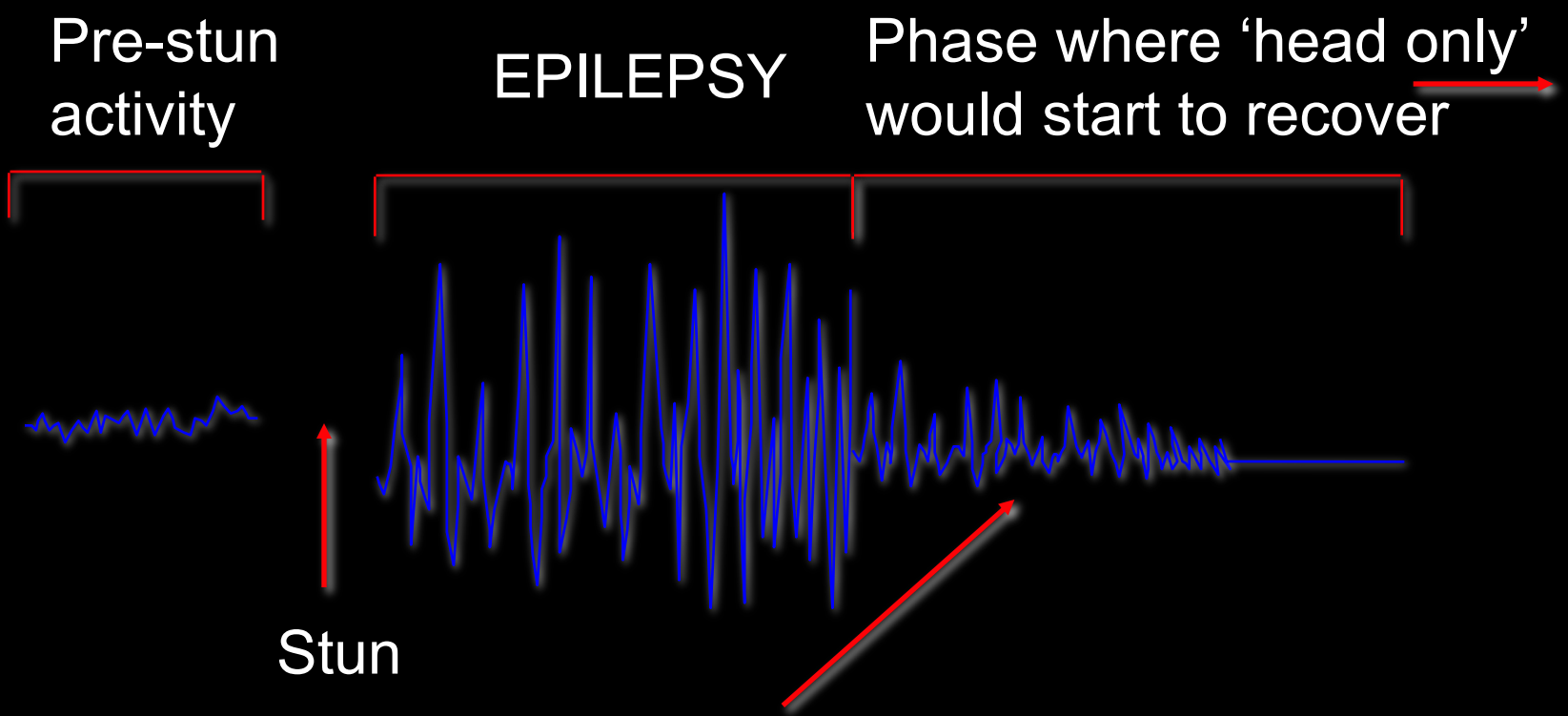
1) Breathing inhibited
2) Excessive salivation
3) Uncontrollable involuntary motor (physical) activity
4) Unconsciousness

# 50 Hz stunning

## Recovery / return of reflexes

- Return of breathing
- Then the feeling of pain - can respond to painful stimuli ( e.g. pin prick )
- Lastly able to recognise own surroundings
- Able to a stand up
- Defensive behaviour

# Effect of Head-to-back stunning on the time to loss of brain responsiveness




Because head-to-back stunning stops the heart ( cardiac arrest ), the chance of recovery is abolished and brain activity decays rapidly.

# Captive bolt stunning

## Aim : Disruption of brain activity by concussion

- Types of guns

  - Penetrating :

-blank cartridge, air injected bolt, air injected bolt with air injection
-- free bullet ( horses )

  - Non - penetrating ( blow to head ) :

- Mushroom head gun, cash knocker ( religious slaughter )

# Factors that determine captive bolt stunning

1. Hitting the right target area
2. Bolt velocity
3. Impact
4. Amount of energy
5. Penetration
6. Bolt diameter
7. Tissue damage

## Energy - Kinetic energy

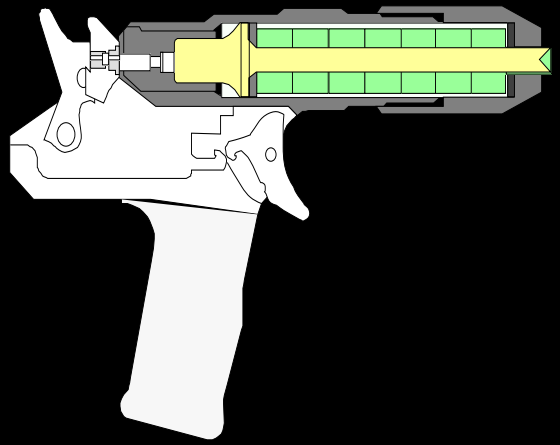
Energy - $^1/_2\ mv^2$ where m = mass, size of bolt & v = bolt velocity

More important than penetration

That is the reason why non penetrative stunning guns are as effective - Because impact imparts energy into head - hence effective stun.

# Shooting position in cattle

The intersection point of the imaginary lines from the top ridge of the eyes to the top of the horn buds.



With horned animals, aim slightly higher ( as shown above )

# Captive bolt stunning

## Signs of an effective captive bolt stun

- Animal collapses
- Eyes fixed
- No corneal reflex
- No rhythmic breathing,
  but heart does not stop for sometime

## Signs of an ineffective captive bolt stun

- Attempts to raise head and stand up
- Eyes rolled down
- Positive corneal reflex
- Rhythmic breathing

