# Final Project Report No. 1000003778

# Rapid Evidence Assessment: Cost and impact of castration in lambs

Lot 9 - Evidence for Farming Initiative

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# 1 Executive Summary

This report was commissioned by AHDB to evaluate the existing evidence-base of lamb castration techniques on lamb productivity and welfare and how these techniques could be replaced, reduced, or refined (the 3 Rs) on farms in England. This report gives insights into the overall picture of the evidence landscape for practices applicable to castration in lambs across hill, upland, and lowland systems. These systems cover extensive systems selling predominantly store lambs, forage-based systems finishing the majority of lambs at grass/ forage crops, and intensive systems that aim to sell finished lambs from creep-fed systems at a young age.

The outputs of this research will enable farmers to evaluate their on-farm practices and support informed decision making, at an individual farm level, on lamb castration techniques that may improve welfare, productivity and profitability and minimise environmental impacts.

This project used a rapid evidence assessment (REA) approach to determine the welfare impact, productivity, profitability, and environmental impacts of lamb castration practices. An REA is a method of quickly collating and analysing the evidence base on a particular subject, by being limited in size (number of papers) and/or scope (metrics or measures/indicators) assessed). The study investigated the impact of each practice on lamb welfare, productivity metrics (productivity indicators), profitability metrics and environmental metrics (Green House Gas (GHG) emissions, air and water quality, soil health and biodiversity).

In total, ten castration practices were identified and assessed. For practices where sufficient evidence was identified, a narrative summary was produced. Each summarises the impacts of a practice across primary areas of concern to both farmers and consumers, such as animal welfare and additional costs borne by the producer and presents the information in a farmer-facing format covering: what the practice is, what best practice looks like, where it is most applicable and how robust the evidence base is. For practices where there was limited evidence, a brief discussion was provided, summarising what the practice is, highlighting the evidence gaps.

This process provided a review of established and newly emerging castration practices (Table 1). Six castration practices were found to have multiple papers providing quantitative data with which to create a full narrative summary. Four of the practices investigated in this REA were found to have limited quantitative data to support their value in improving welfare, productivity, profitability, or environmental sustainability. Recommendations on how to address the evidence gaps for each of these practices are presented in Section 6. While these practices may be the subject of comprehensive reviews, with much discussion on the practice, the problem it is addressing and the

barriers to uptake, there was limited quantitative evidence to be able to determine the impact on the outcomes investigated. A summary of the outcomes of each practice is presented below.

*Table 1 List of practices selected for review, highlighting where there was sufficient evidence to complete a full narrative summary and where evidence was limited, and recommendations were provided instead.*

| **Practice** | **Description/scope** | **Summary or recommendations** |
|---|---|---|
| Leave lambs entire | Not castrated - baseline practice against which the others are assessed | Full summary |
| Rubber ring (elastration) | Rubber ring (band) applied to neck of scrotum | Full summary |
| Clamp castration (e.g. Burdizzo) | Spermatic cords are crushed by application of a clamp to the neck of the scrotum | Full summary |
| Rubber ring and clamp combined | Combination of the two practices above - rubber ring applied, and clamp (Burdizzo) used | Full summary |
| Short scrotum | Testicles are pushed against body wall with rubber ring applied to the empty scrotum | Full summary |
| Surgical | Testicles are completely removed via an incision in the scrotum | Full summary |
| Immunocastration | Vaccine which prevents the release of the gonadotrophin releasing hormone (GnRH) | Recommendations |
| Chemical/hormonal castration | Injection of chemicals into the testicles | Recommendations |
| Castration with use of anaesthetic simultaneously | NumNuts® technique.<br>Application of rubber ring with local anaesthetic applied at same time using a combination applicator | Recommendations |
| Other crush methods | ClipFitter system – Use of a plastic clip applied to the neck of the scrotum | Recommendations |

The discussion explored how each castration practice impacts on lamb welfare, productivity, profitability and environmental sustainability and how these techniques could be replaced, reduced, or refined (the 3 Rs) on farms in England.

# 2 Introduction

## 2.1 Background

Castration is a routine husbandry procedure performed on some male lambs. There is no public information available at a national level on the proportion of lambs castrated across the UK, although there appear to be regional differences, with Gascoigne et al. (2021) reporting anecdotally that fewer lambs are castrated in Wales than England. The key reasons for castrating ram lambs include ease of behavioural management, such as preventing fighting between rams, and being able to keep male and female lambs together whilst mitigating the risk of unwanted pregnancies. Castration reduces 'ram taint', which is an alteration in the qualities of the meat which develops due to the presence of testosterone, which causes an unpleasant taste (Craigie et al., 2012; Gravador et al., 2018; Schreurs, 2013). This creates issues for the supply chain due to customer expectations and the impact of poor-quality products on repeat purchases of lamb products.

Castration is governed by several pieces of legislation with slight differences seen between England, Scotland and Wales. The following are relevant to England:

- Veterinary Surgeons Act 1966,
- The Welfare of Livestock (Prohibited Operations) Regulations 1982,
- The Animal Welfare Act 2006
- The Mutilations (Permitted Procedures) (England) Regulations 2007

This legislation covers the method of castration permitted in England, the age limits for different methods, the requirement of anaesthesia for castration, and who is legally permitted to carry out the procedure. Links to the legislation can be found in Section 8, and a summary of relevant passages and implications for castration practices can be found in Appendix 1.

In England, lambs can be legally castrated using the following methods:

- Rubber ring (elastration)
- Clamp castration
- Short scrotum castration,
- Combined rubber ring and clamp castration
- Surgical castration

Figures on the relative popularity of the techniques are not reported, but castration by rubber ring is anecdotally the most commonly used method (Farm Animal Welfare Council, 2008; Animal Welfare Committee, 2022). This involves the application of a rubber ring to the neck of the scrotum to stop

blood supply to the testicles, which may be less painful than surgical castration (Farm Animal Welfare Council, 2008; Gascoigne et al., 2021).

The pain caused by castration and its widespread use in sheep production is of concern amongst consumers (Connor and Cowan, 2020), and also for the sheep sector in general, with the British Veterinary Association and the Sheep Veterinary Society issuing a joint policy statement on the matter (British Veterinary Association, 2020). Various animal welfare charities, such as Compassion in World Farming and People for Ethical Treatment of Animals, have also expressed concerns (CIWF, 2022; CIWF, 2023; PETA, 2023; Stevenson, 1994). Farm assurance schemes, such as Red Tractor, require consideration to be given as to whether castration is necessary and for the chosen method to be detailed within the flock health plan (Red Tractor, 2022). Whilst the RSPCA assurance scheme (RSPCA, 2020) additionally requires specific permission to be granted to an individual farm on an annual basis. The RSPCA scheme will not grant permission where lambs are slaughtered before reaching sexual maturity or where lambs can be segregated by sex. It also requires the use of long-acting pain relief when castration is carried out. Where rubber ring castration is used the RSPCA scheme recommends the use of both local anaesthetic and long-acting pain relief. Similarly, the Soil Association standards state that castration may only be carried out to 'maintain product quality and traditional production practices' and that 'any suffering to the animals must be reduced by applying adequate anaesthesia and/or analgesia' (Soil Association, 2023).

