

Recent developments and concerns in relation to animal health, meat industry practices and public health in the United Kingdom



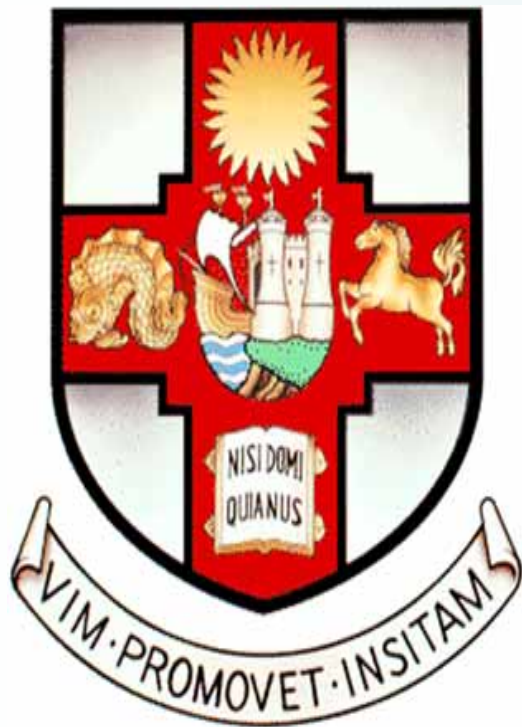
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UK, European & Global Public Health Concerns

- **Transmissible spongiform encephalopathies**
BSE, vCJD, Atypical Scrapie
- **Microbial contamination and other zoonoses**
Campylobacter, Salmonella, E. coli 0157, Listeria monocytogenes, Clostridium Perfringens
and Avian Influenza

Public health implications of stunning and slaughter methods



- 1) **Animal welfare effects**
- 2) **Product quality**
- 3) **Public health concerns**

Effects and consequences:

- 1) Animal welfare effects
- 2) Product quality
- 3) Public health concerns
 - Contamination by pathogen bacteria
 - Contamination by central nervous system (CNS) tissue
 - Stunning methods → Brain fragments
 - Carcass splitting → Spinal tissue/D
 - Collagen, gelatine and blood products

Captive bolt guns



Non-penetrating CBG

Penetrating CBG

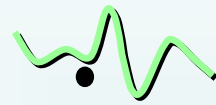


Pneumatically operated

Cartridge operated

Comparison of slaughter methods - visual evoked responses in cattle-

Shechita



0 - 20

20 - 41

41 - 61

61 - 82

TREATMENT

Time following treatment (sec)

50 μ V

50ms

Captive bolt



0 - 16

16 - 32

32 - 48

48 - 64

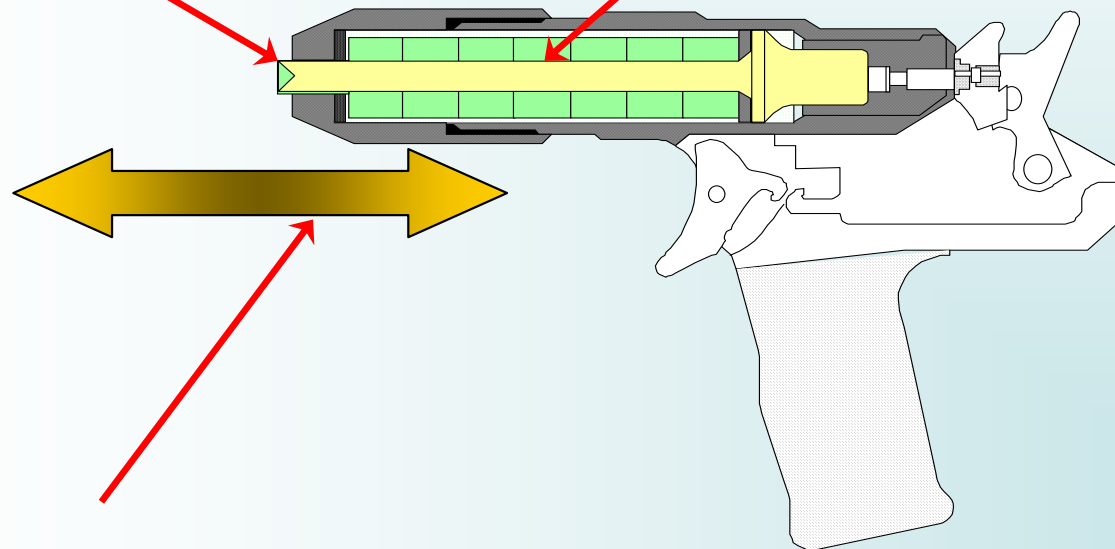
Time following treatment (sec)

Daly *et al* (1988)

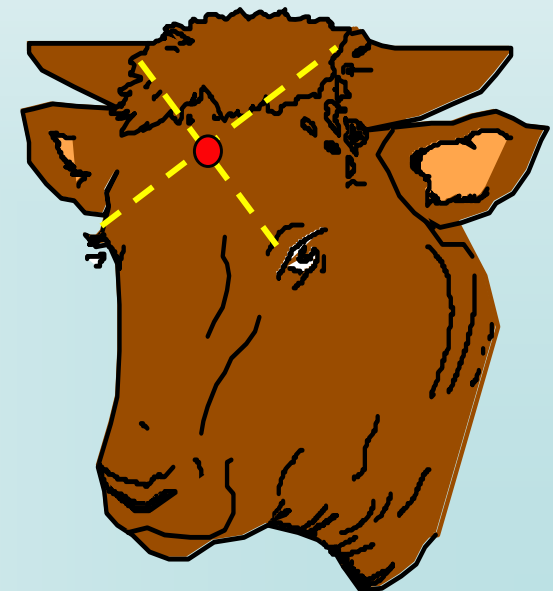
Potential for transfer of microbial contamination via a penetrative captive bolt stunning pistol

Accumulation of contaminated material and potential growth of bacteria

Surface contamination from top of head and / or brain of stunned animal



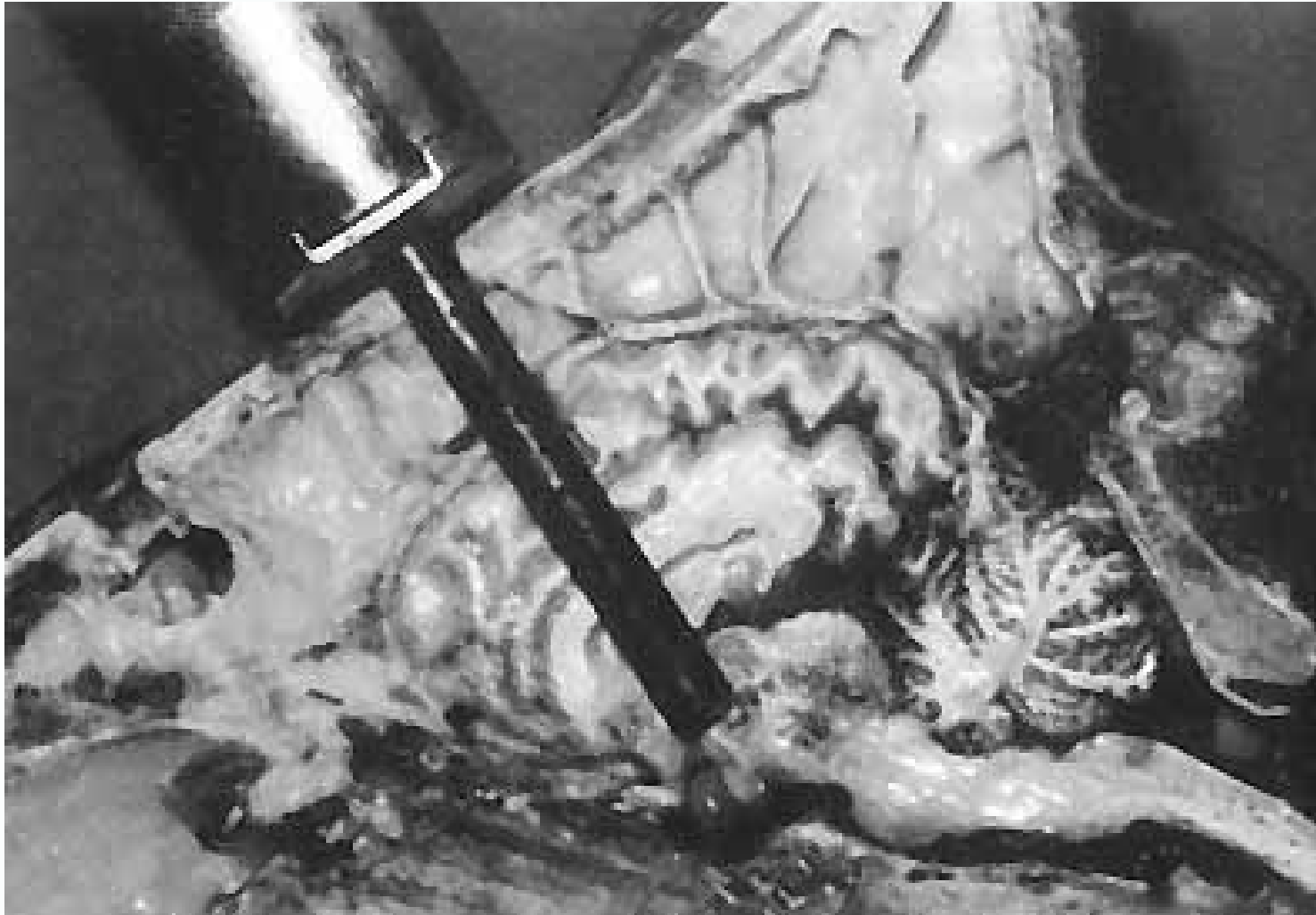
Transfer of bacteria in and out during consecutive stunning of animals