# Shooting position in sheep

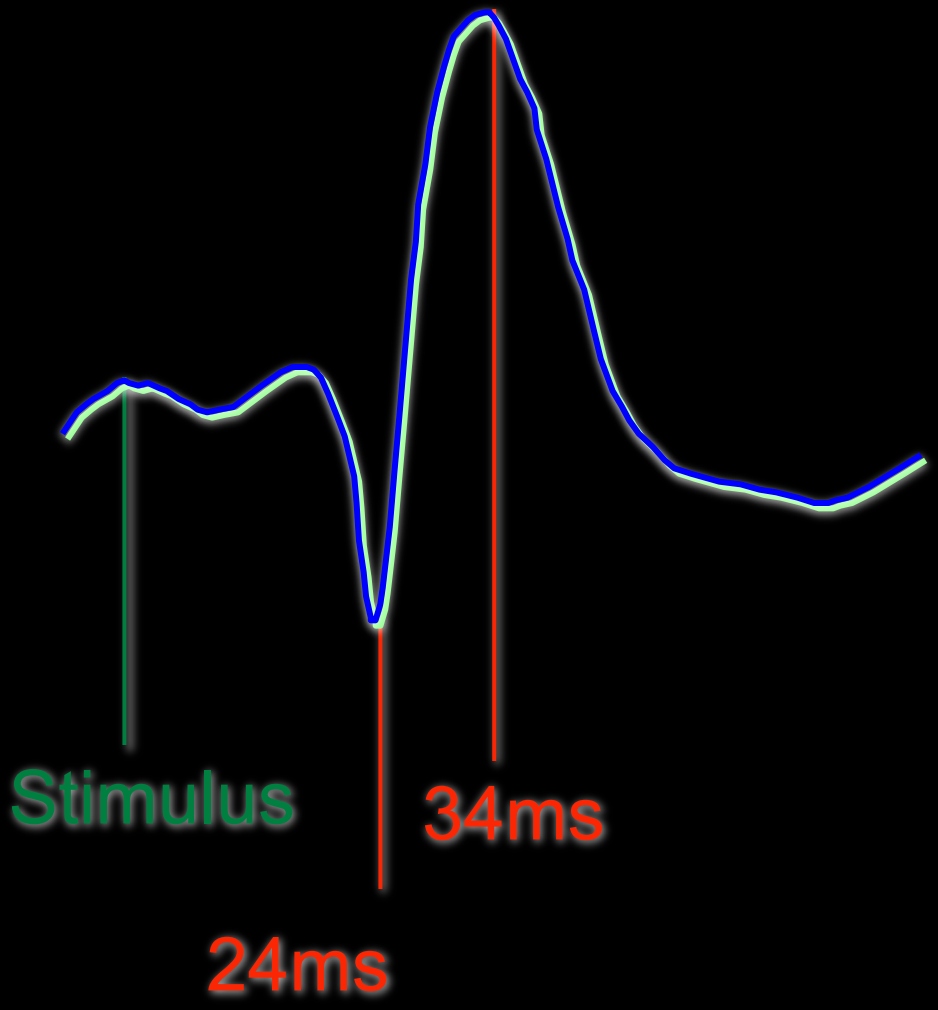
## Hornless sheep

Highest point of head & aim towards angle of jaw

## Horned sheep

Place muzzle just behind the ridge which runs between the horns & aim towards the mouth

# Typical evoked potential waveform



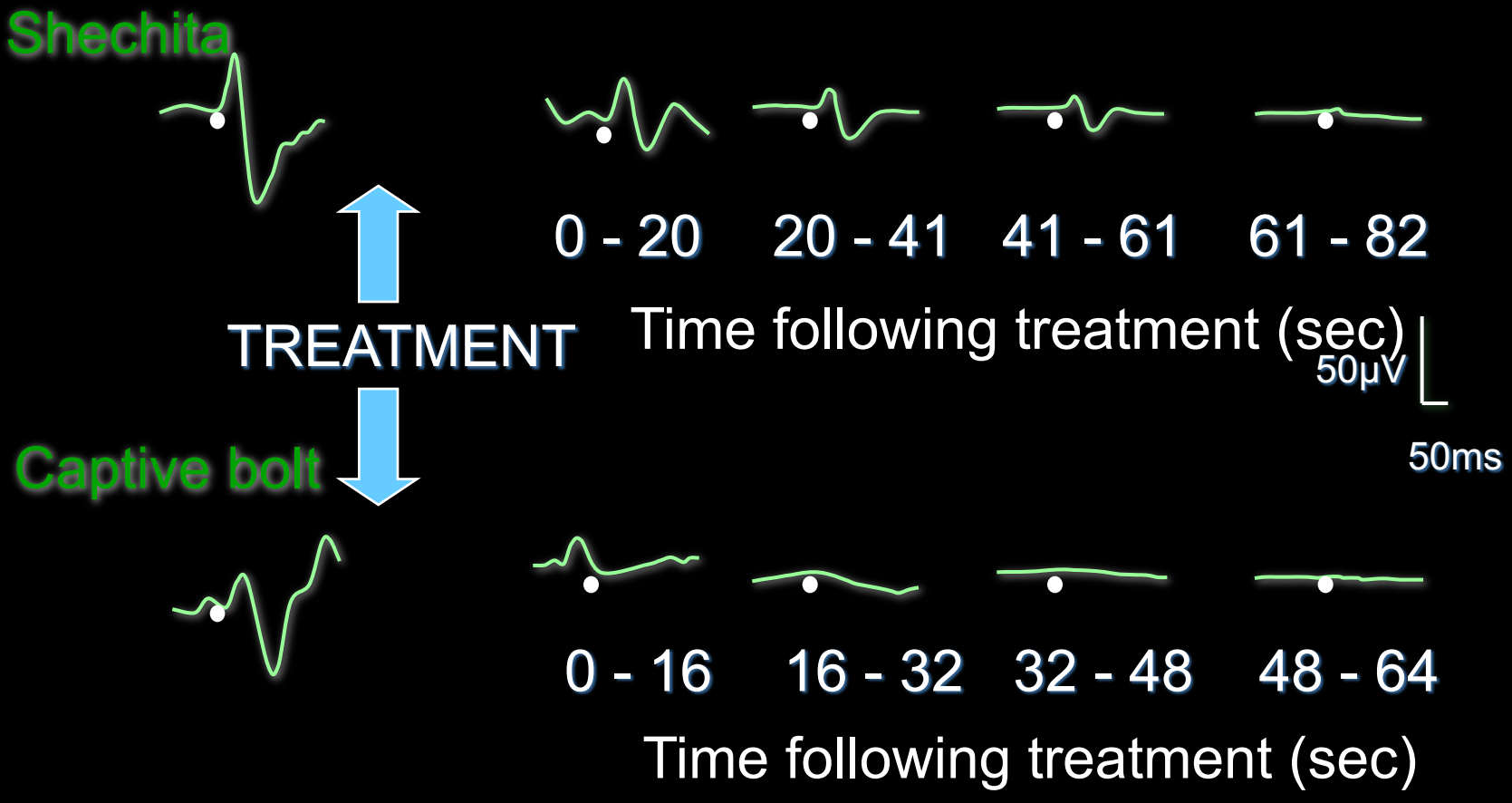
# Effect of Shechita slaughter on evoked responses

Potenziali (o risposta) evocati sensoriali


Potenziali evocati visivi

Daly *et al* (1988)

# Comparison of slaughter methods
# - visual evoked responses in cattle-



# Gas Stunning

Methods :

1) $CO_2$
2) Alternative gas mixtures - e.g. Argon and Oxygen

Mode of action of $CO_2$ :

- Acidic and anaesthetic
- Inhalation and carried by blood
- Reaches spinal cord and brain
- Fall in pH in CSF
- Anaesthesia

# Research into stunning methods

- Electrical Stunning :

  Mechanism of action during induction
  Physiological basis
  Effects on chemicals in the brain

  Problem areas :
    - Repeat application
    - Incorrect position
    - Long stun-to-stick intervals
    - Carcass quality

# Research into stunning methods

- Captive bolt stunning
  - Problem areas :
    - Shooting positions in cattle
    - Sows and boars
    - Possible contamination

- Gas stunning :
  - Problem areas :
    - $CO_2$ - Induction phase - breathlessness ? - distress ?
    - Other mixtures - Carcass convulsions ?

# Novel stunning methods

Objectives :

- No possible pain or distress during induction
- No adverse effects on carcass and meat quality
- Ease of application
- Universal acceptance
- TMS ?

# Religious slaughter and animal welfare

# The aim of stunning

“The purpose of any method of stunning is to render the animal immediately unconscious until it is dead”