AHDB is interested in evaluating the evidence landscape in relation to lamb castration procedures, and what practices work for improving lamb productivity and welfare across all production systems to enable informed decision making according to individual farm needs. Each method is reviewed for how each practice can be reduced, refined or replaced (the 3 Rs). These cover extensive systems selling predominantly store lambs, forage-based systems finishing the majority of lambs at grass, and intensive systems that aim to sell finished lambs from creep-fed systems at a young age. In this context, Gascoigne, et al. (2021) argue that reduction would focus on decreasing the number of lambs exposed to the procedure by identifying lambs that do not require castration; for example, those expected to reach finished condition before sexual maturity. Refinement would involve the modification of the techniques already used on a given farm to reduce the pain involved through, for example, the use of local anaesthetic or analgesia (pain relief). In contrast, replacement would exchange existing castration practices for different ones, with the potential to cause less pain and raised welfare standards. The project also considers the direct and indirect impact of the chosen practices on profitability and the wider environmental sustainability at individual farm and the wider sector level. The evidence gathered in this project has been evaluated and synthesised using the

AHDB evidence framework and presented as a series of narrative summaries targeted at a farmer audience. Where evidence or data is missing these gaps are highlighted.

## 2.2 Definitions

**Animal welfare** can be defined by considering three different aspects: 1) the mental status of an animal, such as whether the animal is content or is it suffering, 2) the physical status of an animal, such as whether the animal is healthy and pain free, and 3) the naturalness of an animal, for example, is the animal able to live a normal life?

**Productivity** is defined in this report as the ratio of outputs to inputs. Inputs are defined as labour, feed, veterinary costs, and other consumables. Outputs are defined as weight of finishing lambs, carcase quality, and meat quality. For the purpose of this report the main output of the sheep flock is considered the number of weaned lambs and/or average weight of weaned lambs. This metric (performance indicator) was selected to ensure continuity across all production systems where lambs may be sold finished, sold as stores, or retained as breeding stock.

**Profitability** can be associated with productivity, though profitability can also be increased by creating more value per unit of output or by reducing losses. Key indicators of profitability include feed conversion efficiency and meat quality.

Different castration practices have varying associated costs, for example the purchase of equipment, labour costs, or veterinary and medicine costs.

**Environmental sustainability** considers several aspects of the natural environment that are affected by lamb production. No studies were found during the REA process that specifically explored the environmental sustainability impact of different castration techniques. However, practices that result in improved productivity are likely to contribute to a reduction in environmental impact by reducing the emission levels per unit of production. The use of consumables (rubber rings) in rubber ring castration may also have a lifecycle impact on the environmental sustainability of the practice.

**The 3Rs (reduce, refine, and replace)** were initially developed in a laboratory context, but here they are considered in relation to castration practices in male lambs. The definitions were revised by Gascoigne et al. (2021) and have been adapted for use as an improvement framework in this context. For the purpose of this report, the 3Rs are defined as:

- Reduce – Reducing the number of animals exposed to the current practice

- Refine – Modifying the existing practice on an individual farm to improve the welfare outcome associated with the procedure
  Replace – Switch to a different castration practice

# 3 Aims and Objectives

**Aim:** Determine what castration methods are effective for improving lamb welfare, productivity, profitability, and environmental sustainability, through replacement, reduction and refinement at farm level.

**Objectives:**

- Identify and provide evidence on the range of castration practices used across the full range of English sheep production systems (hill, upland, and lowland)
- Provide evidence on welfare, productivity, profitability, and environmental sustainability metrics (measures/indicators) in a format which is accessible to farmers
- Identify gaps in the evidence and future technologies which would support future improvements in lamb welfare and productivity.
- Provide context as to how each castration practice discussed relates to existing legislation and to farm assurance schemes.

# 4 Methodology

A rapid evidence assessment (REA) is an approach to review an evidence base under time or resource constraints. An REA applies the same methodological steps as a more comprehensive literature review but makes concessions in terms of the number of databases searched, the quantity or type of evidence collected, or the amount of data extracted from each piece of evidence. This enables REAs to be delivered within a relatively short period of time while still providing a robust evidence summary (Collins et al., 2015). Section 4.1 provides a summary of the REA methodology used.

The REA methodology was used to generate and evaluate an evidence base of academic, grey and industry literature on the impact of different castration practices on lamb welfare, productivity, profitability, and environmental sustainability across the full range of English sheep production systems. This evidence base was then evaluated using the framework outlined in Section 4.2**Error! Reference source not found.**.

## 4.1 Rapid Evidence Assessment

The REA methodology consisted of the following steps:

1. Identify practices
2. Define search terms
3. Literature search and evidence collation
4. Evidence screening
5. Evidence evaluation

### 4.1.1 Identify practices

An initial list of castration methods of interest was provided by AHDB, which were reviewed to ensure that each method had a clear action and measurable outcome. A review of key literature sources and position statements was carried out to identify any other relevant castration practices. These included the following:

- FAWC Report on the implications of castration and tail docking for the welfare of lambs (Farm Animal Welfare Council, 2008)
- BVA Policy statement on Sheep castration, tail docking and pain management (British Veterinary Association, 2020)
- Considering the 3Rs for castration and tail docking in sheep (Gascoigne et al., 2021)

No additional castration methods were identified following the review, and the final list of 10 methods were discussed and agreed with AHDB.

### 4.1.2 Define search terms

For each practice, search terms were created using an adapted version of the Population, Intervention, Comparator and Outcome (PICO) methodology as described by James et al. (2016). This enables consistent and comprehensive searching of each database for evidence that may support the impact of the practice. The search terms capture what the practice is, what the desired outcomes are (e.g., welfare, productivity, profitability, and environment), as well as restricting to certain evidence types (e.g., review papers). Inclusion and exclusion criteria were used to draw boundaries between what is and is not relevant to typical English sheep systems, e.g., by excluding certain countries or production systems (e.g. dairy systems were excluded as they fall outside the remit of AHDB). An example set of search terms is shown in Table 2.