Schematic diagram of bovine head and vessels



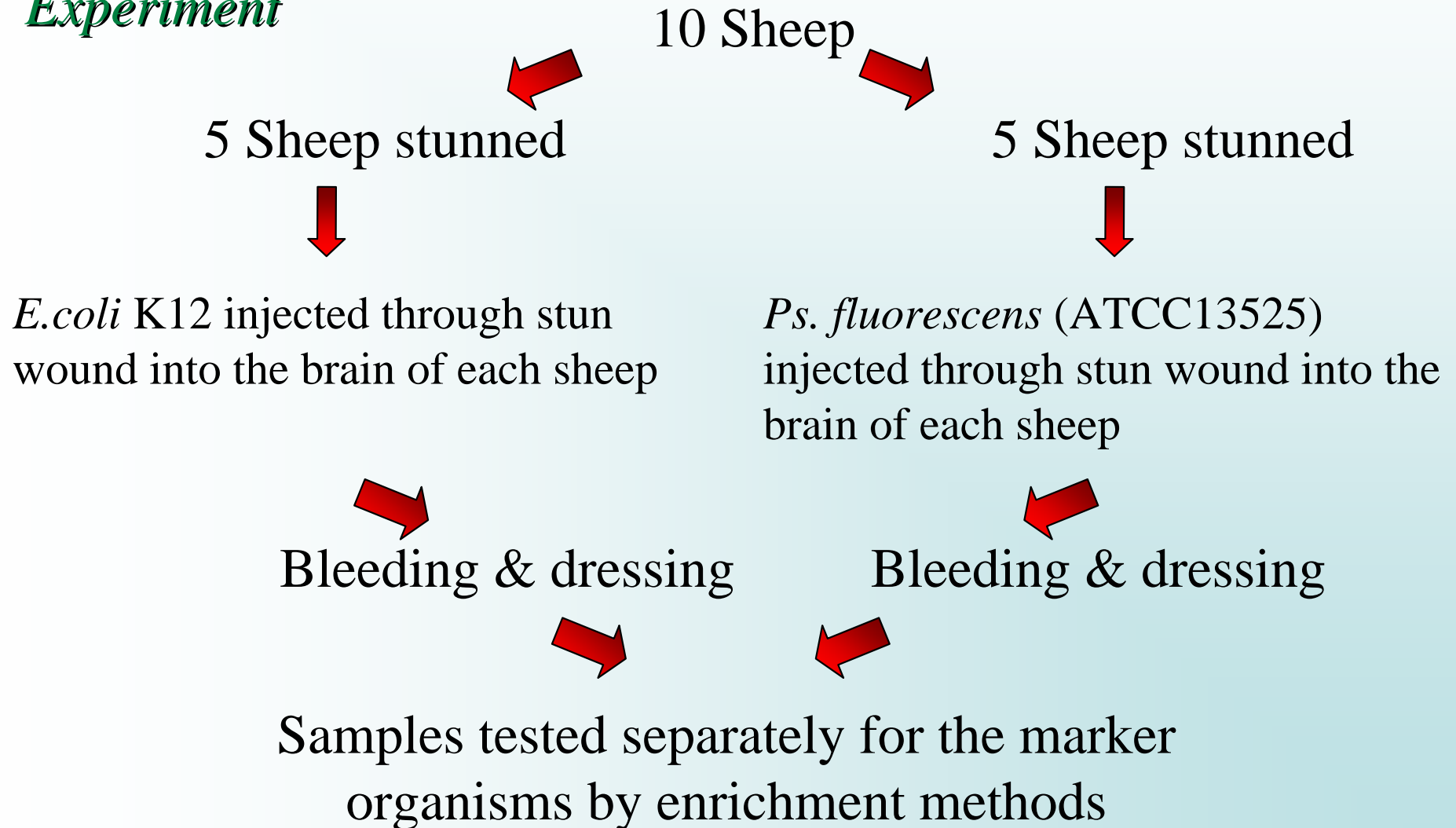
Diagram of bovine head with bolt in situ



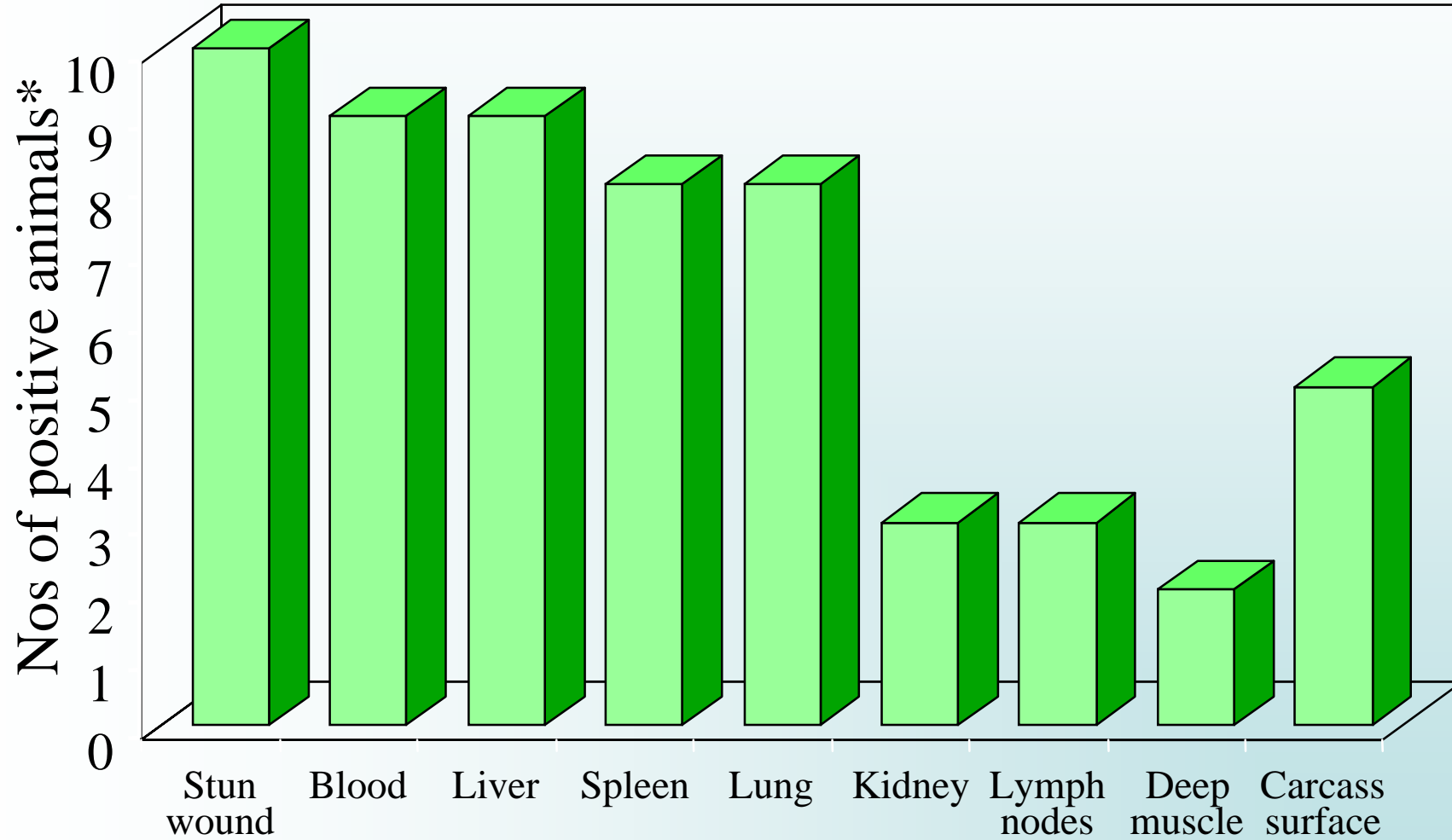
(Kaegi,
1988)

Internal and external spread of contamination of brain material to tissues and organs following penetrative captive bolt stunning