*- The Welfare of Animals (Slaughter or Killing) Regulations 1995*

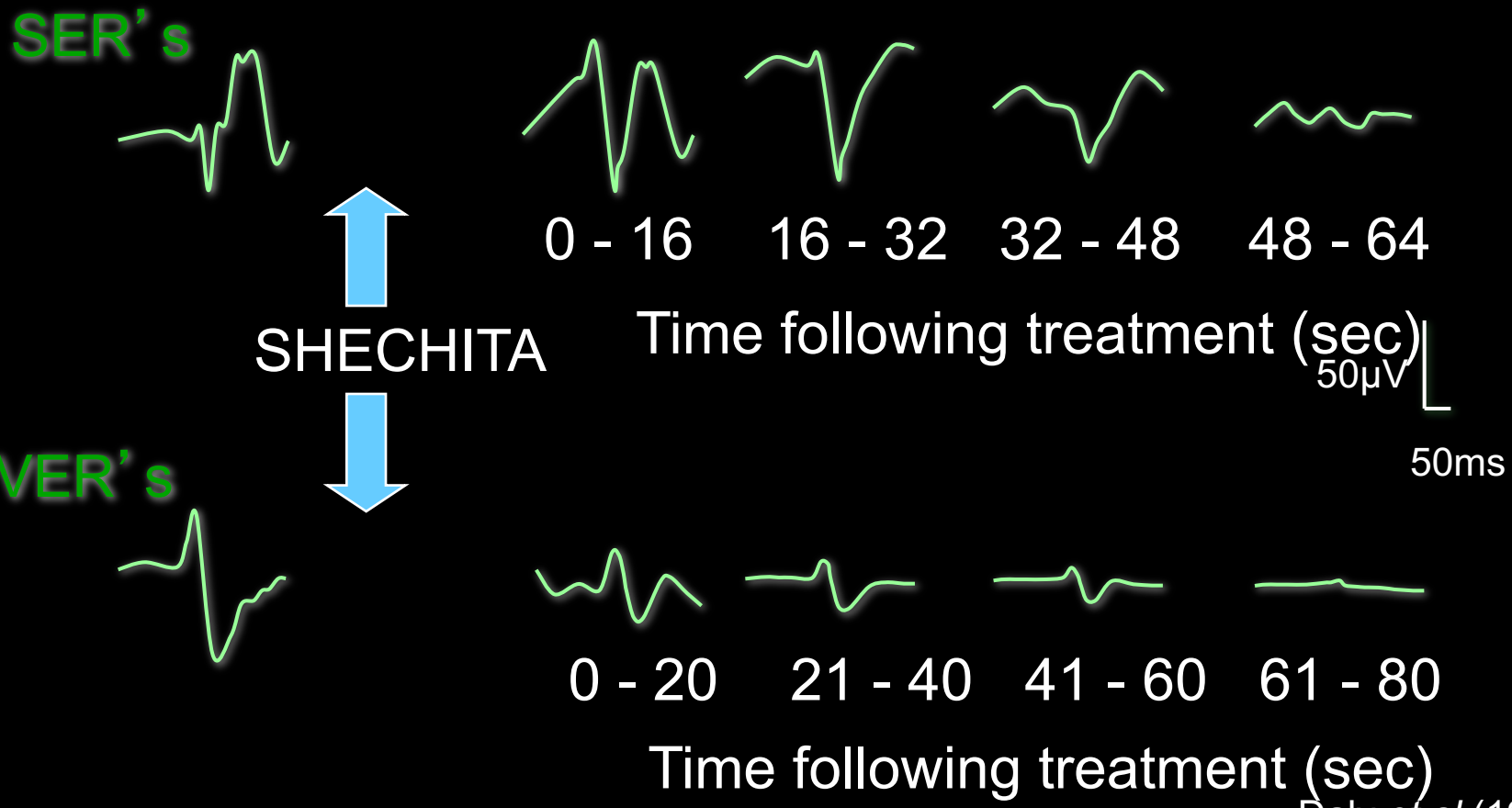
# Concerns about religious slaughter

1) Is preslaughter handling stressful ?

2) Is exsanguination cut painful during severance and /or afterwards?

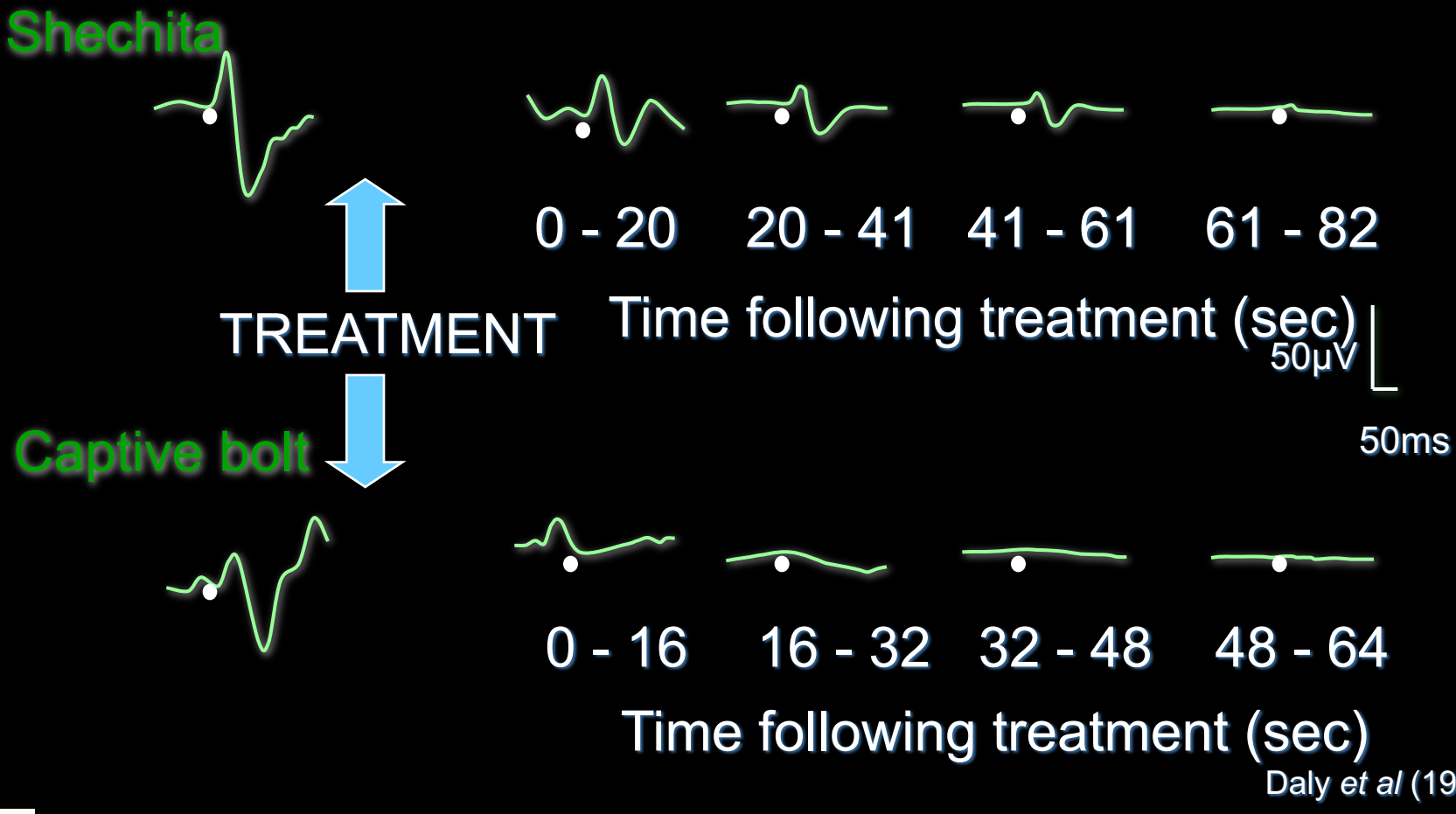
3) How long does it take before brain function is lost ?

# Effect of Shechita slaughter on evoked respo




Daly *et al* (1988)

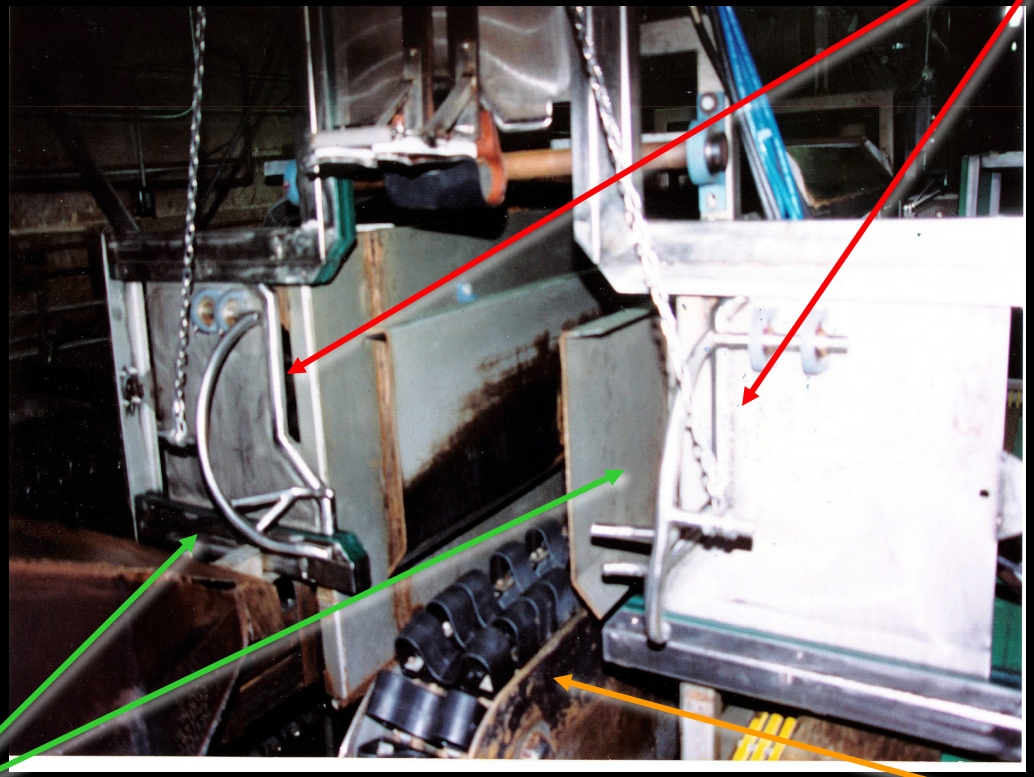
# Comparison of slaughter methods - visual evoked responses in cattle-