*Table 2 Example set of search terms created using the PICO methodology.*

| Practice | Population | Intervention | Outcome | Include | Exclude |
|---|---|---|---|---|---|
| **Clamp castration (Burdizzo)** | (Review OR meta-analysis) AND (lamb OR ram OR sheep) | (clamp* OR castration* OR clamp castration* OR Burdizzo) | (product* OR efficiency OR welfare OR profitability OR sustainability OR environment) | UK, Europe (top 5 lamb producers), New Zealand, Australia, USA | South America, Africa, Dairy sheep |

### 4.1.3 Literature search and evidence collation

The search terms were then used to collate up to twenty pieces of literature (e.g., academic papers, reports, industry articles) for each practice, which provided evidence that the practice had an impact on lamb welfare, productivity, profitability and/or environmental sustainability. Selecting up to twenty papers balances the need for a robust selection of papers that cover the practice adequately and the time and resource restrictions of the REA process. Where no conclusive results were found during the main searches, a more targeted search was carried out. A tiered search process was used to maximise the quantity and quality of evidence (*Figure 1*). Initially, the search focused on review papers on the Web of Science platform, then Google Scholar and then the wider grey literature, adjusting the search terms and/or database until enough evidence was collated. Once the process had been completed or the maximum of twenty papers had been reached, each paper was downloaded and catalogued using referencing software Zotero, to ensure consistency of referencing. Throughout the search process, preliminary title screening was done to remove any papers that were obviously irrelevant and provide a higher quality evidence base for subsequent analysis.




*Figure 1. Summary of tiered search process.*

### 4.1.4 Evidence screening

The aim of screening was to refine the list of up to twenty papers for each practice down to only those that were relevant. Previous REAs carried out for Defra and the Levy Boards have shown that 3-5 high quality meta-analyses can provide a robust evidence base for evaluation, with additional papers used to clarify specific points. Abstracts/summaries for each paper were reviewed and scored using a traffic light system based on the relevance of the information, with 'green' papers judged to

contain substantial amounts of high-quality evidence on at least one of the key areas of interest/indicator, 'amber' papers having a lesser degree of relevant information or lacking detail or accuracy needed for a 'green' rating, and 'red' papers no relevant information or not meeting the inclusion criteria due to geographic location or production system. Green papers were progressed to evaluation, red papers were excluded, while amber papers were screened by a second reviewer who assigned either a green or red score.

### 4.1.5 Evidence evaluation

Each paper that passed the screening process was evaluated using a strict framework. Metadata for each paper were recorded, including paper type, study type, author, year of publication, country of study, etc. The reported impact of the paper's focus on various outcomes was recorded alongside the metadata, which provides a proxy for the robustness of impacts reported in the paper. This information was recorded in an Excel based framework, with a column for each assessed metric (indicator) and a row for each paper being evaluated. A visual summary is provided in Table 3.

Once all papers were evaluated, the scores for both the effectiveness of the method and the quality of the evidence base were assessed using the AHDB evidence standards outlined in Section 4.2 below to determine the overall impact.

Practices discussed in this report are scored against the baseline approach of leaving males entire. This therefore leads to a baseline position of all castration practices in fact having a potentially negative impact on welfare. This 'doing nothing' approach could be considered to have fewer welfare implications compared to castration, provided that the producer has adequate space, infrastructure, labour, and time to keep entire rams and ewes separately, or ram lambs are moved off-farm before reaching sexual maturity.

Allowing rams to remain entire still has welfare implications, such as frustration and fighting between rams, though these can be minimised with effective management. Profitability can also be impacted, with reduced market appeal for older entire male lambs from some processors/retailers due to the potential for ram taint in entire ram meat, though this is minimised where lambs are slaughtered before reaching maturity (Clements and Bright, 2010).

*Table 3 Example of the assessment framework table showing how reference sources were identified and the categories used to extract information from each paper.*

| **ID** | **Metadata** | | **Welfare** | **Productivity** | | **Profitability** | **Environment** |
|---|---|---|---|---|---|---|---|
| | | | | Outputs | Inputs | | |
| Practice no.<br>Paper no. | Author<br>Publication date | Paper type<br>Study type | Behaviour<br>Pain response<br>Infection/disease<br>Hunger/thirst<br>Mortality<br>3Rs | Number lambs weaned<br>Avg. weight weaned lambs<br>Growth rate lambs<br>Carcase attributes<br>Meat quality | Labour<br>Feed<br>Vet and med<br>Infrastructure<br>Other inputs | Added value<br>Reduced costs<br>Resilience<br>Diversification<br>Consumer perception | Air<br>Water<br>Soil health<br>Biodiversity<br>GHG |

## 4.2 Creation of narrative summaries

Where there were multiple papers providing quantitative evaluation of the impact of the practice across one or more outcomes, a narrative summary was produced, bringing together the evidence collected in the REA process. Narrative summaries are farmer-facing overviews of the practice and its impact, answering key questions on:

- What the practice is
- What is the impact on animal welfare?
- What is the impact on productivity?
- What is the impact on profitability?
- What is the impact on environmental sustainability?
- Where does the practice work?
- How much does the practice cost?
- How can the practice be done well?
- What are the legal implications of the practice?
- How do farm assurance schemes manage the practice?
- How strong is the evidence for the practice?
- How the 3Rs (Replace, Reduce, Refine) could be applied
- Where can further information be found?

Where there was insufficient evidence to quantify the impact of the practice, a shorter summary was provided, with a section making specific recommendations to address evidence gaps going forward.

### 4.2.1 Summary tables

Each narrative summary is accompanied by a summary table (Table 4), which shows the impact of the practice across a range of key metrics (indicators). To streamline the summary tables, some metrics have been grouped together as the outcomes were consistently similar with reference to impact. Information is included on the quality of the evidence base, costs, and time associated with implementation, and applicability to different English sheep production systems. Symbols are used to describe the overall result of the evaluation and an explanation of these is given below. These symbols and definitions are consistent with AHDB's Evidence for Farming Initiative Draft Evidence Standards and allow for a semi-quantitative comparison of the impacts and costs of different practices, as well as understanding the strength of evidence that supports these assumptions.

*Table 4 Example narrative summary table (please note this is for illustrative purposes only)*

| **Practice impact on:** | | | | | |
|---|---|---|---|---|---|
| **Welfare** | **Productivity** | | **Profitability** | **Environmental sustainability** | |
| Relative to entire lambs | Increased outputs | Decreased inputs | Added value | Soil and Water | GHG<br>Air and climate<br>Biodiversity |
| - | + | ++ | 0 | + | + |
| | | | | | |
| **Evidence base** | | | | | |
| Quality | ●●●●○ | | **Cost to implement** | | £ |
| Relevance | ●●●●○ | | **Speed of change** | | Fast |
| Overall | ●●●●○ | | **Production system** | | All |

### 4.2.2 Effectiveness

Effectiveness is assessed in terms of positive versus negative effect on the farm. With '+' indicating positive and '–' indicating negative. However, the evidence is often not as clear cut in the case of some practices (i.e. a given practice might not necessarily always be one way or the other), so the evaluation framework allows for some nuance in that assessment – see Table 5**Error! Reference source not found.**. Effectiveness was assessed across the three core focus areas of productivity, profitability and environment. Details are given below of the questions asked and what they mean.