Experiment

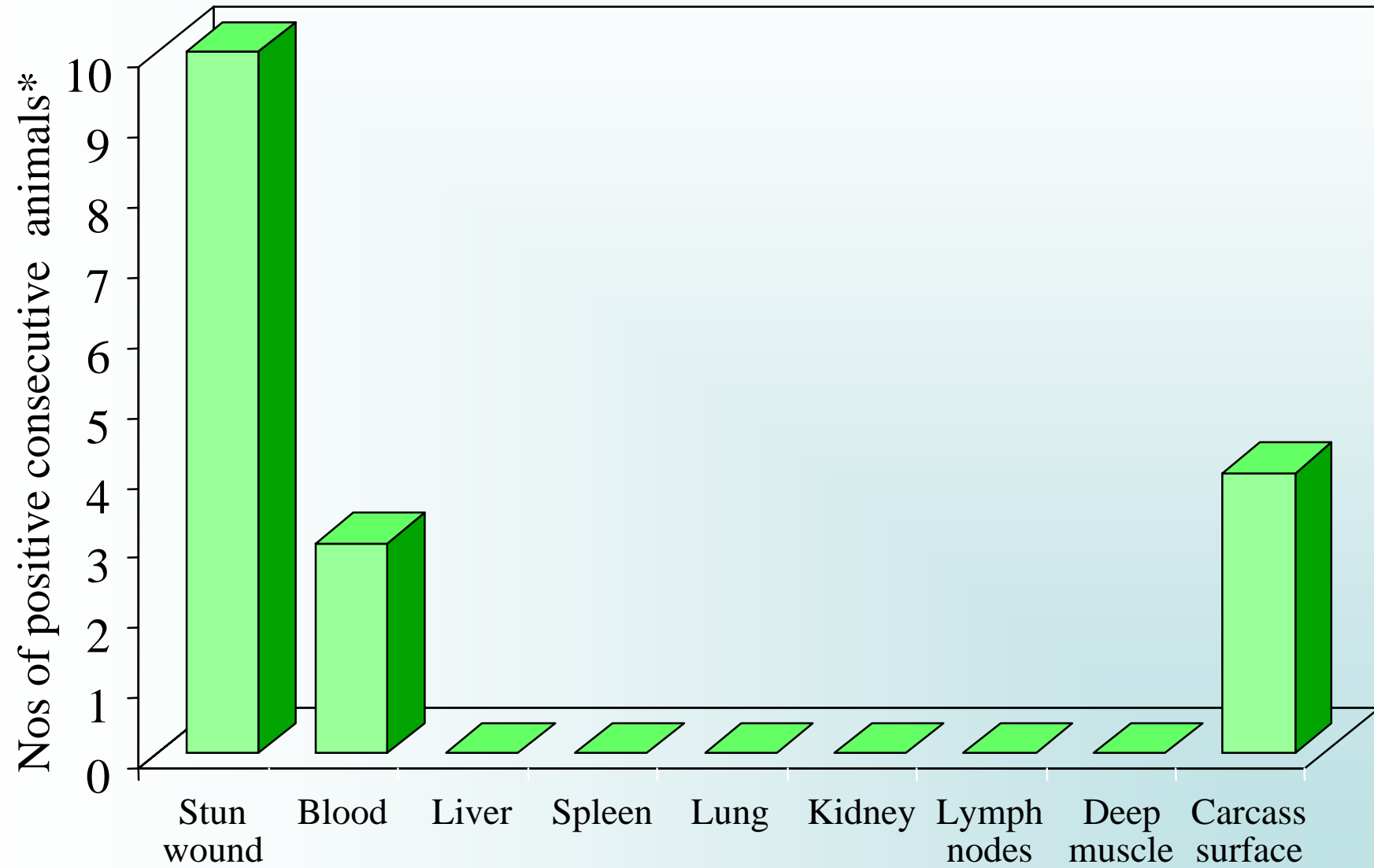


Results



11 * Positive for either marker organism

Results



12 * Positive for either marker organism

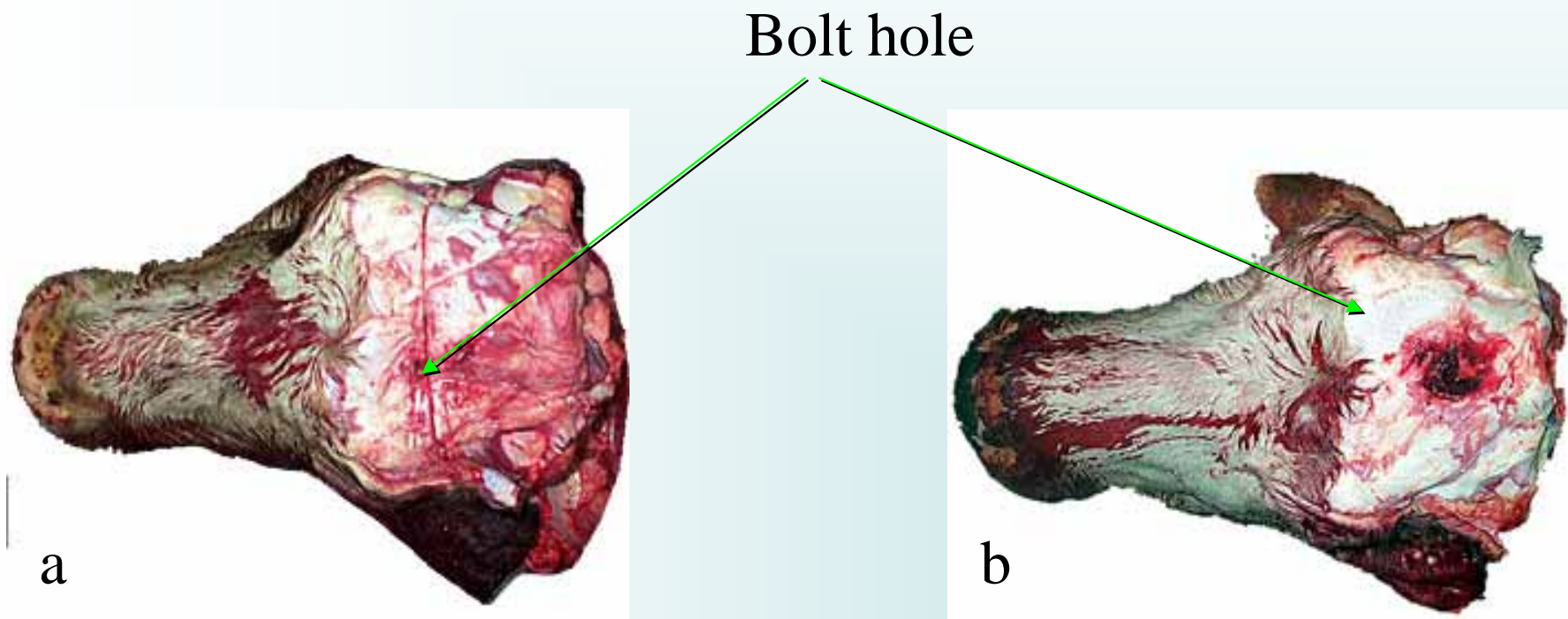
Contamination by CNS tissue

- Concern about stunning and slaughter
- Contamination of carcass with brain tissue emboli after the use of captive bolt guns

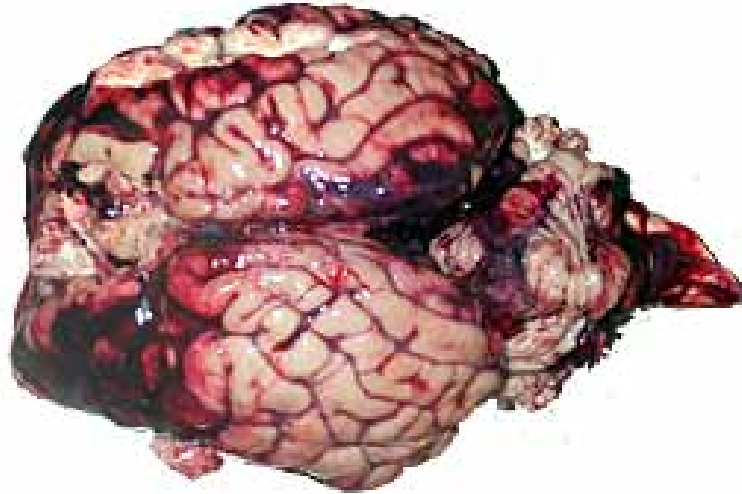
Cranial trauma caused by captive bolt gun stunning in cattle

Examination of cattle heads after use of penetrative and non-penetrative captive bolt guns

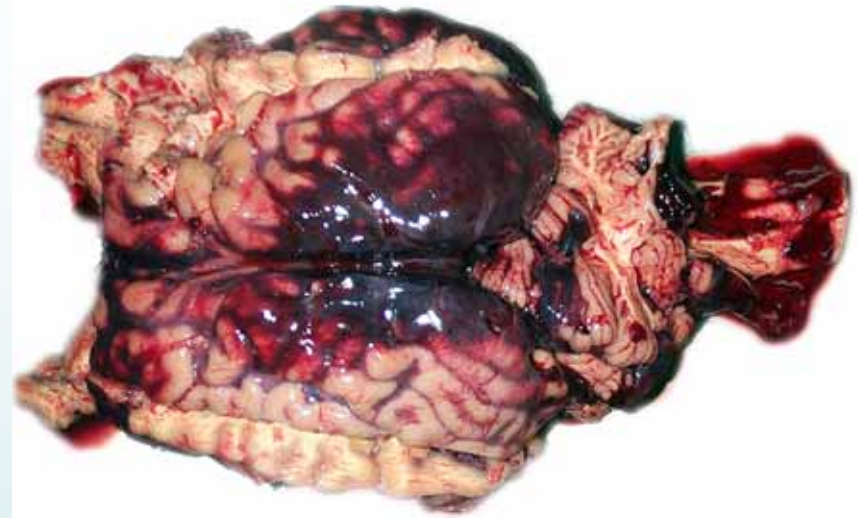
- a) Cattle head following penetrating captive bolt stunning;
- b) Cattle head following non-penetrating captive bolt stunning;



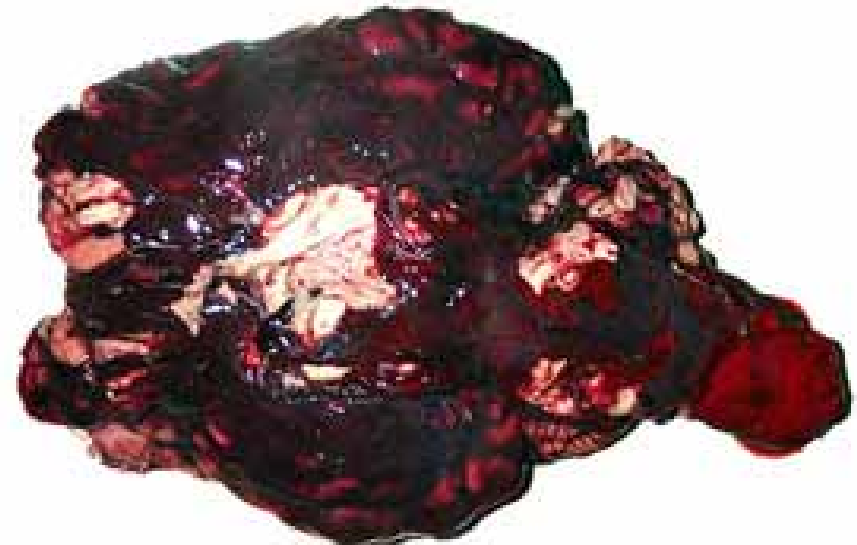
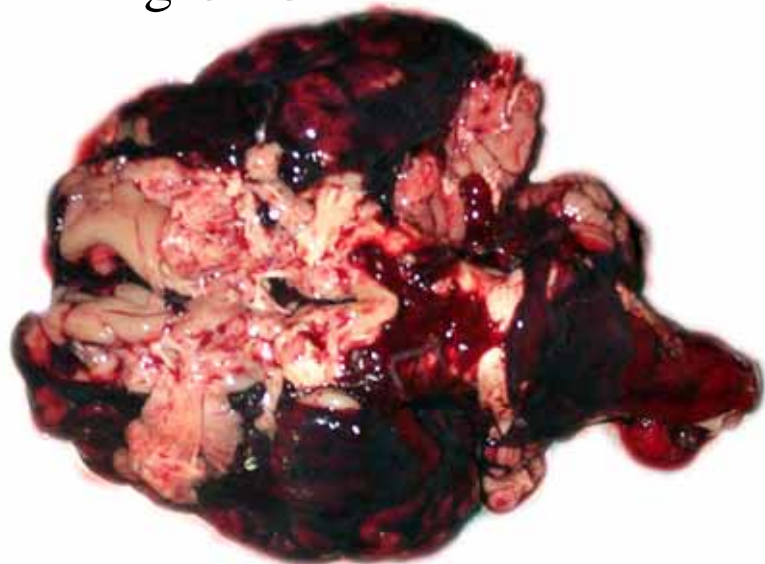
Cattle brains showing damage and haemorrhaging following penetrating captive bolt stunning