Daly *et al* (1988)

# Stunning restraining conveyor for cattle

View from front



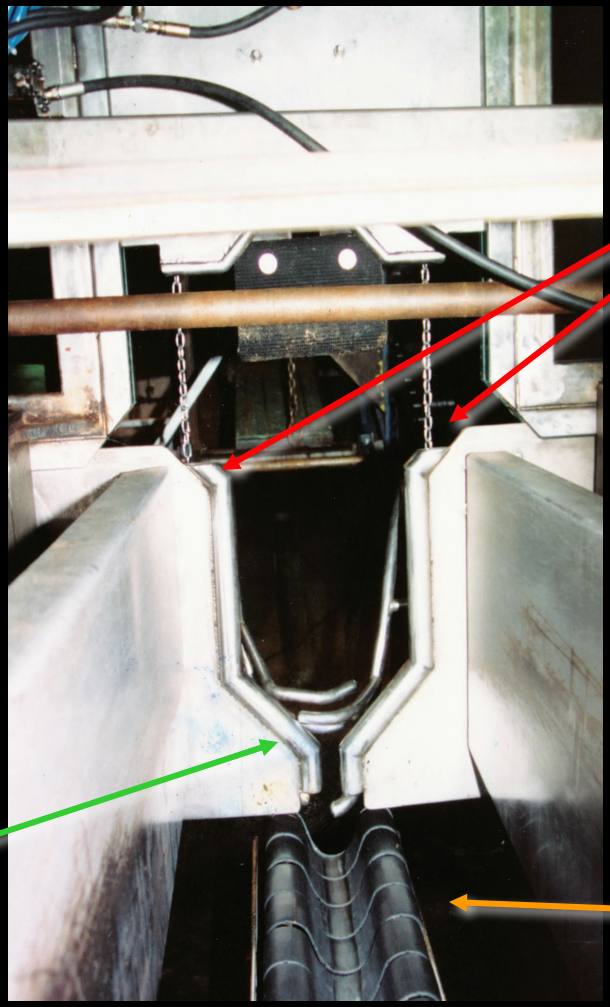
Neck restraint

Chin lift

Monorail

# Stunning restraining conveyor for cattle

View from inside



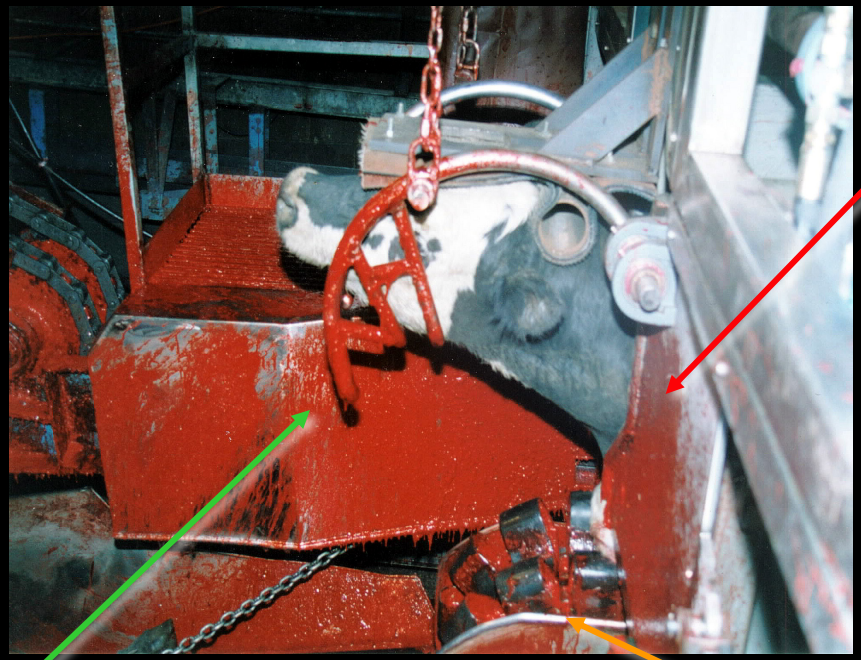
Neck restraint

Chin lift

Monorail

# Stunning restraining conveyor for cattle

View from front



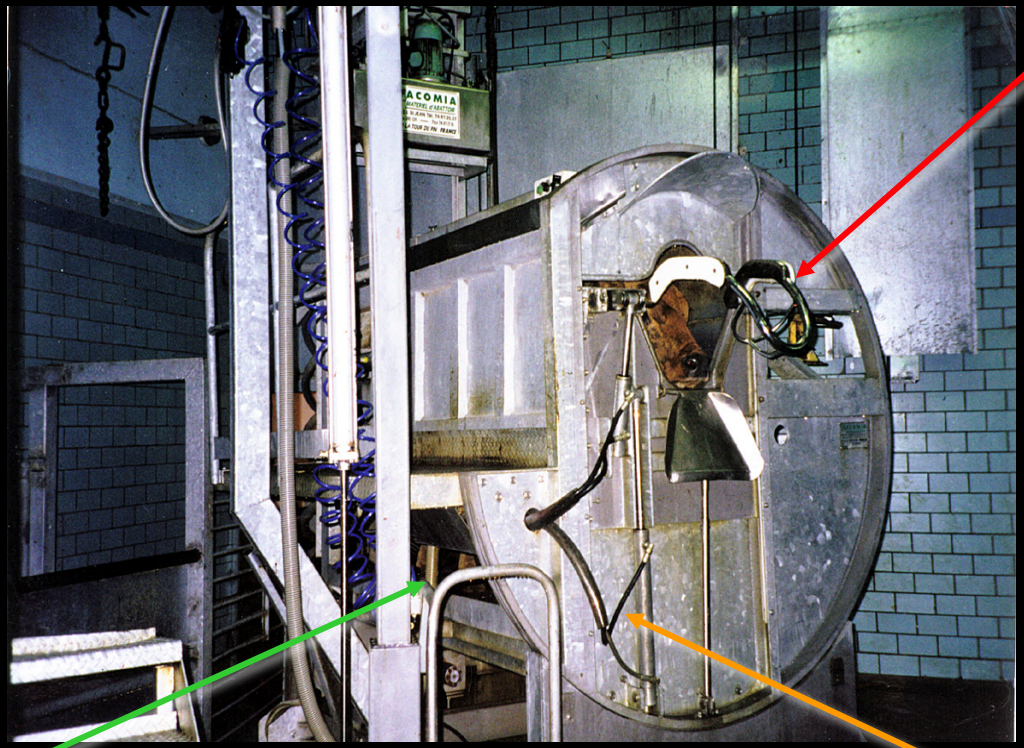
Neck restraint

Chin lift

Monorail

# Facomia restraining pen for cattle

View from front