*Table 5 Evidence for Farming Initiative – Symbols used to quantify the effectiveness or impact of the practice on the core focus areas of productivity, profitability, and environment.*

| | |
|---|---|
| **-** | **Evidence tends to show a negative effect.** The balance of evidence (including the pooled effect size where available) suggests that the practice has a negative effect, meaning the practice made things worse. This takes into consideration the number of studies showing positive and negative effects, and the levels of involvement (number and size of participating entities) in those studies |
| **0** | **No effect.** The balance of evidence (including the pooled effect size where available) suggests that the practice has no effect overall |
| **+/-** | **Evidence tends to show a mixed effect.** Studies show a mixture of effects and the criteria for 'tends to negative effect' or 'tends to positive effect' are not met |
| **+** | **Evidence tends to show positive effect.** The balance of evidence (including the pooled effect size where available) suggests that the practice has a positive effect. This takes into consideration the number of studies showing positive and negative effects, and the levels of involvement in those studies |
| **++** | **Evidence shows consistently positive effect.** The evidence (including the pooled effect size where available) consistently suggests that the practice has a positive effect. This takes into consideration the number of studies showing positive and negative effects, and the levels of involvement in those studies. This does not intend to reflect the magnitude of the effect |

### 4.2.3 Welfare

- Does the practice have a positive/negative impact on the welfare of lambs when compared to the baseline practice of leaving lambs entire?

### 4.2.4 Productivity

- Number of lambs sold: Does the practice increase/decrease the number of lambs sold? A positive effect was assumed to be an increase in lambs sold.
- Average weaned weight: Does the practice increase/decrease the average weight of weaned lambs? A positive effect was assumed to be an increase in average weight of weaned lambs.

### 4.2.5 Profitability

- Added value: Does the practice increase/decrease the average price per kg received? A positive effect was assumed to be an increase in average price per kg sold.
- Reduced cost: Does the practice increase/decrease input costs, e.g. feed, labour? A positive effect was assumed to be a reduction in input costs.

### 4.2.6 Environment

- Air quality: Does the practice increase/decrease ammonia emissions? A positive effect was assumed to be a reduction in ammonia emissions.

- Water quality: Does the practice increase/decrease nitrate leaching? A positive effect was assumed to be a reduction in nitrate leaching.
- Soil: Does the practice improve/degrade soil health? A positive effect was assumed to be an improvement in soil health.
- Climate: Does the practice increase/decrease greenhouse gas (GHG) emissions? A positive effect was assumed to be a decrease in GHG emissions.
- Biodiversity: Does the practice increase/decrease net biodiversity on-farm? A positive effect was assumed to be an increase in net biodiversity.

***Other factors affecting the implementation of the practice***

There were several other factors that were used to understand the impact of implementing the practice on farm. These factors aimed to identify the following:

- Cost to implement: How expensive is it to implement the practice? (See Table 6)
- Time to implement: What is the timeframe to implement the practice? (See *Table 7*Table 7)
- Suitable systems: Which lamb production system(s) is the practice relevant to?
- Legislation: what legal requirements are relevant to the practice?

*Table 6. Evidence for Farming – Symbols used to represent the cost of implementing the practice on farm.*

| | |
|---|---|
| **£** | No new equipment or time constraints over and above existing business as usual (BAU) running costs |
| **££** | May need some additional time for training or experiential learning to establish new practice, but once implemented this rapidly transitions into business-as-usual running costs |
| **£££** | As above, plus new equipment and capital costs for machinery and implements on farm |
| **££££** | Major investment in new infrastructure on farm and/or loss of land utility/land use change that is greater than the normal rotation(s) |

*Table 7. Evidence for Farming – Quantification of the speed of change following the implementation of a practice.*

| | |
|---|---|
| **Fast** | Effective immediately, change within 0-3 months |
| **Moderate** | Effective within 12 months |
| **Slow** | Effective in longer than 12 months |

### 4.2.7 Strength of evidence

The final piece in the assessment table is the evaluation of the strength of evidence (see

Table 8) which was separated into three parts:

- Quality: What is the robustness of the literature reviewed?
- Relevance: How relevant are the experimental techniques to commercial farming operations?
- Overall: How confident are we in the overall result determined from the REA?

*Table 8. Evidence for farming – Evaluation of the strength of evidence. Symbols used in the narrative summary tables and the explanation of what they mean.*

| | Very high | High | Moderate | Low | Very low |
|---|---|---|---|---|---|
| | ●●●●● | ●●●●○ | ●●●○○ | ●●○○○ | ●○○○○ |
| **Quality of literature** | An extensive body of high-quality evidence reviews | A developing body of high-quality evidence reviews | Studies of the highest quality (randomised control trial equivalent) OR at least one high-quality evidence review | Studies using quasi-experimental methods OR at least one moderate-quality evidence review | High quality observational studies |
| **Relevance of context** | As level 4, but with excellent contextual and implementation insight drawn from high-quality studies and on-farm practice | Includes evidence generated in farming and growing businesses with farmers and growers testing the practice | Evidence generated in farming and growing businesses with the practice applied by professional researchers | Evidence generated in research centre farming and growing facilities | Evidence generated through laboratory research |
| **Overall** | We can draw very strong conclusions about impact and be highly confident that the practice does/does not have the effect anticipated.<br><br>The body of evidence is very diverse and highly credible, with the findings convincing and stable | We can draw strong conclusions about impact and be confident that the practice does/does not have the effect anticipated.<br><br>The body of evidence is diverse and credible, with the findings convincing and stable | We can draw some conclusions about impact and have moderate confidence that the practice does/does not have the effect anticipated.<br><br>The design of the research allows contextual factors to be controlled for | We believe that the practice may/may not have the effect anticipated. The body of evidence displays significant shortcomings.<br><br>There are reasons to think that contextual differences may substantially affect practice outcomes | The body of evidence displays very significant shortcomings.<br><br>There are multiple reasons to think that contextual differences may unpredictably and substantially affect practice outcomes |

## 4.3 Outcome of the REA

In total ten practices were evaluated via REA covering each of the agreed castration practices. Six were deemed to have a sufficient evidence base to present a full narrative summary, while four had more limited evidence which meant a full summary was not possible and so background information and recommendations were provided instead (Table 9).