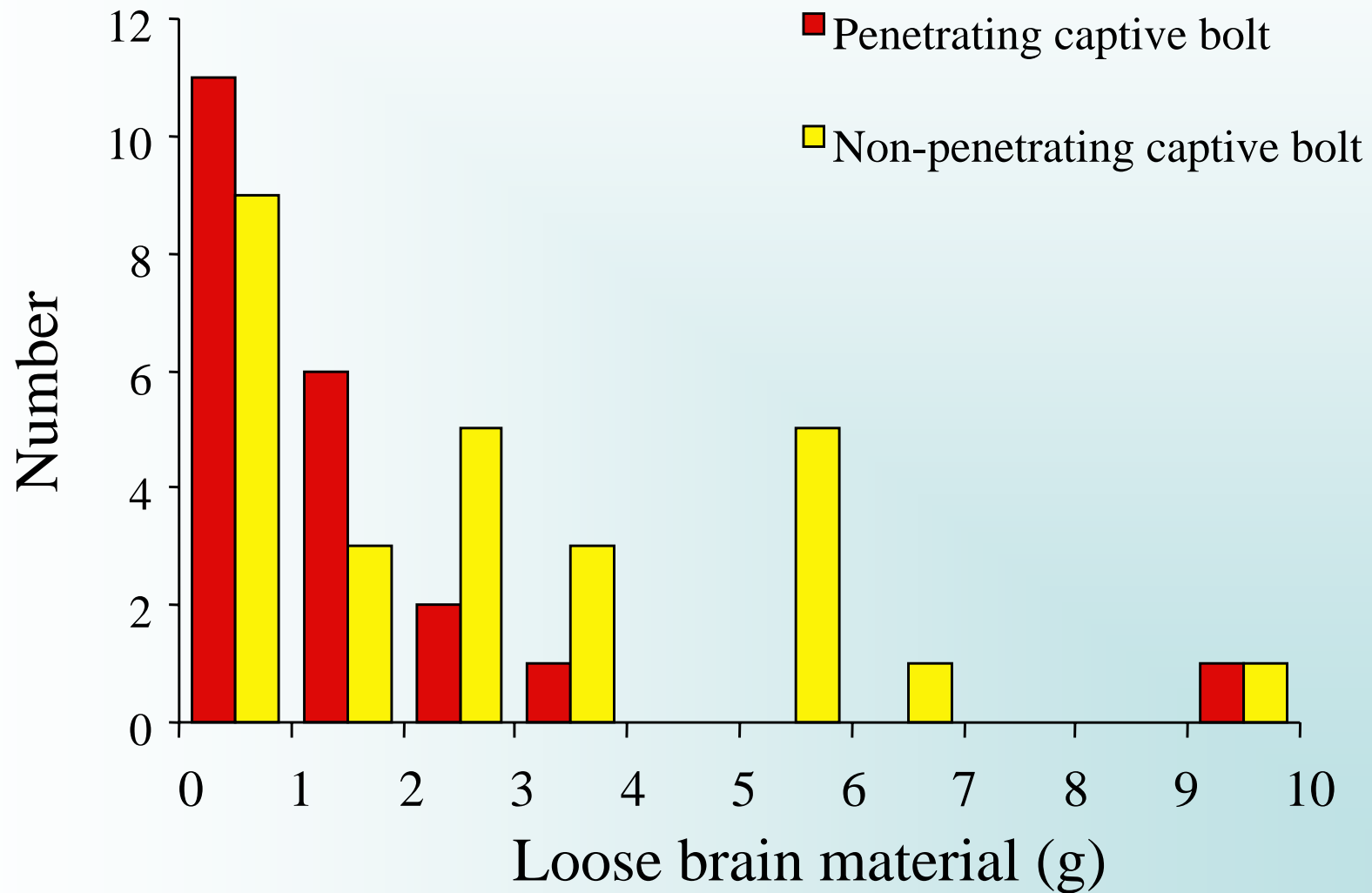
Penetrating CBG



Non-penetrating CBG



Frequency distribution of loose brain material found during captive bolt stunning in cattle



Prevalence of brain tissue in cattle and sheep

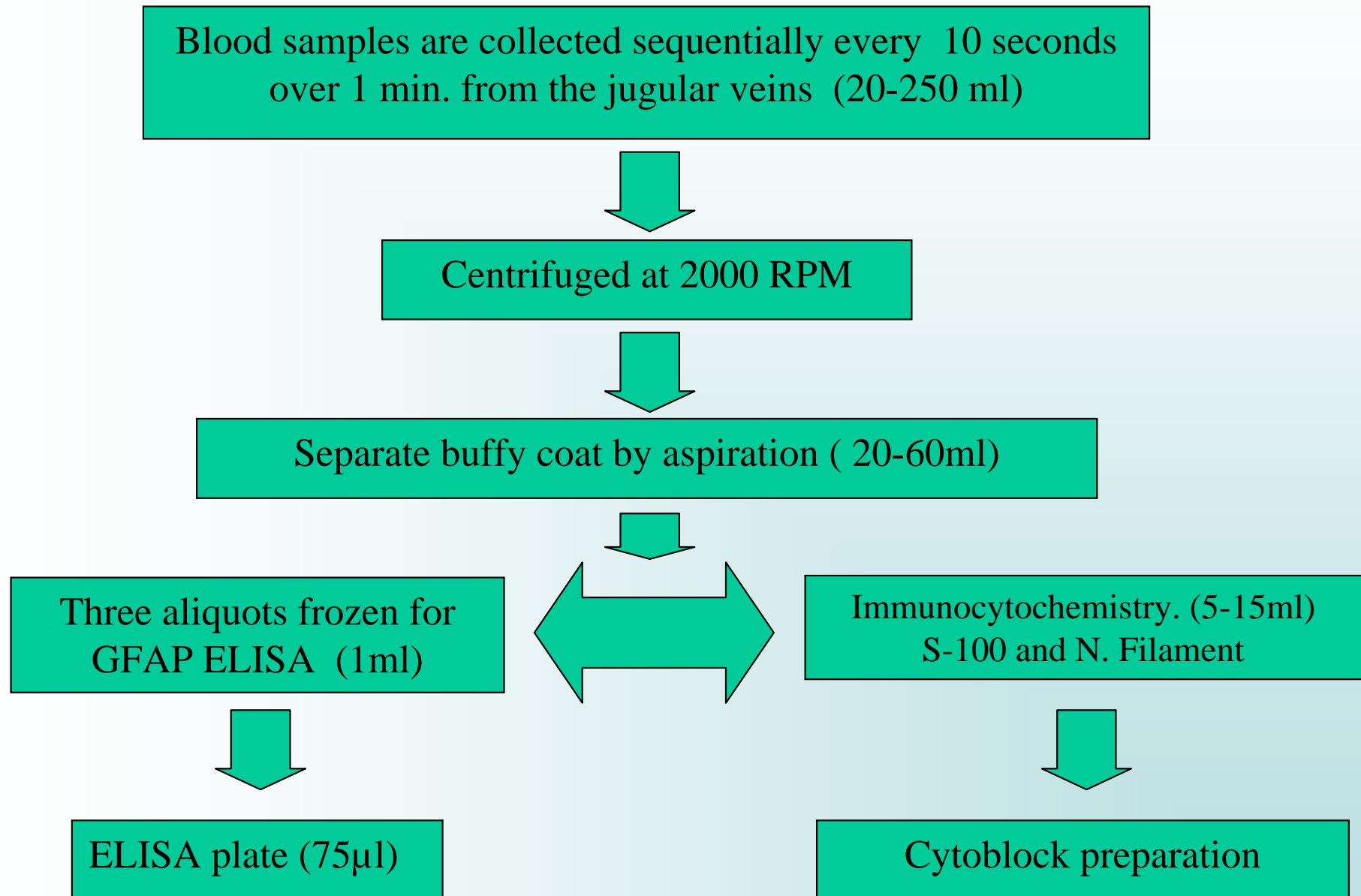
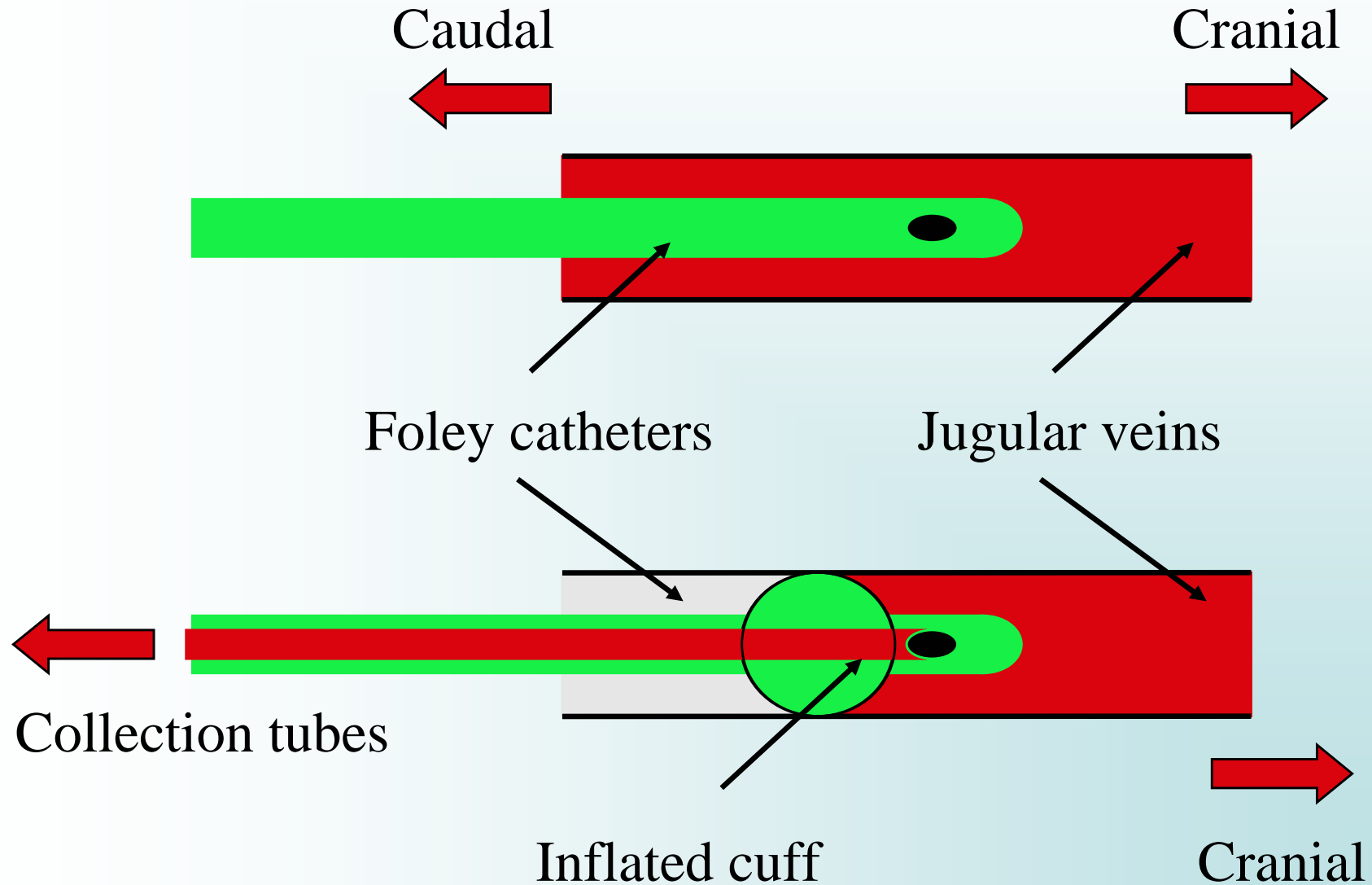
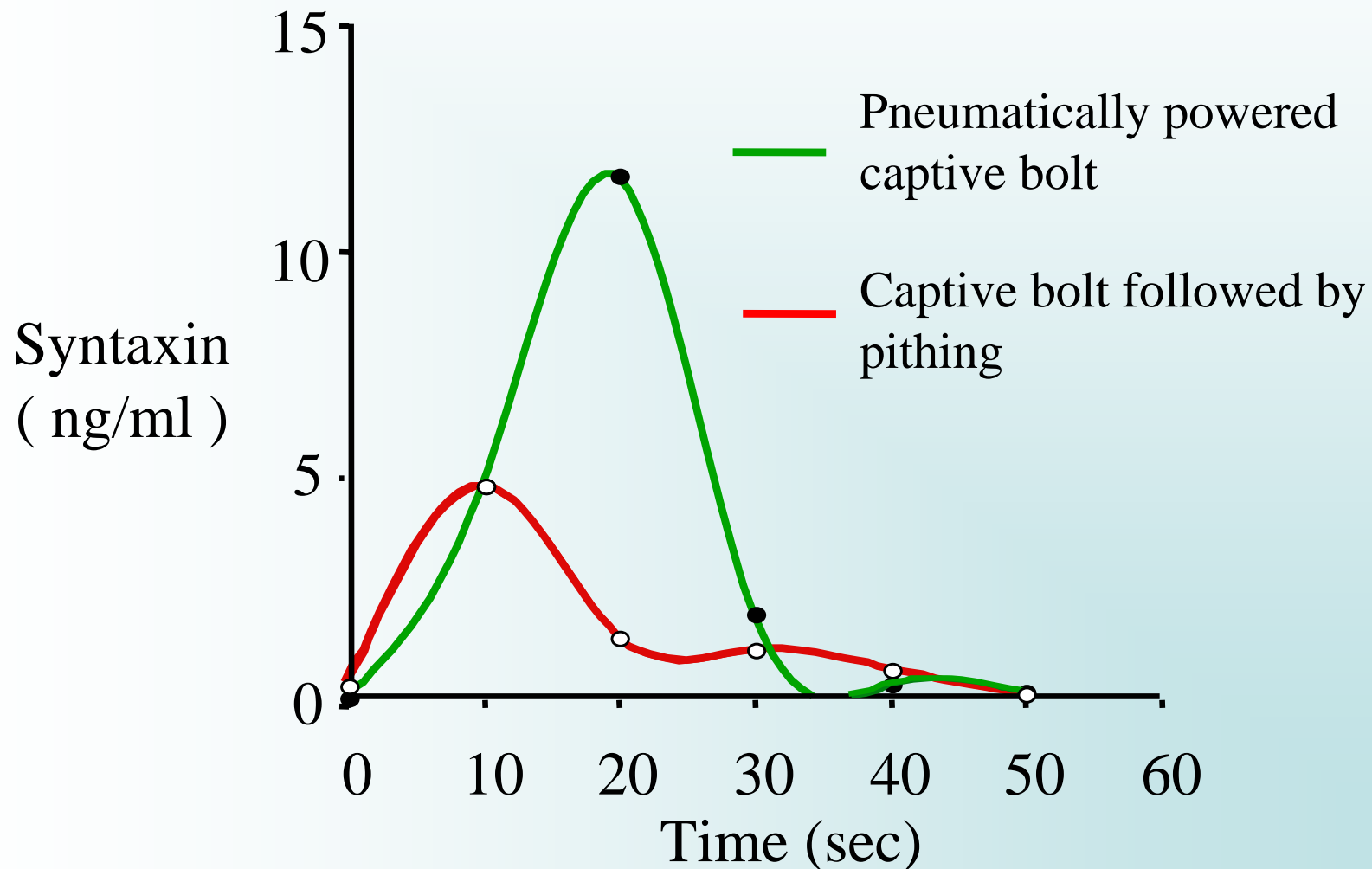