Chin lift

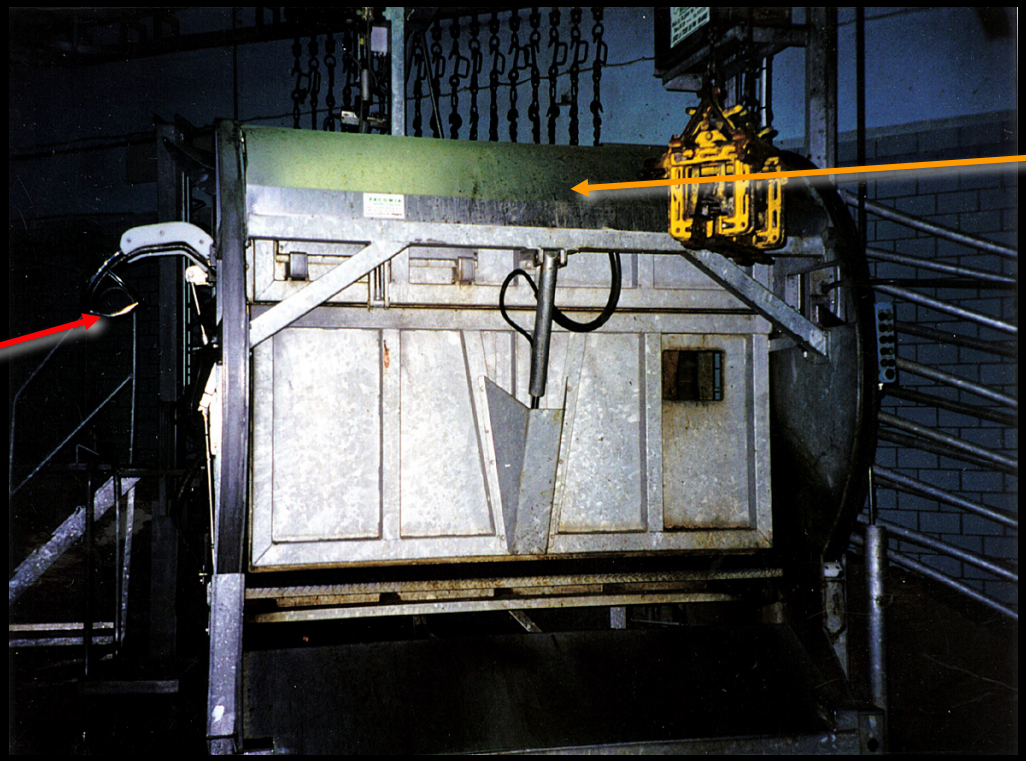
Belly lift

Rotating pen

# Facomia restraining pen for cattle

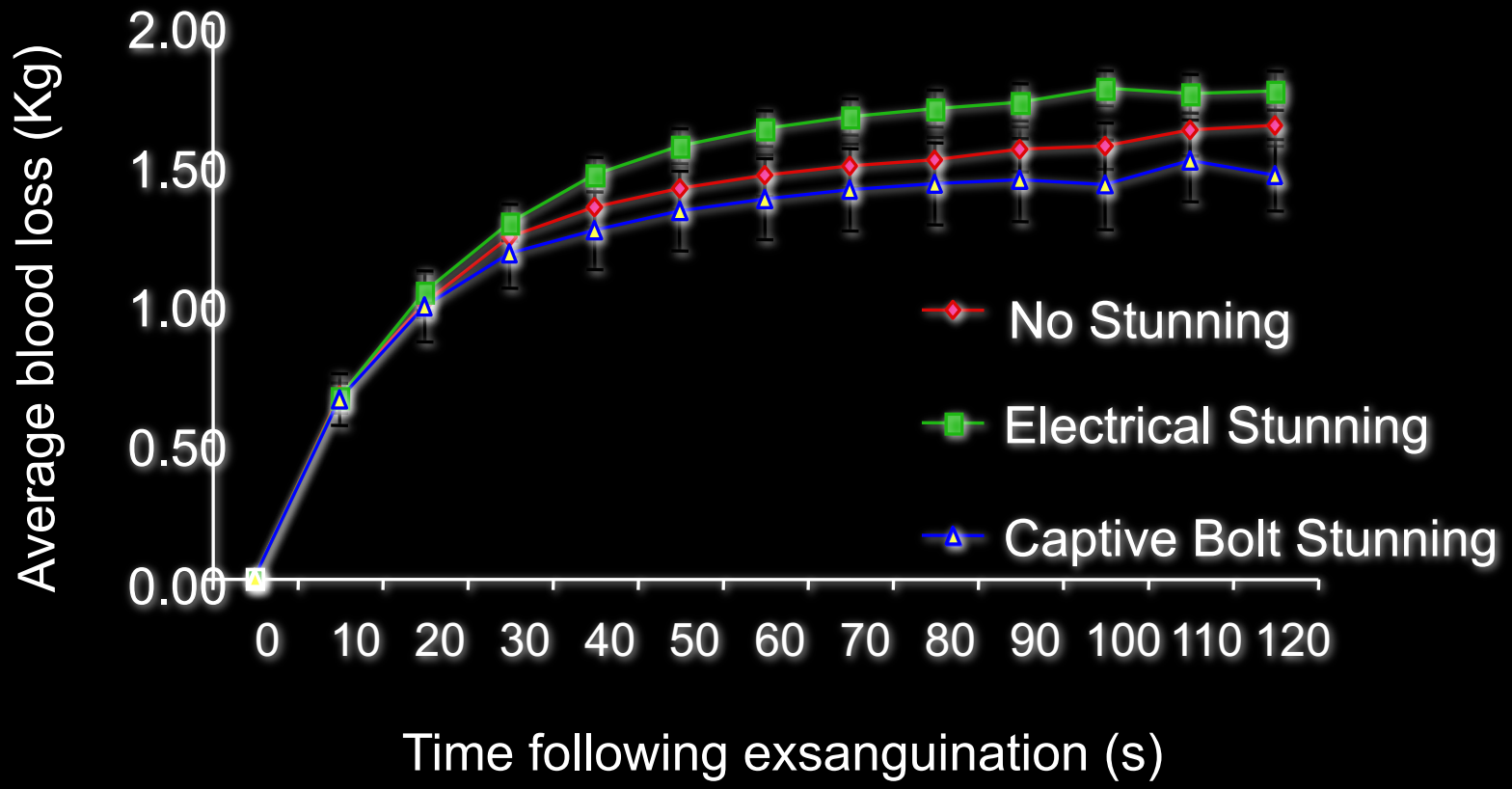
View from Side

Chin lift

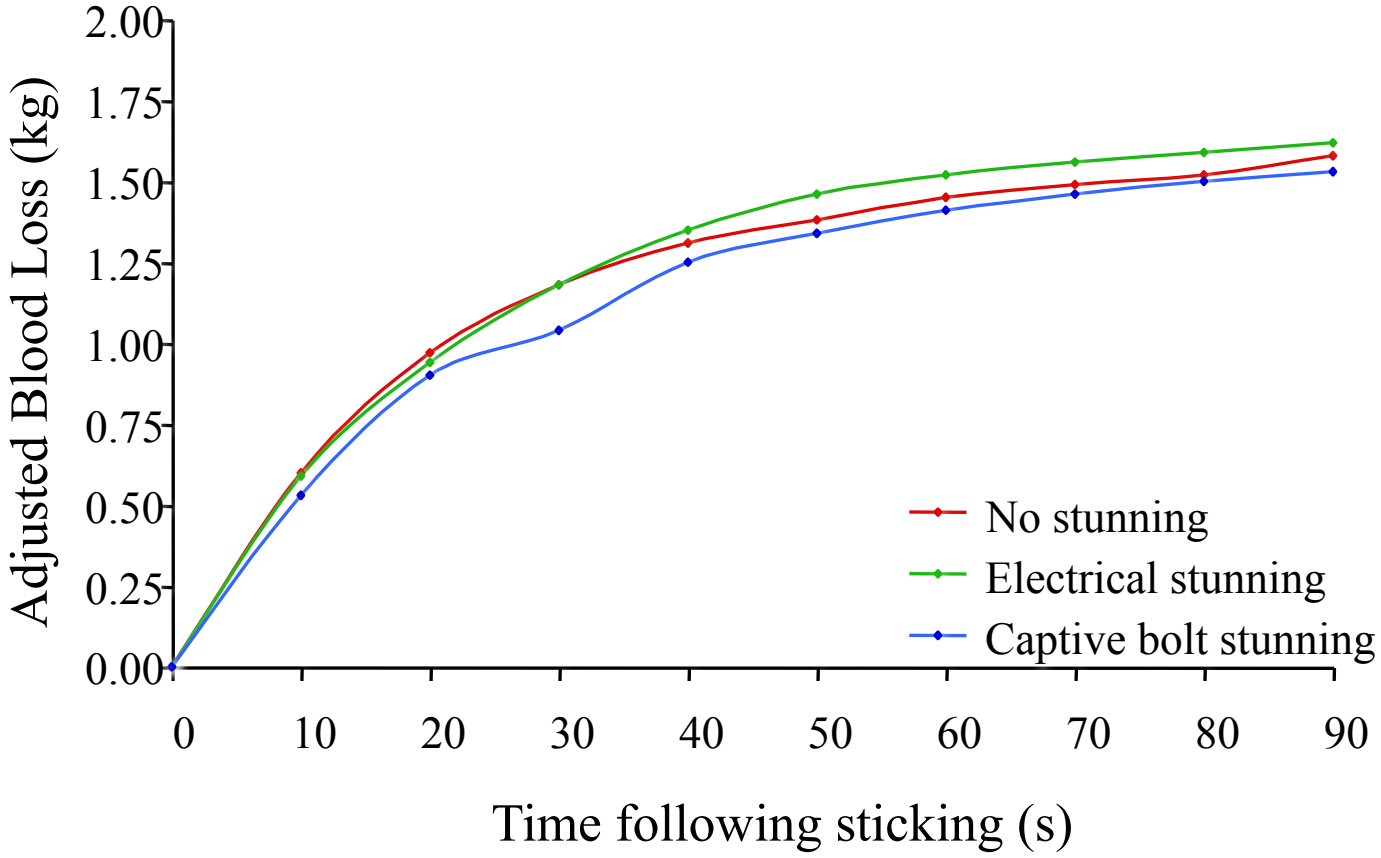


Animal ejected from top, once pen rotated through 90°

# Comparison of slaughter methods - on blood loss in sheep-



# Comparison of slaughter methods - on blood loss in sheep -



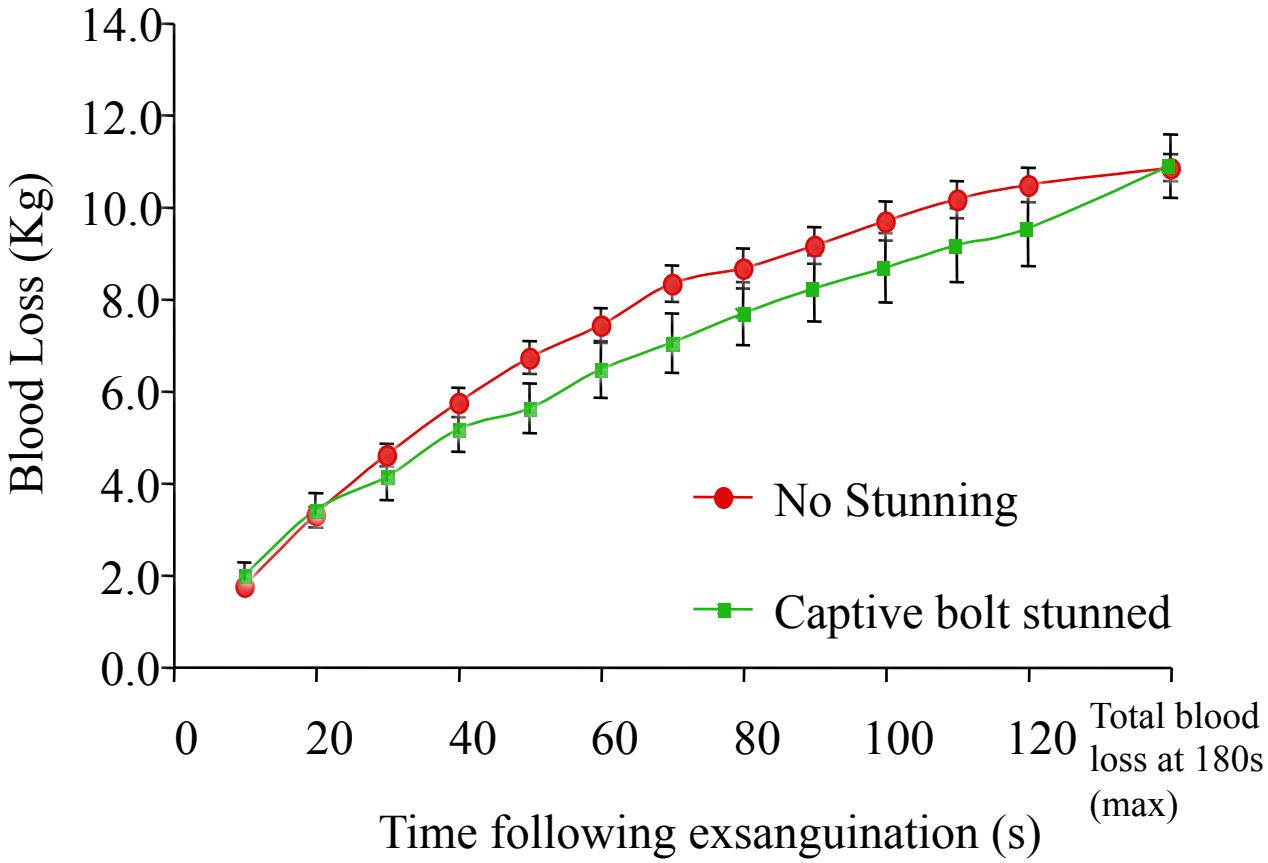