*Table 9 List of practices selected for review, highlighting where there was sufficient evidence to complete a full narrative summary and where evidence was limited, and recommendations were provided instead.*

| **Practice** | **Description/scope** | **Summary or recommendations** |
|---|---|---|
| Leave lambs entire | Not castrated – baseline practice against which the others are judged | Full summary |
| Rubber ring (elastration) | Rubber ring (band) applied to neck of scrotum | Full summary |
| Clamp castration (e.g. Burdizzo) | Spermatic cords are crushed by application of a clamp to the neck of the scrotum | Full summary |
| Rubber ring and clamp combined | Combination of the two practices above – rubber ring applied, and clamp (Burdizzo) used | Full summary |
| Short scrotum | Testicles are pushed against body wall with rubber ring applied to the empty scrotum | Full summary |
| Surgical | Testicles are completely removed via an incision in the scrotum | Full summary |
| Immunocastration | Vaccine which prevents the release of the gonadotrophin releasing hormone (GnRH) | Recommendations |
| Chemical/hormonal | Injection of chemicals into the testicles | Recommendations |
| Castration with use of anaesthetic simultaneously | NumNuts® technique.<br>Application of rubber ring with local anaesthetic applied at same time using a combination applicator | Recommendations |
| Other crush methods | ClipFitter system – Use of a plastic clip applied to the neck of the scrotum | Recommendations |

# 5 Practices with a robust evidence base

This section presents narrative summaries for practices that had a sufficient quantity and quality of evidence identified within the literature base. In practice, this means at least one high quality review or multiple individual papers providing data on the impact of the practice on welfare, productivity, profitability and/or environmental sustainability.

## 5.1 Narrative Summary – Leaving rams entire

*Table 10 Narrative summary table – Leaving rams entire*

| **Practice impact on:** | | | | | |
|---|---|---|---|---|---|
| **Welfare** | **Productivity** | | **Profitability** | **Environmental sustainability** | |
| Relative to entire lambs | Increased outputs | Decreased inputs | Added value | Soil and Water | GHG<br>Air and climate<br>Biodiversity |
| **N/A** | **N/A** | **N/A** | **N/A** | **N/A** | **N/A** |
| | | | | | |
| **Evidence base** | | | | | |
| Quality | ●●●○○ | | **Cost to implement** | £ | |
| Relevance | ●●●○○ | | **Speed of change** | Fast | |
| Overall | ●●●○○ | | **Production system** | All.<br>Especially in systems that finish lambs before sexual maturity or can manage entire rams separately | |

### 5.1.1 What is leaving rams entire?

Leaving lambs entire is a practice through which management techniques, such as aiming to achieve slaughter weight before rams reach sexual maturity, or managing rams and ewes separately, are used as a replacement for castration in its entirety. For this review, leaving rams entire is considered the baseline for animal welfare.

### 5.1.2 What is the impact of leaving rams entire on animal welfare?

Leaving male lambs entire means that the animals are not exposed to any potentially painful procedures that could have an impact on their freedom from pain, injury and disease, their freedom from discomfort and their freedom to express more normal behaviours. Whilst various castration practices may expose lambs to short term acute and potentially long-term chronic pain, leaving males entire means that exposure is non-existent. However, leaving lambs entire could result in adverse welfare impacts, such as frustration, fighting and unwanted/unplanned pregnancies, which are potential barriers to uptake.

Keeping male lambs entire is the preferred option only where it is a practical and feasible option on-farm. Infrastructure and management procedures need to be in place to cater for lambs reaching sexual maturity, or careful planning must be implemented to ensure that rams are moved off farm before reaching sexual maturity; where this is not possible, castration may be a more appropriate practice.

### 5.1.3 What is the impact of leaving rams entire on productivity?

The literature indicates that keeping rams entire has a positive effect on daily liveweight gain, improves feed conversion efficiency and produces leaner carcases (HCC, 2004). Sales (2014) found that average daily liveweight gain was lower in wethers; similarly, Wellington et al. (2003) describe how in general, males with circulating androgens (male hormones e.g., testosterone) display a more rapid weight gain, reaching the target slaughter weight more rapidly. Entire rams achieved a liveweight of 49kg in 222 days (equivalent to 221g/day), compared to wethers which achieved a liveweight of 50kg in 272 days (equivalent to 184g/day) (Wellington et al., 2003). Gravador et al. (2018) found total weight gain of rams was higher compared to wethers, with Sales (2014) finding no difference in feed intake between wethers and rams. Most studies suggest that entire males have improved feed conversion efficiency compared to castrates (Gravador et al., 2018; Haddad et al., 2006). HCC (2004) report that the combination of higher growth rates and improved feed conversion could result in early crossbred lambs achieving higher slaughter weights (an extra 2-3kg live weight) or by reaching slaughter condition up to 10 days sooner. In creep fed systems this leads to significant feed savings.

### 5.1.4 What is the impact of leaving rams entire on profitability?

The profitability of keeping rams entire may be negatively impacted due to the meat quality of ram lambs being generally considered inferior to the meat quality of castrated lambs. This may present a barrier to uptake of this practice. However, the evidence on meat quality is mixed HCC (2004) suggests that meat from entire males is completely acceptable provided they are managed well and slaughtered at a young enough age. Gravador et al. (2018) conducted a study asking consumers for an evaluation of the sensory quality of Irish lamb meat. Meat from entire rams was not disliked but scored lower in comparison to meat from castrated lambs. However, Clements and Bright (2010) reported that age of slaughter can also influence the taste and quality of lamb meat, with entire lambs slaughtered before reaching sexual maturity showing no quality differences to castrated lamb meat. It has also been suggested that entire lamb meat contains less saturated fat, which is positively aligned with consumer preferences (Gravador et al., 2018).

Wellington et al. (2003) argued that the pattern among entire males is to have a lower carcase weight and a lower carcase grade, primarily because of a lower fat percentage compared to wethers and ewes. Haddad et al. (2006) found the fat thickness on the loin area of castrated lambs was 2.7mm higher than entire ram lambs, and total fat percentage in castrated lamb legs was found to be 4% higher than entire ram lambs. However, studies by Fisher et al. (2010) and Sales (2014) suggest there may not be any significant overall differences with regards to carcase weight between castrated and entire lambs.

Overall, the financial impact of castration versus leaving ram lambs entire is variable. Where producers can take advantage of the superior growth rates and improved feed conversion of entire lambs and meet the requirements of the target market, profitability can be improved. The profitability of entire males sold later in the season is highly dependent on feed costs and can be negatively impacted if processors are reluctant to take entire males. Any financial benefit from higher castrate carcase weights is likely to be minimal when entire lambs and castrates are slaughtered at the same age (Fisher et al., 2010).

### 5.1.5 What is the impact of leaving rams entire on environmental sustainability?

No papers investigating the direct environmental impact of leaving lambs entire were identified. However, higher growth rates, improved feed conversion and potential feed saving indirectly positively impacts flock efficiency (Haddad et al., 2006), thus reducing Greenhouse Gas (GHG) emissions on farm.