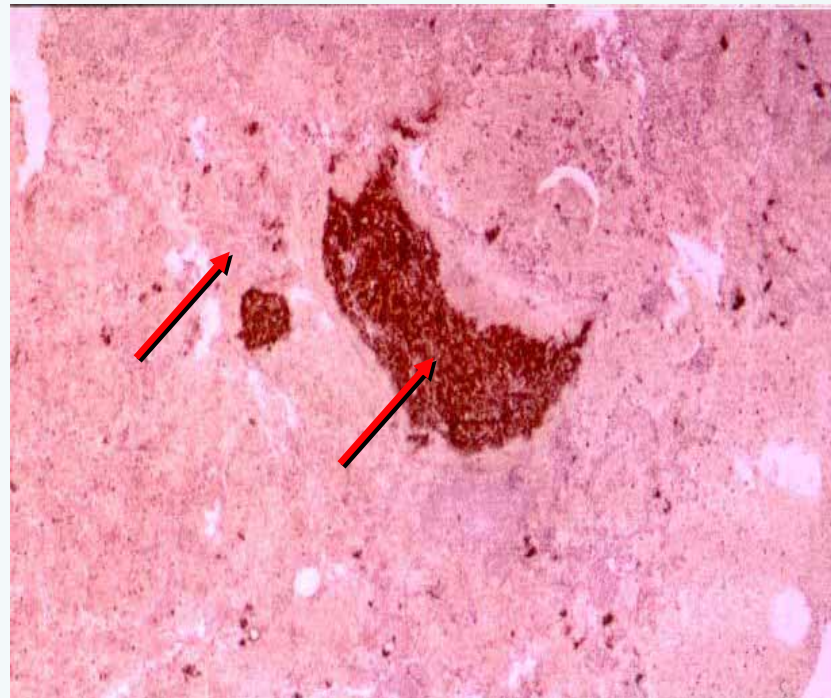
Diagram showing Foley catheters in-situ



Venous blood syntaxin1-B levels in cattle following captive bolt stunning



Jugular blood from cattle containing fragments which were difficult to discern but stained strongly for S 100 β protein (x70)



Recent investigations funded by Food Standards Agency

Prevalence of embolism during application of:

- 1) Penetrating and non-penetrating CBGs in cattle
 - cartridge operated
- 2) Penetrating CBGs in sheep
 - pneumatically and cartridge operated

Results for cattle study

Group	n	<i>GFAP ELISA</i>	<i>Immunocyto- chemistry</i>	<i>Total confirmed positive</i>
Penetrating captive bolt ¹	100	2	3	4
Non-penetrating captive bolt ²	100	0	2	2

¹ 95% confidence interval from 1.6 - 9.8%

² 95% confidence interval from 0.6 - 7.0%

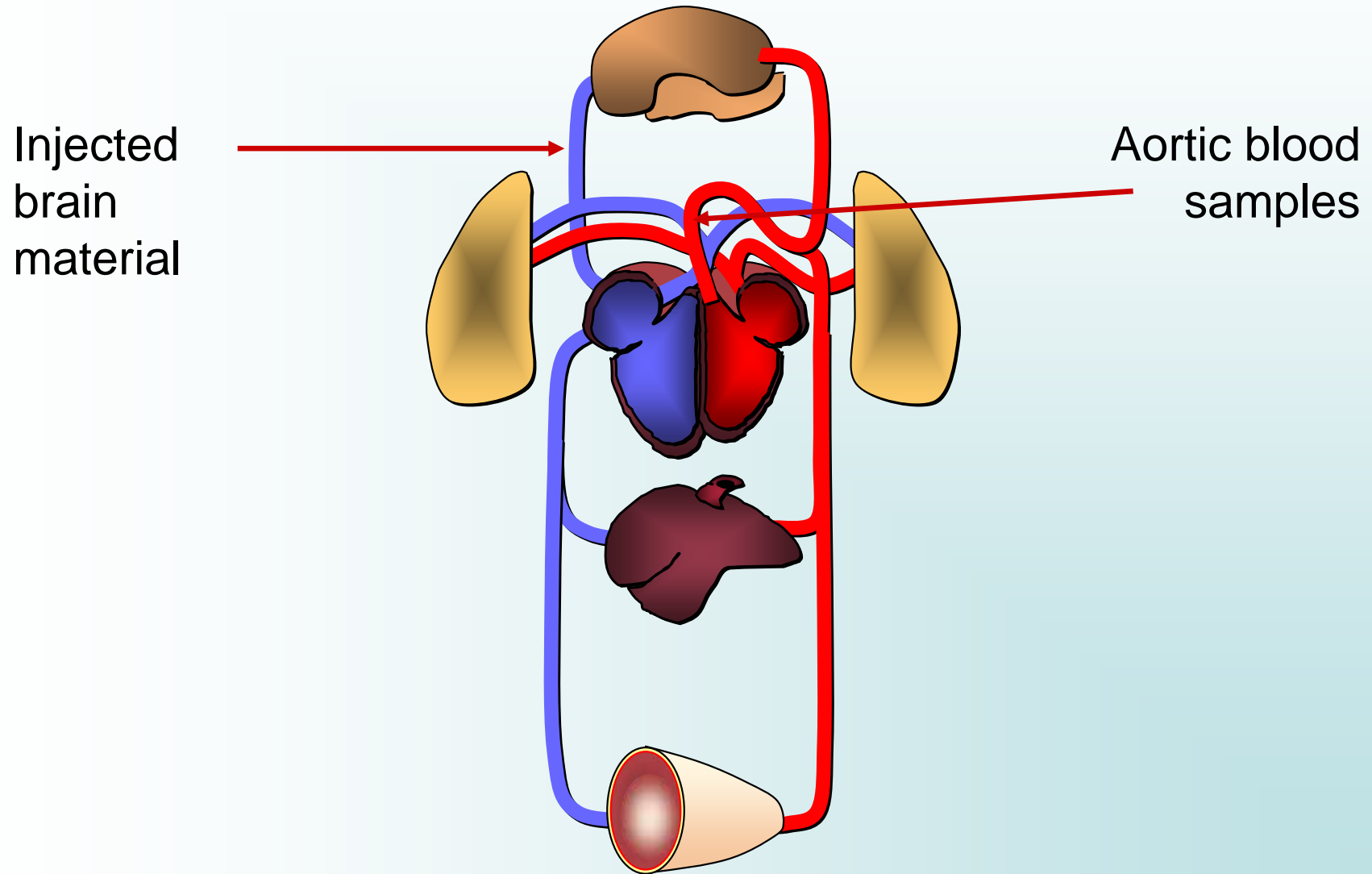
Results for sheep study

Group	n	<i>GFAP ELISA</i>	<i>Immunocyto- chemistry</i>	<i>Total confirmed positive</i>
Cartridge activated ¹	100	14	18	23
Pneumatically activated ²	100	10	13	14

¹ 95% confidence interval from 15.8 - 32.2%

² 95% confidence interval from 8.5 - 22%

Diagram of circulation.