# Comparison of slaughter methods - on blood loss in sheep -

| | Live Wt (Kg) | Fleece Wt (Kg) | Organ Wt (Kg) | Total blood loss (Kg) |
|---|---|---|---|---|
| No stunning | 38.3±1.5 | 4.1±0.2 | 1.8±0.1 | 1.6±0.1 |
| Electrical stunning | 45.6±1.9 | 3.9±0.3 | 2.1 0.1 | 1.8±0.1 |
| Captive bolt stunning | 37.5±2.8 | 4.2±0.2 | 1.4±0.1 | 1.5±0.1 |

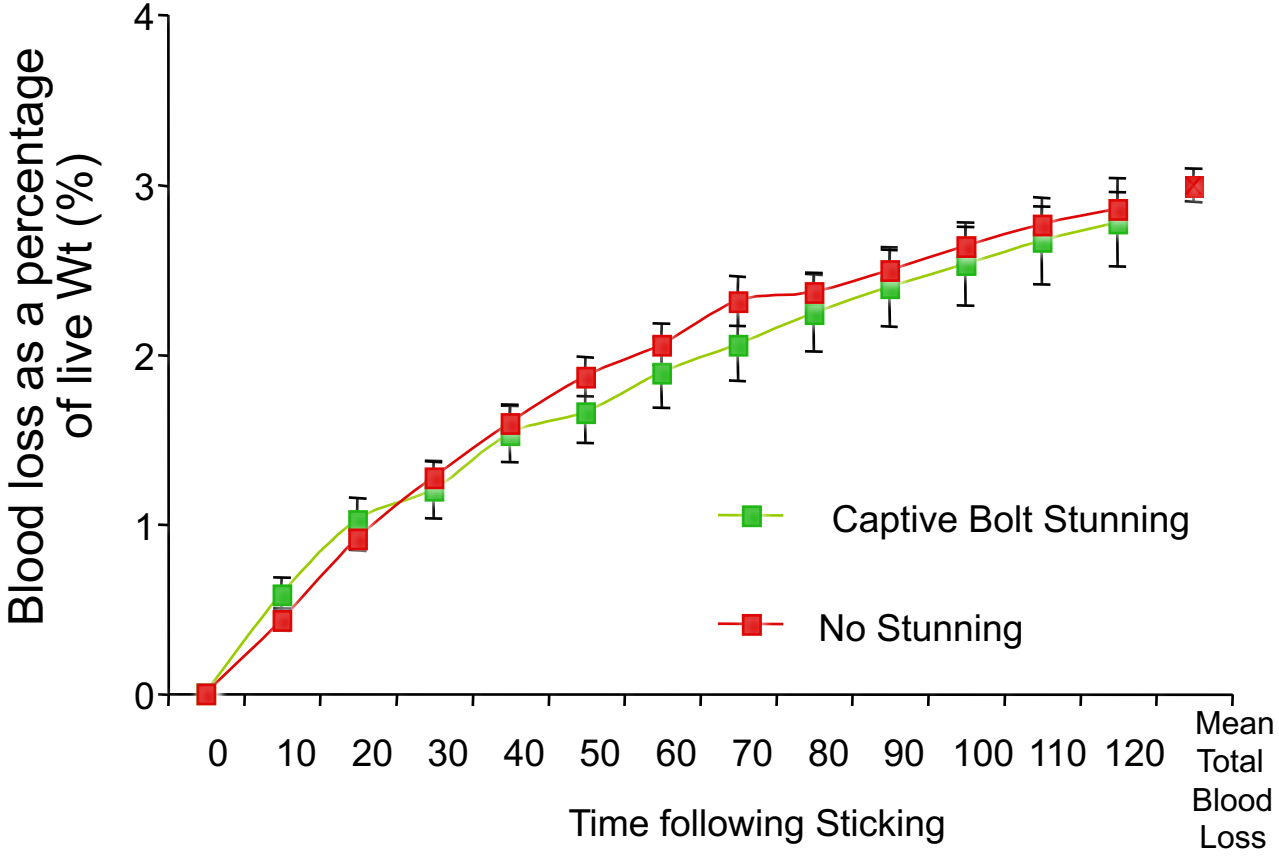
# Comparison of sheep slaughter methods
# - on welfare and meat quality parameters -