### 5.1.6 Where does leaving rams entire work?

Castrating ram lambs intended for slaughter is a widespread practice within the UK, due to concerns over unwanted pregnancy and potential ram taint. However, leaving ram lambs entire can work in a range of systems provided the appropriate management procedures, infrastructure, and land are available to manage ewes and entire ram lambs separately. It is particularly suitable for systems which aim to sell lambs finished before sexual maturity is reached, such as lowland systems that achieve high performance at grass and aim to sell lambs before weaning. Producers may choose to operate a system where they leave single and larger twin lambs that are born early in the lambing season entire; and then castrate later born and smaller males. It can also be suitable if there is sufficient land available to manage ewe lambs and ram lambs in separate management groups, post weaning. General advice is to separate lambs at weaning or by 20 weeks of age at the latest (HCC, 2004). Care should be taken with very early maturing breeds such as Poll Dorset, as sexual maturity may be reached before 14 weeks of age. In these cases, it would be prudent to wean lambs promptly by around 12 weeks of age (Gascoigne et al., 2021).

### 5.1.7 How much does leaving rams entire cost?

There are no direct costs associated with leaving rams entire, with savings made from consumables and labour costs associated with castrating lambs. However, the management of entire ram lambs is likely to incur indirect costs, such as the establishment and/or maintenance of adequate fencing, and additional labour costs, although such expenses are hard to define as they will vary from farm to farm.

### 5.1.8 How can leaving rams entire be done well?

To be able to keep male lambs entire, producers need to have the right management tools and infrastructure in place to mitigate potential risks. Producers need proactive forward plans in relation to the time of year in which they plan to market lambs, to ensure that entire males can be managed separately or are sent to slaughter before they reach sexual maturity. Producers should also operate a contingency plan, to ensure sufficient space and appropriate fencing are available to separate entire male lambs from ewes should they reach sexual maturity before being sent to slaughter (BVA, 2020). For improved welfare (as well as meat quality and reduced feed costs) it would be considered good practice to finish entire lambs as quickly as possible.

To achieve a production system which allows rams to be left entire, some consideration could be made to the selection of breed. Gascoigne et al. (2021) noted that breed selection can be used as part of a castration reduction strategy, by choosing breeds that will finish before sexual maturity. HCC (2004) suggest that early maturing breeds (e.g. Hampshire Down, Dorset, Suffolk, Charollais etc.) with high potential growth rates would benefit from being left entire. Studies have shown that any difference in growth rates or performance that exists between castrated and uncastrated lambs is not influenced by breed (Claffey et al., 2018; Fisher et al., 2010; Ribeiro et al., 2003), however this does not necessarily translate into equal welfare outcomes across breeds. Different breeds show different levels of distress following castration (Archer et al., 2004) and farmers have reported that certain breeds of sheep are easier to castrate than others (Hosie et al., 1996). Therefore, for some breeds, the highest welfare option available could be to always leave rams entire. While more research on breed choice must be done before definitive guidance can be made, this option may still be considered by a farmer as part of their health and welfare planning and could influence the decision to castrate male lambs.

In breeds that participate in genetic improvement programmes, the selection of rams with Estimated Breeding Values (EBVs) can be used to produce lambs that grow more quickly and reach finished condition at a younger age. Whilst this would increase the number of male lambs reaching sale

before sexual maturity and reduce the need for castration, there is a potential risk that pushing for ever faster growth rates could have unintended welfare consequences. The Animal Welfare Committee report (2022) highlights the need to manage the selection for growth rate carefully to reduce the risks of increased dystocia, reduced fertility and potential health issues that have been seen in other species.

The consequences of running sexually mature ram lambs with ewe lambs means in-lamb ewe lambs are seen in abattoirs, which raises both ethical and welfare concerns. In addition, the performance of pregnant ewe lambs is likely to be impacted due to the diversion of nutrients to the growing foetus, affecting productivity and farm profitability. The Welfare of Animals (Transport) (England) Order 2006 and the EU retained regulation Council Regulation (EC) No 1/2005 state that animals must be fit for transport. Heavily pregnant females in the last 10% of their gestation period, or females who have given birth in the week prior, are legally not considered fit for transport by virtue of this legislation, including transport to slaughter. This is also reiterated in the guidance of farm assurance schemes such as Red Tractor (2022) standards. The RSPCA standards extend this stating that pregnant ewes must not be transported to slaughter in the last two months of pregnancy, except in the case of emergency slaughter for disease control.

Producers should also consider the markets that they supply and check whether there are likely to be any penalties applied for presenting entire lambs. This is more likely to be an issue in older lambs, and processors/retailers may issue a 'blanket ban' on entire ram lambs after a particular date, which may start as early as October (although this will likely vary between processors/retailers) and continue through until the switch to new season lamb the following year. There are, however, markets that prefer older entire ram lambs which may offer marketing opportunities for some producers at certain times of the year. The Muslim festival of Eid-al-Adha requires the act of Qurbani (Urdu) or Udhiyah (Arabic), which is the slaughter of an animal as thanksgiving (AHDB, 2021). For an animal to be used for Qurbani it needs to meet specific age requirements and be sexually mature (AHDB, 2021). In general, entire lambs over six months are acceptable (AHDB, 2021).

### 5.1.9 What are the legal implications of leaving rams entire?

Section 4 of the Animal Welfare Act 2006 states that any suffering that an animal endures must be out of necessity, such as for the benefit of the animal in question, the safety of other animals or protection of people and property. This puts a legal onus on producers and other responsible individuals to avoid castration unless there is a legitimate interest in doing so.

There are also legal considerations further along the production cycle. Council Regulation (EC) No 1/2005 states that sexually mature male and female animals may not be transported together, and heavily pregnant or recently lambed ewes are not permitted to be transported. For these reasons, producers need to consider the logistics and potential adaptions required to maintain entire rams within their farm system.

### 5.1.10 How do farm assurance schemes manage leaving rams entire?

Most farm assurance standards advocate for castrating only when necessary. The RSPCA standards additionally state that their ultimate aim is to phase out the practice altogether, although a timeframe for this is not given. Many, however, also include requirements beyond those in law for transport of animals. For example, Red Tractor do not permit sexually mature entire males to be transported with other males they are unfamiliar with, and the Soil Association suggests not transporting any ewes over three months in lamb. These restrictions could impact the logistics for some producers at the end of the finishing period.

### 5.1.11 How strong is the evidence for leaving rams entire?

Currently, the majority of the evidence for keeping rams entire is related to meat quality and ease of management rather than animal welfare. Although leaving ram lambs entire reduces exposure to potentially painful procedures, there remain welfare concerns regarding the separation of ewes and entire ram lambs to prevent unwanted/unplanned pregnancy. More robust evidence exploring the animal welfare implications of leaving lamb rams entire is likely to emerge in the future.

### 5.1.12 How the 3Rs (Replace, Reduce, Refine) could be applied

**Strategies for reduction:** For the purpose of this report, leaving male lambs entire is considered to be the baseline as it is the approach with lowest risk of adverse effects on animal welfare. As such, there is no scope to reduce the number of lambs that are kept entire.