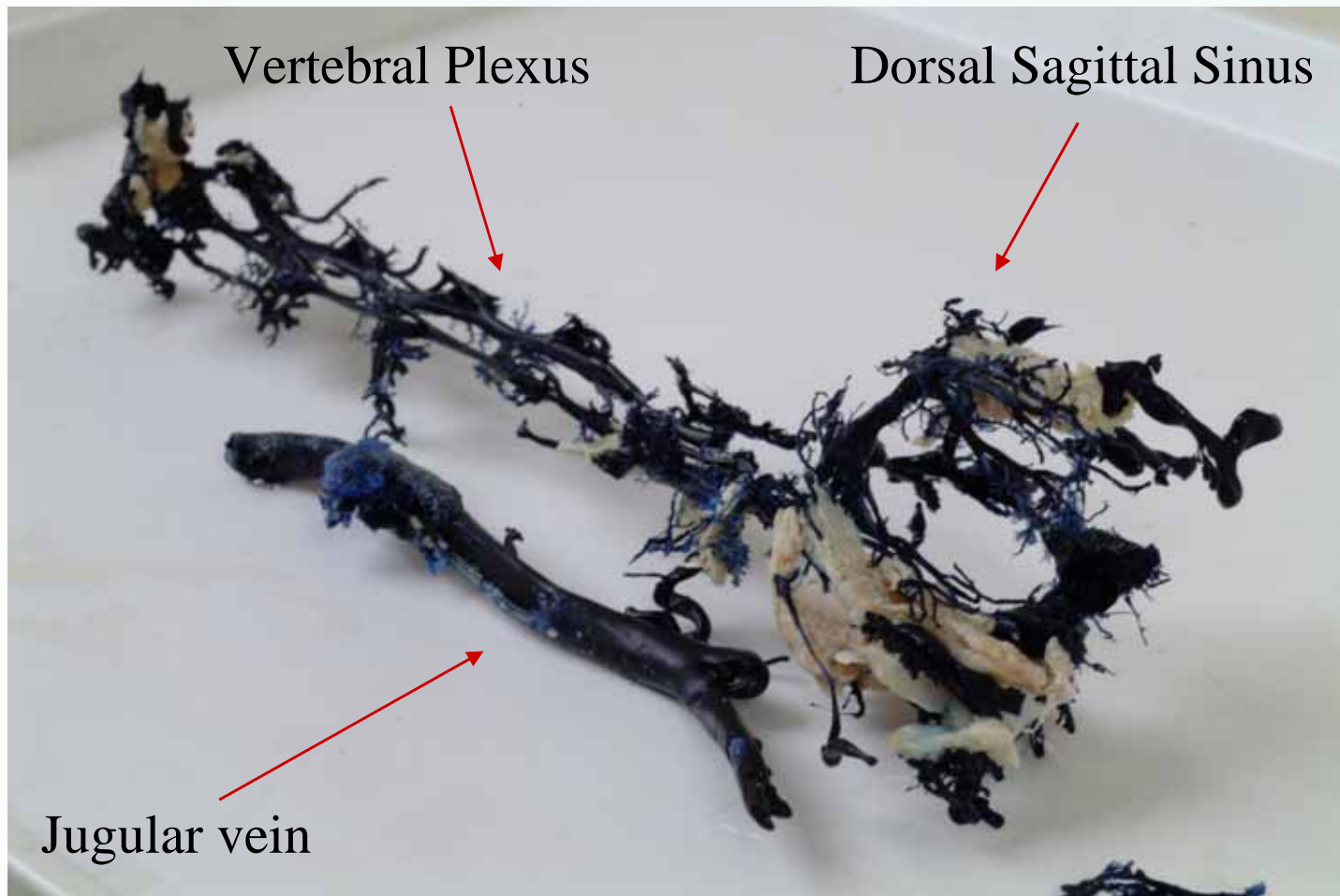
Dissemination of brain emboli after CBG stunning in sheep

- AIM: To determine whether brain tissue emboli can traverse the pulmonary capillary bed to enter the systemic circulation and contaminate edible parts of the carcass.

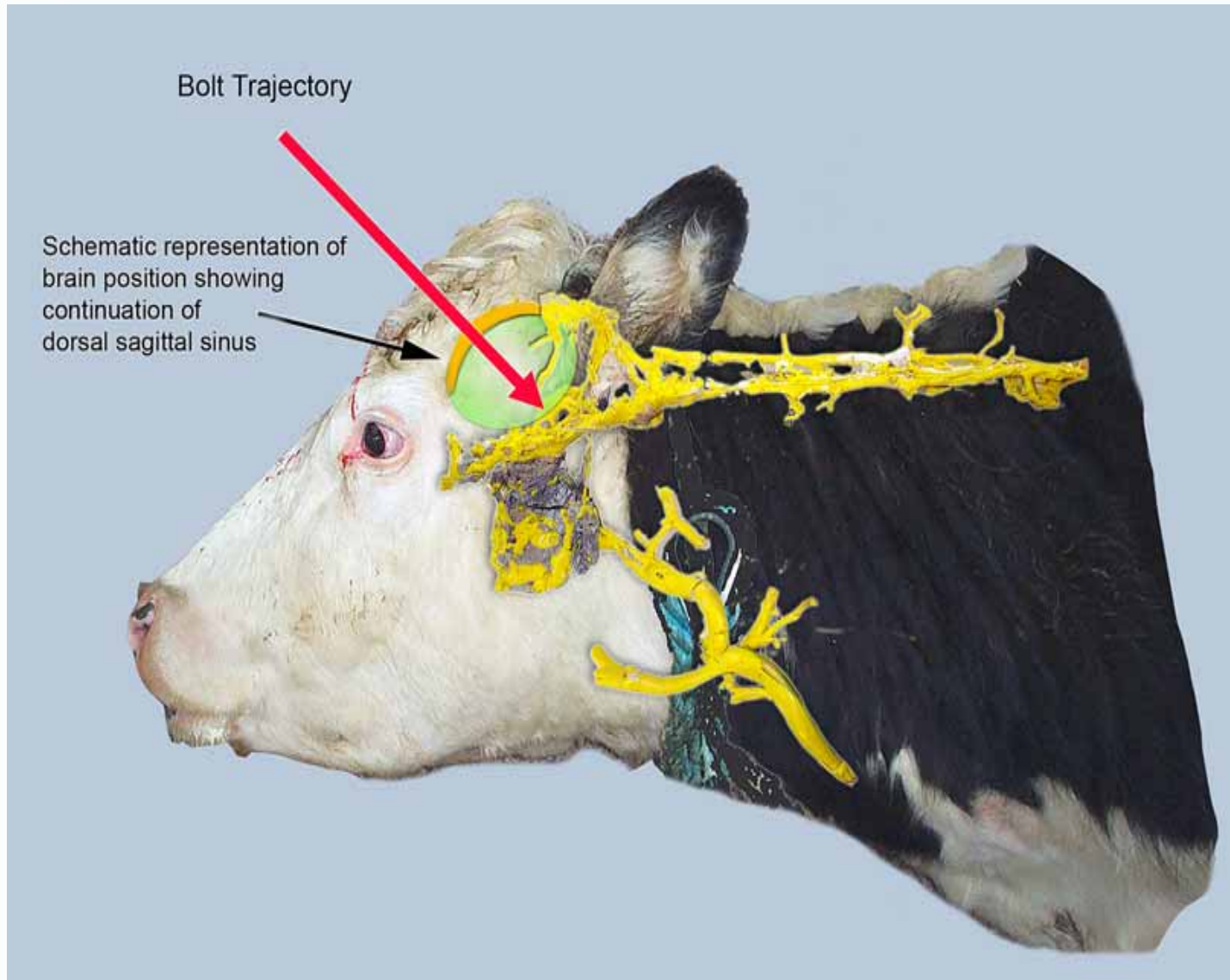
Dissemination of brain emboli following CBG stunning in sheep - Results

- 6 of 11 sheep were positive for neural embolism by GFAP ELISA
- In 5 animals GFAP was detectable within the first minute of sampling
- 2 of 11 were positive for neural embolism by immunocytochemistry
- Positive control sample S(g) was correctly identified by both assays at all dilutions

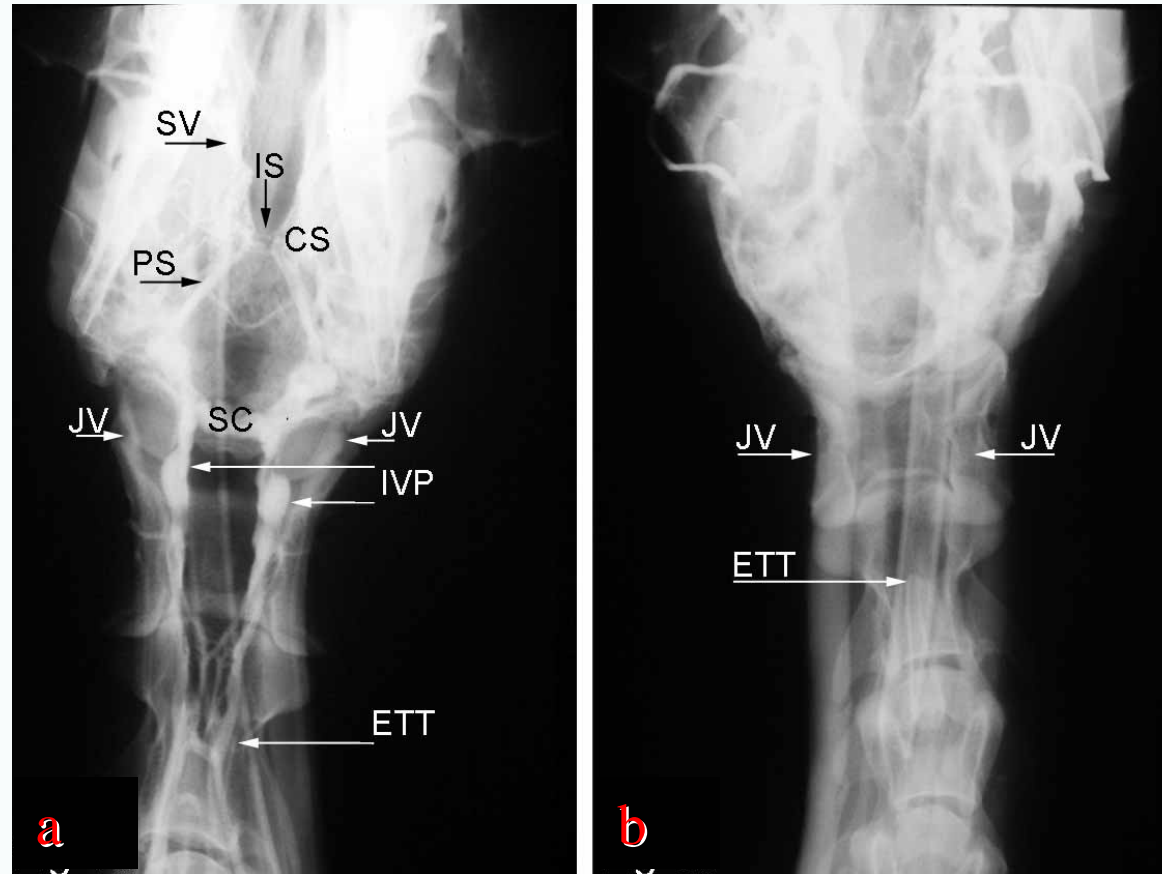
Anatomical study - Venous sinuses and vertebral plexus in sheep



Resin cast of venous drainage in adult bovine



Radiographs of head and neck with the animal in recumbent position (a) animal hoisted into a head down position (b)