| | PCV (%) | pH | | Colour |
|---|---|---|---|---|
| | | 45min | 24hrs | |
| No stunning | 36.4 ±1.0 | 6.6 ±0.05 | 5.7 ±0.1 | 2.8 ±0.1 |
| Electrical stunning | 36.5 ±1.5 | 6.4 ±0.04 | 5.1 ±0.03 | 2.5 ±0.2 |
| Captive bolt stunning | 35.6 ±0.5 | 6.7 ±0.03 | 6.2 ±0.01 | 3.1 ±0.1 |

# Comparison of slaughter methods - on blood loss in cattle -



# Comparison of slaughter methods - on blood loss in cattle -



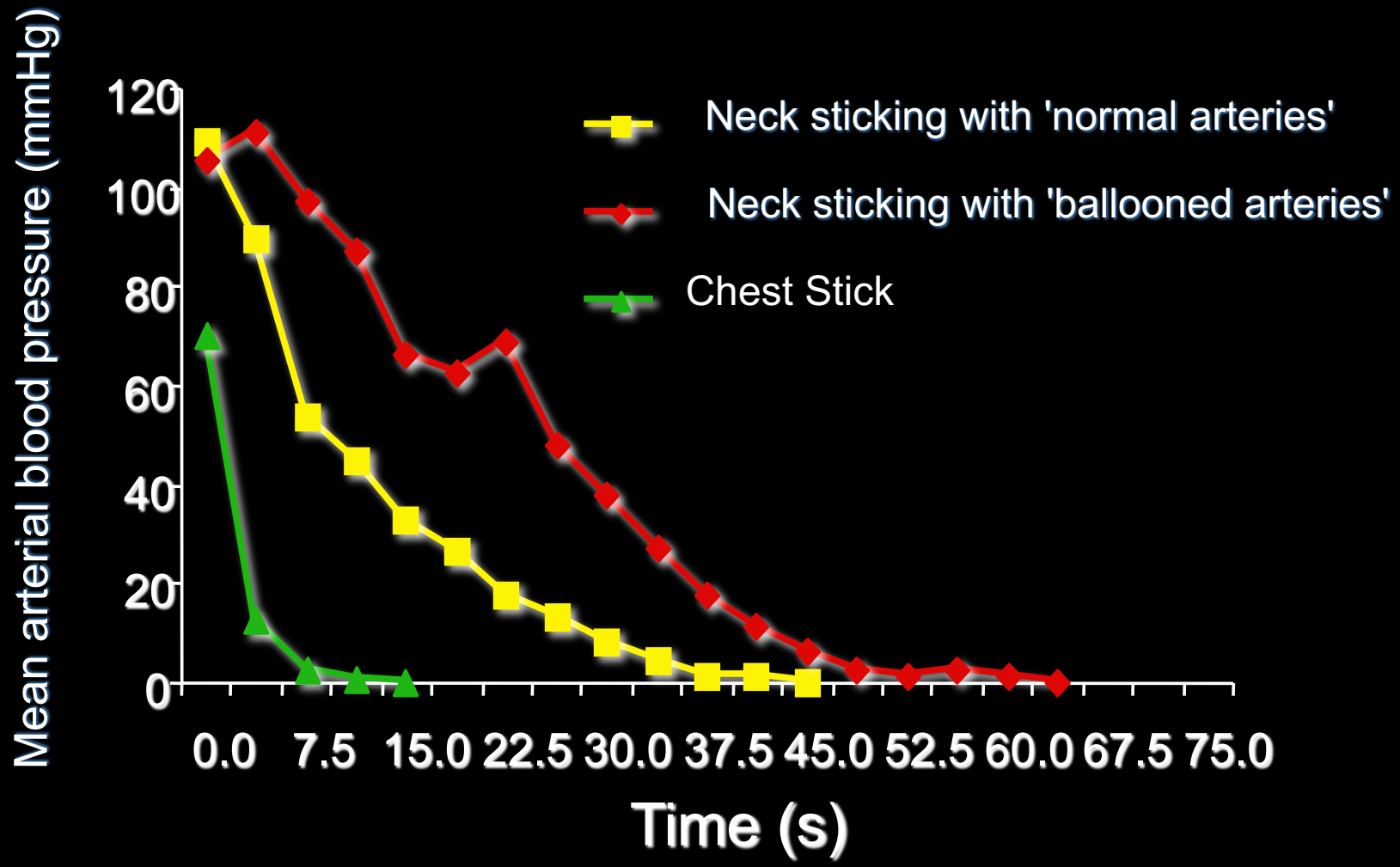
# Comparison of slaughter methods - blood loss in cattle -

| | Live Wt (Kg) | Hide Wt (Kg) | Organ Wt (Kg) | Total Blood Loss (Kg) |
|---|---|---|---|---|
| No Stunning | 363.5 ± 5.7 | 31.2 ± 0.8 | 11.6 ± 0.3 | 10.9 ± 0.4 |
| Captive Bolt Stunning | 355.0 ± 12.3 | 31.5 ± 1.0 | 11.7 ± 0.3 | 10.9 ± 0.3 |

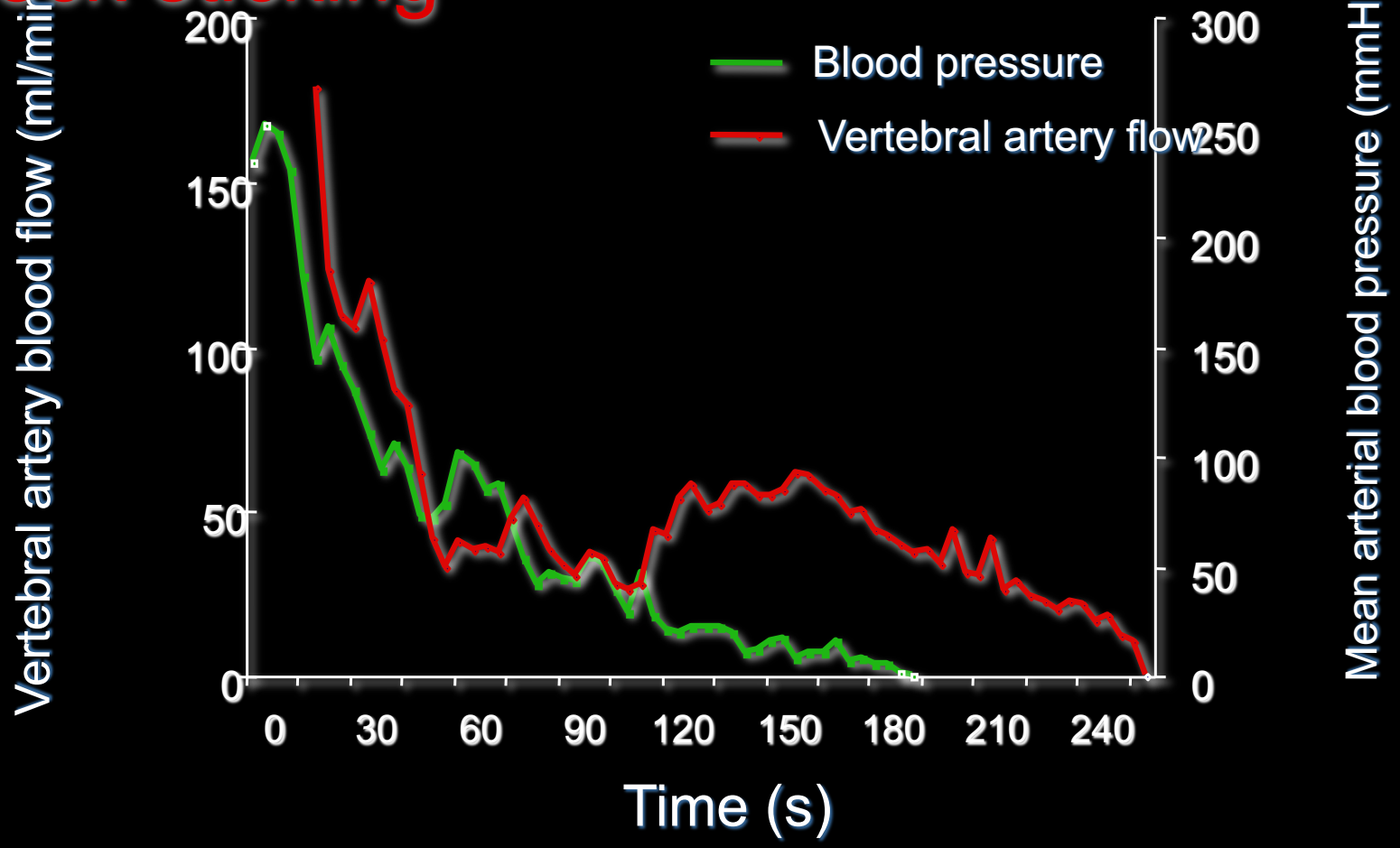
# Comparison of slaughter methods -welfare and meat quality parameters in cattle -