**Strategies for refinement:** The practice of keeping male lambs entire can be refined by ensuring that the right management tools are available and accessible to producers. Contingency planning is crucial to mitigate any potential disruptions and/or delays with getting lambs off farm in a timely manner. Adequate space and infrastructure should be in place to minimise potential issues should the lambs reach sexual maturity, and growth rates should be monitored.

**Strategies for replacement:** This practice should not be replaced with any castration method, unless the producers are unable to meet the necessary management procedures, including

infrastructure, space, and adequate fencing. This is a decision which should be made depending on individual farm circumstances.

### 5.1.13 Where can I find further information?

- SRUC Technical Note TN679 https://www.sruc.ac.uk/media/urenl4or/tn679.pdf

- FAWC report on the Implications of Castration and Tail Docking for the Welfare of Lambs https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/325125/FAWC_report_on_the_implications_of_castration_and_tail_docking_for_the_welfare_of_lambs.pdf

- BVA Policy Statement – Sheep castration, tail docking and pain management https://www.bva.co.uk/take-action/our-policies/sheep-castration-tail-docking-and-pain-management/

- HCC Rearing Entire Males https://meatpromotion.wales/images/resources/Rearing_Entire_Males.pdf

## 5.2 Narrative summary – Rubber ring castration (Elastration)

*Table 11 Narrative summary table – Rubber ring castration (Elastration)*

| **Practice impact on:** | | | | | |
|---|---|---|---|---|---|
| **Welfare** | **Productivity** | | **Profitability** | **Environmental sustainability** | |
| Relative to entire lambs | Increased outputs | Decreased inputs | Added value | Soil and Water | GHG<br>Air and climate<br>Biodiversity |
| **-** | **-** | **N/A** | **+/-** | **N/A** | **-** |
| | | | | | |
| **Evidence base** | | | | | |
| Quality | ●●●○○ | | **Cost to implement** | £ | |
| Relevance | ●●●○○ | | **Speed of change** | Fast | |
| Overall | ●●●○○ | | **Production system** | Any system where lambs are routinely handled at ≤7 days of age | |

### 5.2.1 What is rubber ring castration?

The rubber ring castration method (also known as elastration) achieves castration through the application of a thick rubber ring to the neck of the scrotum, with the testicles below the ring. The rubber ring is left in place until the scrotum and testicles detach. The rubber ring has a small internal circumference and applies sufficient pressure to cut off the blood supply, which causes the entirety of the scrotum and testicles to drop off over a period of 2-4 weeks. Legally, this procedure cannot be commenced past seven days of age in the UK, according to the Mutilations (Permitted Procedures) (England) Regulations 2007.

### 5.2.2 What is the impact of rubber ring castration on animal welfare?

Gascoigne et al. (2021) draws on evidence from Stafford (2017) to suggest that lambs castrated using the rubber ring method may be exposed to chronic pain; thus, having a damaging effect on their welfare, and impairing their freedom from pain as well as from discomfort.

Although rubber ring castration causes a smaller peak in plasma cortisol (stress hormone) response compared to surgical castration, the wound healing from rubber rings is slower (Gascoigne et al., 2021; Mellema et al., 2006). Lambs display pain related behaviours, such as turning to look at their scrotum, six weeks after castration using a rubber ring (Gascoigne et al. 2021). Furthermore, lambs aged 2-7 days which were castrated using rubber rings, without local anaesthetic, displayed pain behaviour responses (foot stamping, kicking, restlessness) at a rate 10.8 times higher compared to clamp castration without local anaesthetic in the first 2 hours post-castration (Mellema et al., 2006). The use of anaesthesia significantly reduced the pain behaviour responses.

Melches et al. (2007) observed statistically significant pain responses to manual examination of the castration site between 1- and 30-days post-castration. Although this study was conducted on lambs aged over 10 weeks, which exceeds the bounds of the law in England under the Mutilations (Permitted Procedures) (England) Regulations 2007, Molony et al. (1993) found that age has little impact on pain response in lambs.

Overall, it is suggested that rubber ring castration has an adverse effect on the welfare of the lambs, both in form of acute short-term pain response as well as a longer term, chronic exposure to pain (Melches et al., 2007; Mellema et al., 2006; Stafford, 2017).

### 5.2.3 What is the impact of rubber ring castration on productivity?

Rubber ring castration carried out within 48 hours of birth can result in lambs failing to ingest protective amounts of colostrum which puts the lamb at increased risk of disease and mortality (Collins et al., 1985; Henderson, 1990; Kent et al., 1998; Mellor and Stafford, 2004).

Haddad et al. (2006) found weight and growth performance of rubber ring castrates were not affected by castration, with castrated lambs displaying a 16.8kg total weight gain at an average of 280g/day. These findings are contradictory to the findings of Wellington et al. (2003), who found entire rams had better growth performance than castrates. It should be noted that Haddad et al. (2006) found feed intake of castrates was 128g/day higher than the feed intake of entire rams, indicating poorer feed conversion efficiency in castrated lambs. The higher feed intake and subsequent cost of feed may represent a barrier to uptake of this practice.

### 5.2.4 What is the impact of rubber ring castration on profitability?

Although no papers were identified directly quantifying the impact on profitability, the higher feed intake and poorer feed efficiency may have a negative effect on profitability. Furthermore, reduced colostrum intake causes a predisposition to disease and illness (Collins et al., 1985; Henderson, 1990; Kent et al., 1998; Mellor and Stafford, 2004) which could incur veterinary treatment costs and/or the potential death of the lamb, both of which negatively impact profitability. Supplementary feeding in lambs which have received insufficient colostrum, and the associated increased labour input will also incur additional rearing costs which will impact the overall profitability of the lamb at time of sale.

### 5.2.5 What is the impact of rubber ring castration on environmental sustainability?

Environmental sustainability could be negatively affected by decreased efficiency of castrated lambs in comparison to entire ram lambs, due to decreased feed efficiency, possible lower growth rates, and predisposition to disease caused by lack of colostrum intake (Collins et al., 1985; Henderson, 1990; Fisher et al., 2010; Haddad et al., 2006; Kent et al., 1998; Mellor and Stafford, 2004). However, there is a lack of evidence at this time specifically related to rubber ring castration to provide a detailed comparison.

The use of consumables (rubber rings) in rubber ring castration should be considered to have a lifecycle impact on the environmental sustainability of the practice. The environmental impact of rubber is complex and dependent on multiple factors (country of production, manufacturing method, natural or synthetic, etc.). We do not have data on the number of rubber rings used in lamb castration at country-level to estimate the impact.

### 5.2.6 Where does rubber ring castration work?

Rubber ring castration must be carried out within the first 7 days to comply with the Mutilations (Permitted Procedures) (England) Regulations 2007. This technique can therefore only be used where lambs are handled within their first week and may make rubber ring castration impractical for use on many hill farms, where lambs from outdoor lambing flocks are typically gathered for castration above this age.