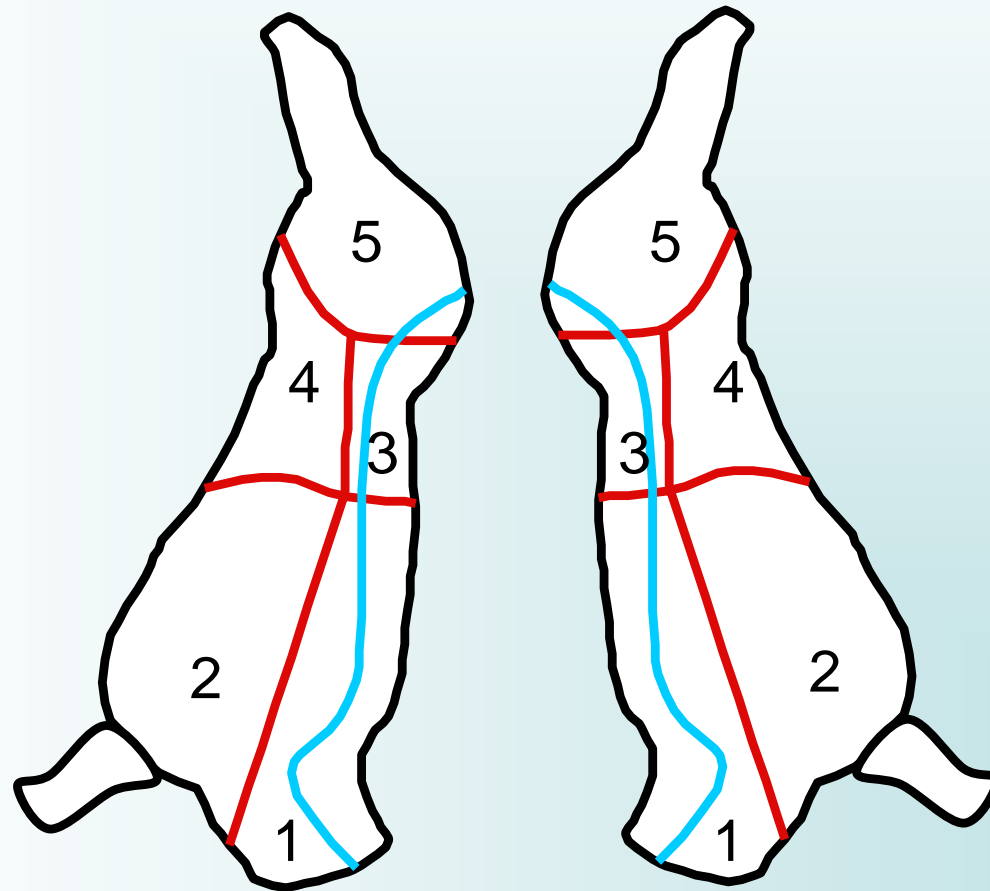


SV= Sphenopalatine vein; CS= Cavernous sinus, PS= Petrosal sinus; IVP= Internal vertebral plexus; JV= Jugular vein; ETT= Endotracheal tube; SC= Sinuum confluens; IS= Intercavernous sinus

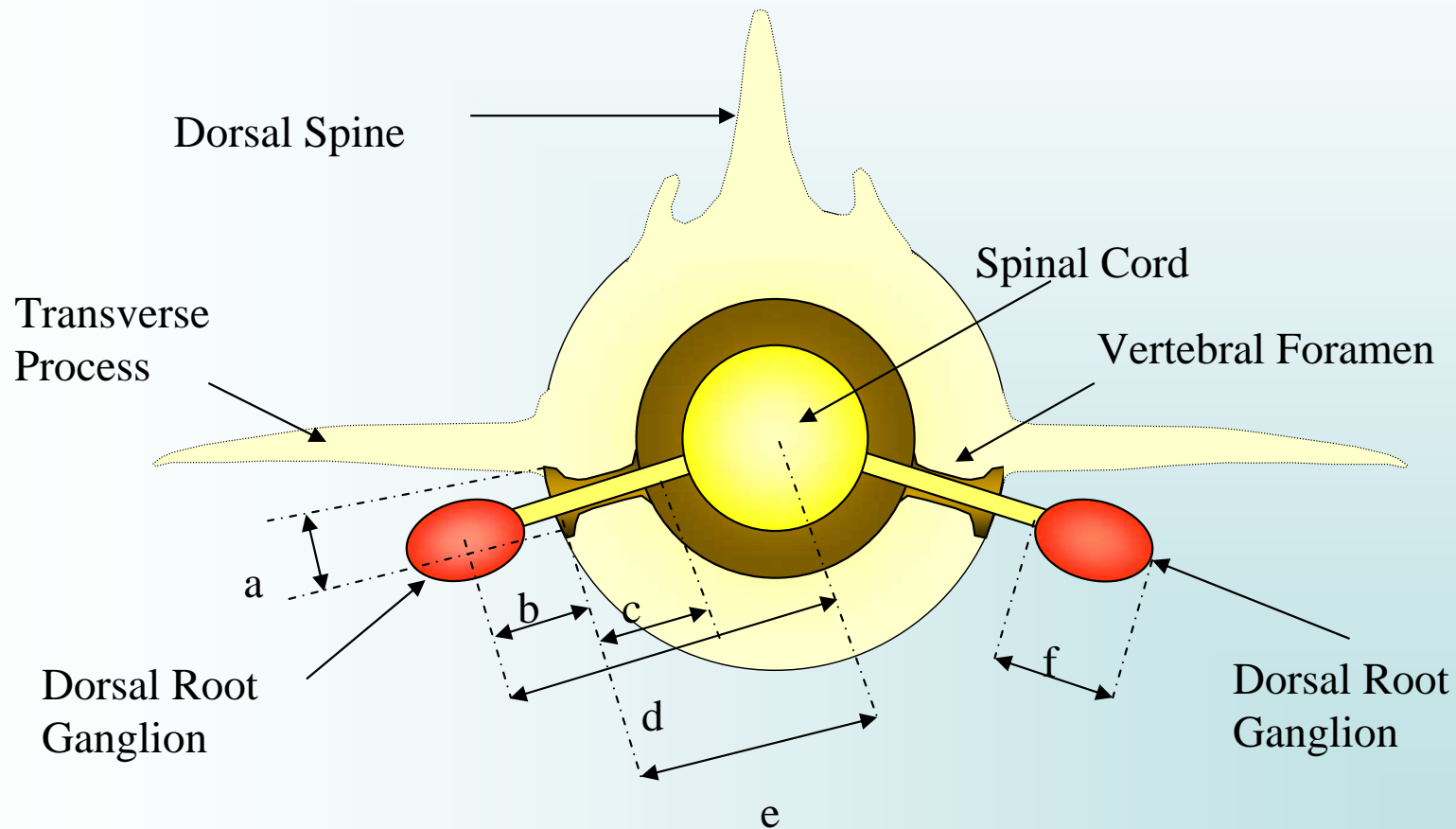
Contamination by CNS tissue during and after splitting and handling