| | | pH | | |
|---|---|---|---|---|
| | PCV (%) | 45 Mins | 24 Hrs | Colour |
| No Stunning | 40.9 ± 0.9 | 7.01 ± 0.03 | 6.17 ± 0.04 | 4.91 ± 0.12 |
| Captive Bolt Stunning | 40.1 ± 1.4 | 7.06 ± 0.03 | 6.20 ± 0.05 | 4.80 ± 0.17 |

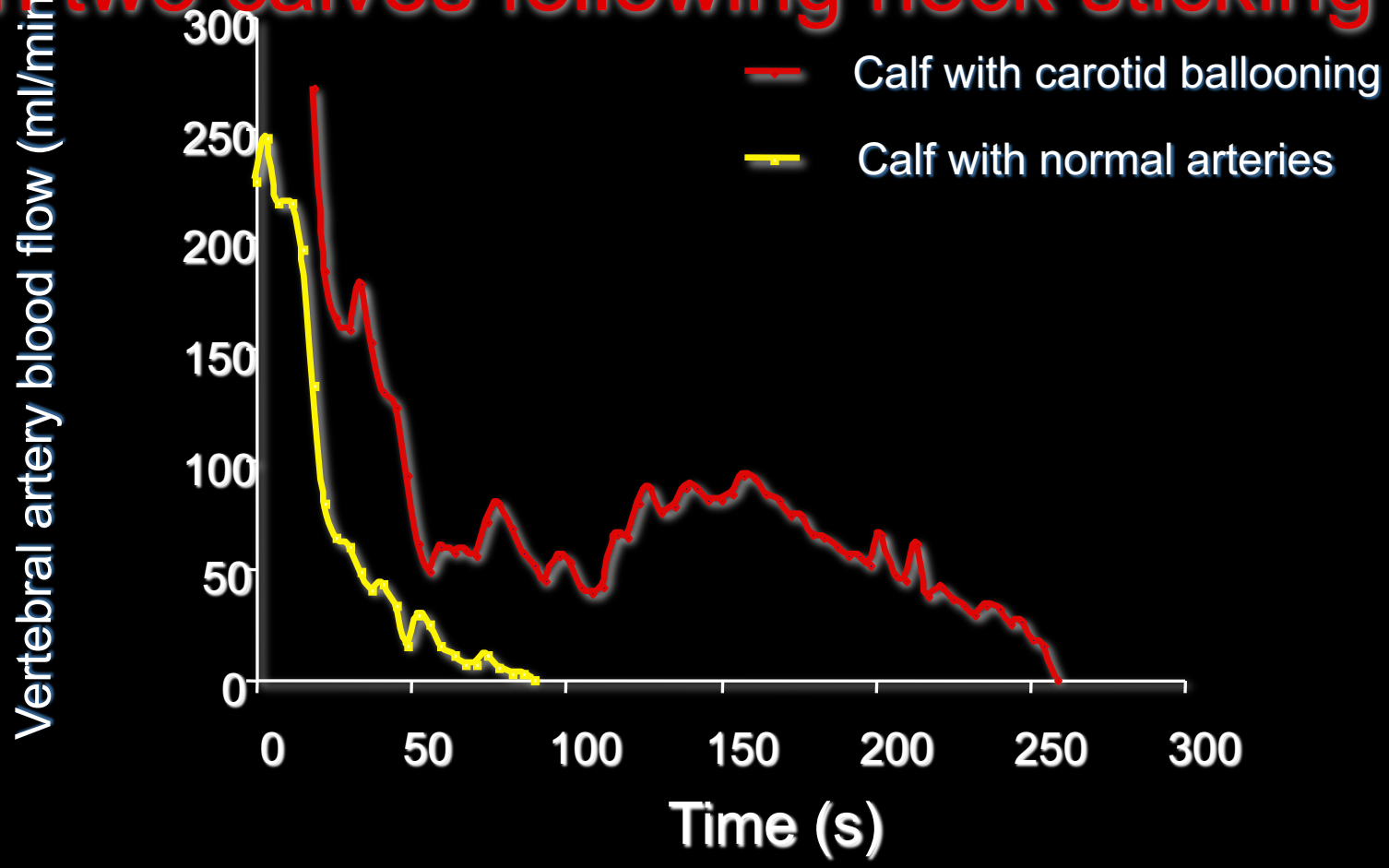
# Blood pressure in calves following neck and chest sticking



# Systemic blood pressure & vertebral artery blood flow in a calf following neck sticking



# Comparison of vertebral artery blood flow in two calves following neck sticking



# Incidence of carotid occlusion and the electrophysiological results following stunning and sticking

| Calf Nos | Stick type | Carotid occlusion | Duration of epilepsy (s) | Time to isoelectric ECoG (s) | Time to loss of VER's (s) |
|---|---|---|---|---|---|
| 55 | Neck | YES | 37 | 39 | 44 |
| 57 | " " | " " | 21 | 127 | - |
| 58 | " " | " " | 37 | 124 | 80 |
| 56 | " " | NO | 24 | 54 | 8 |
| 60 | " " | " " | 22 | 36 | 8 |
| 62 | " " | " " | 18 | 38 | 8 |
| 45 | CHEST | NA | 24 | 36 | * |
| 52 | " " | " " | 18 | 38 | * |
| 53 | " " | " " | 22 | 60 | * |
| 54 | " " | " " | 20 | 45 | - |

# DIALREL project

- European Commission 6th Framework Programme
  Priority 5 Food Quality and Safety
- **Religious slaughter: improving knowledge and expertise through dialogue and debate on issues of welfare, legislation and socio-economic aspects**.

# DIALREL

  - WP1. Religion, Legislation and Animal Welfare: Conflicting Standards
- Aims at reviewing information concerning development of current legislation, religious rules and scientific welfare concerns. It will prepare the ground and set the scene for the debate under WP 5.
  - WP2. Religious slaughter: Evaluation of current practices
- will evaluate the current state by examining, analysing and discussing the evidence from observed or reported incidences of optimum and adverse practices of religious slaughter techniques including shechita and halal methods, in an unbiased and comparative fashion.
  - WP3. Consumer and consumption issues
- will be mainly devoted to building up a synthesis on halal and kosher consumption in selected European Union and associate countries.
  - WP4. Socio-economic issues related to religious slaughtering practices
- will address the concerns, knowledge and information in the general public relating to religious slaughtering practices.
  - WP5. Promotion of the debate and dissemination activities

# LIST OF PARTNERS

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- Cardiff University (United Kingdom)
- Freie Universität Berlin (Germany)
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- Gent University (Belgium)
- Association pour le Développement de l'Institut de la Viande (ADIV) (France)
- Veterinary Association, Istanbul (Turkey)
- Royal Veterinary College, London (United Kingdom)
- Universita di Milano (Italy)
- Animal Sciences Group Wageningen UR (ASG Veehouderij BV) (Holland)
- University of Perugia (Italy)
- Bar Ilan University (Israel)
- Meat and Livestock Australia (MLA), Australia