FSA and European projects

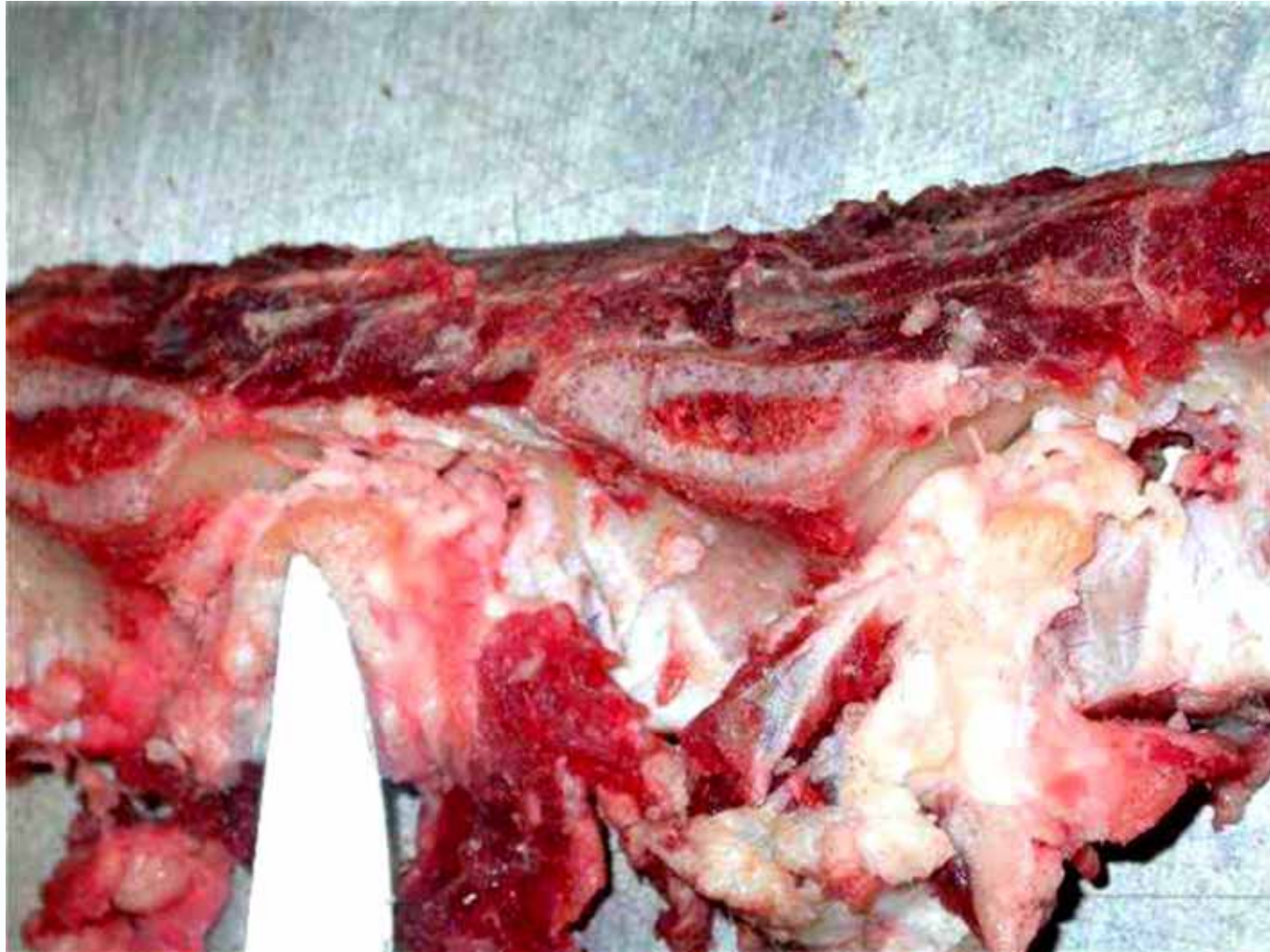
Alan Fisher, Chris helps et al



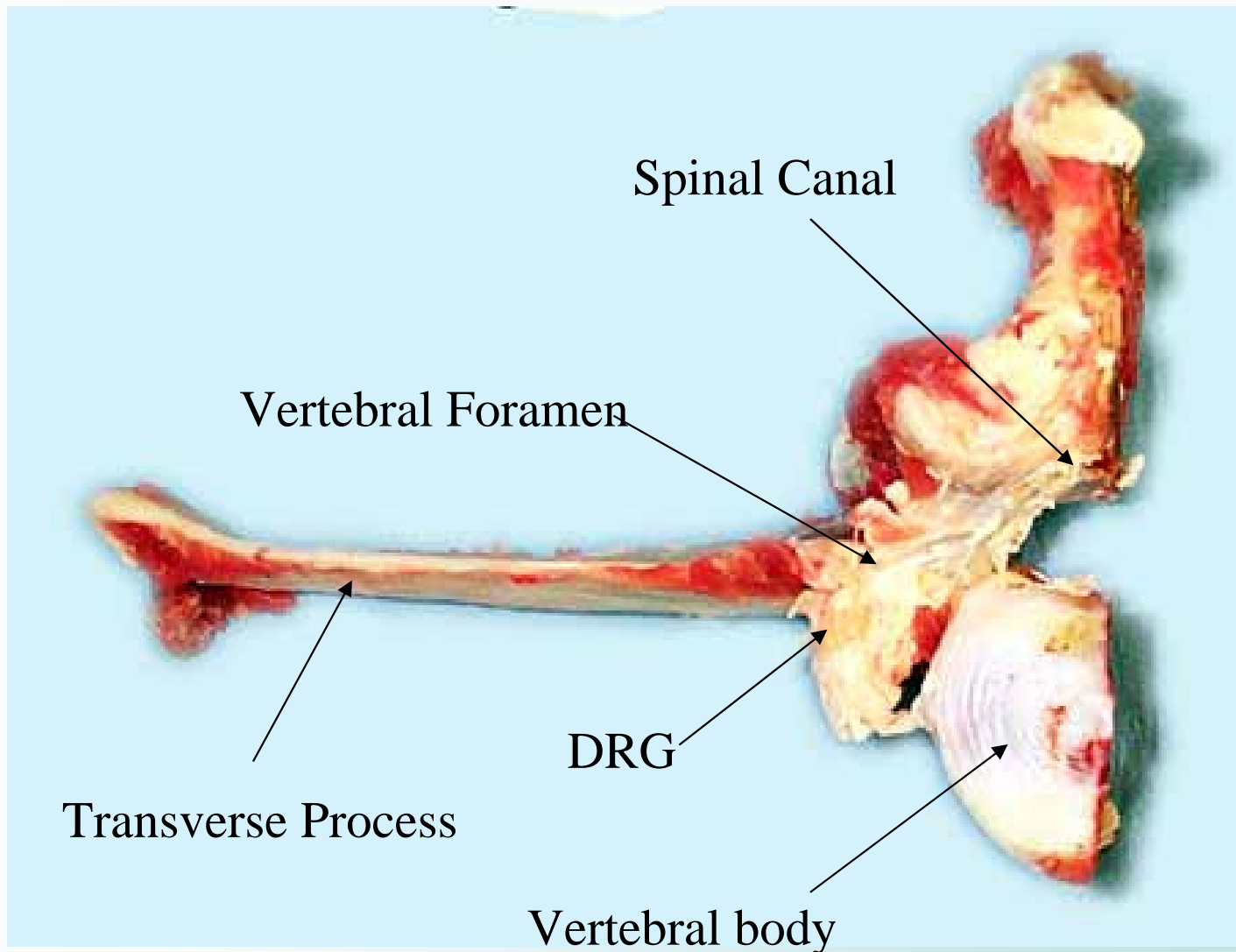
Schematic cross-section of the vertebral column showing measurements taken to define position of DRG in relation to the spinal column



Example of lumbar region showing DRG following dissection



Photograph of lumbar vertebrae showing position of DRG



Monitoring the fate of CNS tissues and dorsal root ganglia (DRG) during carcass dressing and butchery, and proposed remedial action

- ❖ DRG can be removed with meat during boning of beef carcasses. Reduced risk equates to lower yield and more SRM. Two current and one 'designer' boning methods were compared
- ❖ CNS tissue builds up in the chambers of the beef splitting saw and can transmit to subsequently split carcasses. Improved saw design may reduce cross contamination
- ❖ CNS tissue adheres to the split vertebral face after splitting carcasses and contaminates boneless meat. Methods to remove this tissue need to be assessed
- ❖ To avoid carcass self contamination by CNS tissue, alternatives to medial plane splitting must be implemented. One method is to remove meat from the intact skeleton
- ❖ Cross contamination of beef sides by CNS tissue may occur if contact is made with other sides (e.g. during transfer to the chiller). The extent and magnitude of transfer is not known

Experimental approaches: (a) boning

- ❖ Boning comparisons, within carcass basis (different method for each side)
- ❖ 36 carcasses, boned joints contained vertebral bone: neck, chuck, fore-rib, loin and rump
- ❖ Each item weighed to the nearest 0.01kg and the operation timed

Experimental approaches: (b) vacuum removal

- ❖ Vac-San hot water vacuum system (Kentmaster (UK) Ltd.), water sprayed at 98–100⁰ C, 0.7 bar. The water and tissue particles completely re-entrained by the suction head
- ❖ 10 carcasses, one side Vac-San, other control
- ❖ ELISA analysis for GFAP

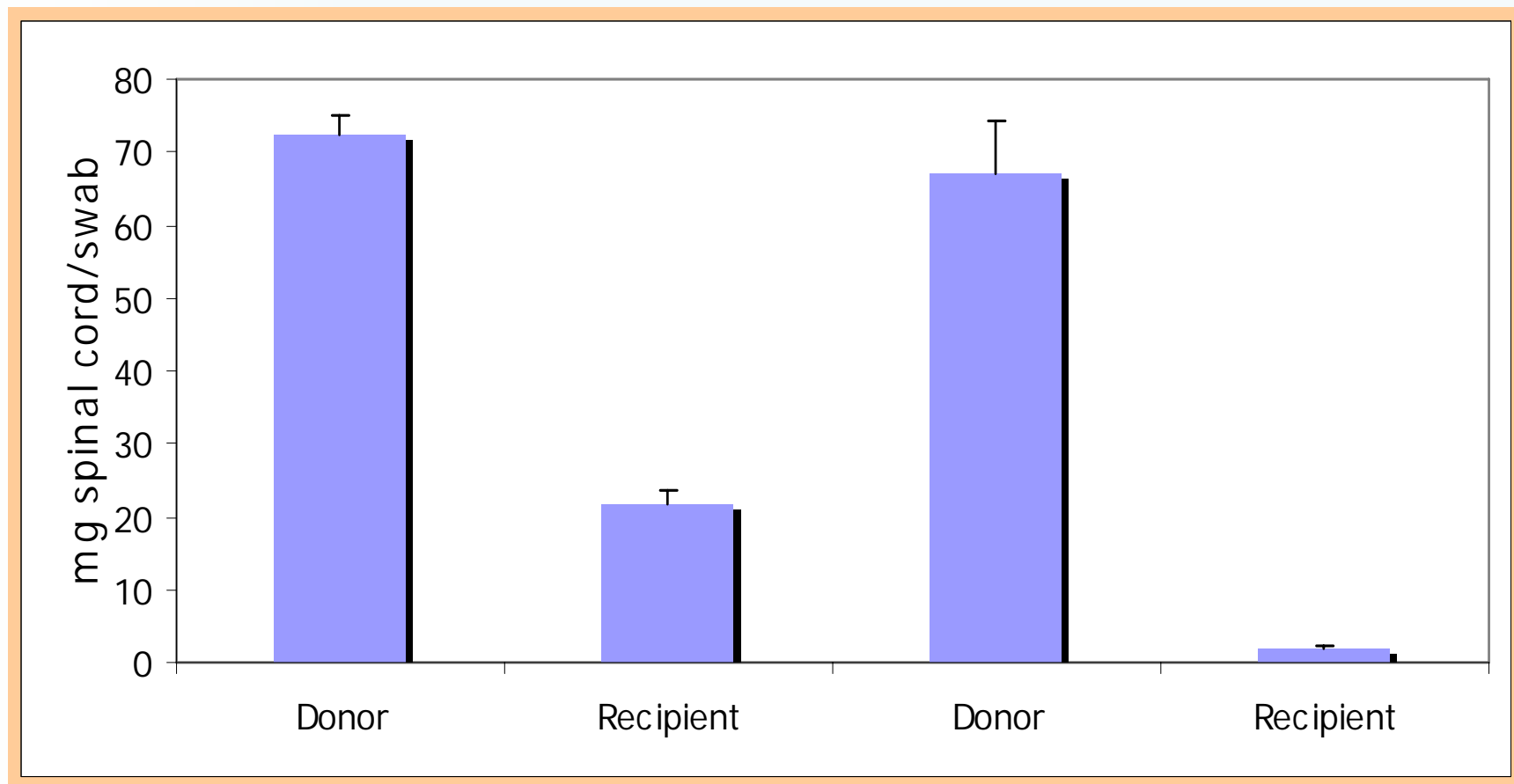
**The bones from the neck joint after removal by the
Traditional method (left), Sheet method (centre) and
DRG Special method (right)**



Mean weight (mg) of spinal cord tissue recovered from the cut surface of the spinal column by sponge (cervical to thoracic) and by knife (lumbar to caudal)

Nominal treatment time	150 seconds Vac-San	0 seconds (control)	Reduction factor
Cervical to thoracic	5.45±2.52	32.99±19.65	x 6.1
Lumbar to caudal	5.23±4.81	24.78±17.55	x 4.7

Amount of spinal cord tissue removed by swab on the lateral surface of beef sides after contact with Y chromosome spiked sides



Removal of whole spinal column by an oval saw



Conclusions

- ❖ Current abattoir and cutting plant procedures can contaminate carcasses with brain tissue, spinal cord and DRG
- ❖ A non-invasive stunning method should be considered
- ❖ A boning method that reduces/eliminates the risk of DRG being included in saleable meat slightly increases the cost to industry
- ❖ Self-cleaning carcass splitting saws can reduce the risk of cross-contamination
- ❖ Hot water-vacuum equipment is effective at removing spinal cord material from beef sides
- ❖ Hot boning avoids invasion of the spinal canal and avoids contamination by spinal cord tissue.

Conclusions

- ❖ In addition to CNS contamination, pathogen bacteria continue to present problems at abattoirs
- ❖ Food Standards agency aims to reduce incidence of foodborne pathogens in the UK by 20% in 2006 (Since 2002)
- ❖ Current concerns include:
Campylobacter species, *Salmonella* species, *Escherichia coli* 0157, *Listeria monocytogenes* and *Clostridium perfringens* and Avian Influenza