### 5.2.7 How much does rubber ring castration cost?

Rubber ring castration is considered inexpensive, requiring only suitable castration pliers to apply the rubber rings, and a supply of rubber rings. Castration pliers cost in the region of £5-£15, while rubber rings cost 1-2 pence per ring (as reported by. As with all castration methods, labour is required to castrate the lambs, although this is typically carried out quickly along with other health checks. Rubber ring castration is widely used and simple to carry out, therefore no specialist training is required.

### 5.2.8 How can rubber ring castration be done well?

It is advised that rubber ring castration should not be used within the first 24 hours of a lamb's life. Using the practice on lambs below this age can lead to mismothering and can also discourage lambs from suckling (due to discomfort), which can result in insufficient uptake of colostrum if this takes place within the critical hours after the lamb is born (Collins et al., 1985; Henderson, 1990; Kent et al., 1998; Mellor and Stafford, 2004).

For rubber ring castration to be effective, both testicles must be entirely below the rubber ring. As such it is important to ensure that both testicles can be clearly felt prior to application of the ring, and that the ring is correctly applied above the testicles. Rubber rings cannot be used on cryptorchids (animals with undescended testicles). Care must also be taken to ensure that the ring does not cover the lamb's rudimentary teats, as anything trapped within the ring will atrophy (waste away) and drop off.

### 5.2.9 What are the legal implications of rubber ring castration?

The Mutilations (Permitted Procedures) (England) Regulations 2007 permits rubber ring castration only up to an age of seven days. This contrasts sharply with the lack of an upper limit on the use of any other technique, excepting that an anaesthetic is required above three months. Given the early age at which this procedure must be carried out and the need to work within a code of practice (as per the Animal Welfare Act 2006), the Defra Code of Recommendations for the Welfare of Livestock are likely to also apply, which states that castration should not be performed until the ewe/lamb bond has become established. This narrows the window in which rubber ring castration can be carried out further still and may make it impractical for some farms. According to the Veterinary Surgeons Act 1966, anyone over the age of 18 is permitted to carry out the procedure, so long as they fulfil any subsequent legal requirements, such as that in the Animal Welfare Act 2006 that any operative is 'reasonably competent and humane'. Since a wound is created by this method, Council Regulation (EC) No 1/2005 applies; castrated males may not be transported until any wounds produced by the procedure have fully healed.

### 5.2.10 How do farm assurance standards manage rubber ring castration?

Rubber ring castration is one of only three permitted techniques in the RSPCA assurance scheme, permitted only between 24 hours and seven days of age. Both RSPCA and Soil Association standards require the use of pain relief with all castration methods. Red Tractor and RSPCA standards both require that any planned castrations are documented in a health plan, reviewed by a veterinary surgeon. RSPCA standards additionally require that permission to castrate is sought annually from their Farm Animals Department.

### 5.2.11 How strong is the evidence for rubber ring castration?

A range of studies which explore the use and effects of rubber ring castration on animal welfare were identified. These studies were largely experimental papers, comparing the effects of rubber ring castration with other castration techniques. Cortisol levels and behaviour assessments were

common metrics used to determine welfare, with some studies comparing the pain levels of lambs castrated with l**ocal** anaesthetics or analgesics and without. Studies conducted outside of the UK often included lambs aged over 7 days, which exceeds the boundary of The Mutilations (Permitted Procedures) (England) Regulations 2007.

Overall, rubber ring castration done without the use of local anaesthetic or analgesics (pain relief) results in acute and/or chronic pain for lambs. As a result, leaving ram lambs entire remains the preferred option where feasible.

### 5.2.12 How the 3Rs (Replace, Reduce, Refine) could be applied

**Strategies for reduction:** Rubber ring castration is often used as a routine management practice in England. There is scope to reduce the number of lambs that are castrated using rubber rings by ensuring that the right management tools and the right infrastructure are in place to allow ram lambs to be kept entire (see chapter 5.1).

**Strategies for refinement:** Rubber ring castration could be refined by providing local anaesthetics or analgesia during the procedure and pain management after the procedure. The requirement to apply the rings up to seven days of age still applies if pain relief is used.

**Strategies for replacement:** Rubber ring castration should ideally be replaced with leaving males entire.

### 5.2.13 Where can I find further information?

- SRUC Technical Note TN679 https://www.sruc.ac.uk/media/urenl4or/tn679.pdf

- FAWC report on the Implications of Castration and Tail Docking for the Welfare of Lambs https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/325125/FAWC_report_on_the_implications_of_castration_and_tail_docking_for_the_welfare_of_lambs.pdf

- BVA Policy Statement – Sheep castration, tail docking and pain management https://www.bva.co.uk/take-action/our-policies/sheep-castration-tail-docking-and-pain-management/

- Animal Welfare Committee (2022). Opinion of the Implications of Castration and Tail Docking for the Welfare of Lambs. https://www.gov.wales/sites/default/files/publications/2023-

09/animal-welfare-committee-opinion-implications-castration-and-tail-docking-welfare-lambs.pdf

## 5.3 Narrative Summary - Clamp castration (Burdizzo)

*Table 12 Narrative summary table – Clamp castration (Burdizzo or bloodless technique)*

| **Practice impact on:** | | | | | |
|---|---|---|---|---|---|
| **Welfare** | **Productivity** | | **Profitability** | **Environmental sustainability** | |
| Relative to entire lambs | Increased outputs | Decreased inputs | Added value | Soil and Water | GHG<br>Air and climate<br>Biodiversity |
| **-/+*** | **-** | **N/A** | **+** | **N/A** | **-** |
| | | | | | |
| **Evidence base** | | | | | |
| Quality | ●●●○○ | | **Cost to implement** | £ | |
| Relevance | ●●●○○ | | **Speed of change** | Fast | |
| Overall | ●●●○○ | | **Production system** | All systems | |

* Increased welfare compared to rubber ring castration (elastration)

### 5.3.1 What is clamp castration?

The clamp castration method achieves castration through the application of a clamp (also known as a bloodless castrator or Burdizzo device) to the neck of the scrotum. The clamp is applied in such a way that the spermatic cords are crushed, resulting in irreversible obstruction of the internal blood supply and destruction of the nerves causing the testicles to atrophy (waste away). Sufficient blood supply to the scrotum remains, ensuring the scrotum itself remains alive (Henderson, 1990). To achieve this effect, the clamp must be applied correctly, and for a sufficient length of time to produce effective destruction of the relevant tissues. As such, the method requires that the operator be adequately trained in the correct application technique.

### 5.3.2 What is the impact of clamp castration on lamb welfare?

Due to the nature of the clamp castration method, there is short term pain for the lamb. Melches et al. (2007) found that 90% of lambs over 10 weeks of age that were castrated using a clamp had a moderate or severe immediate pain response. The same study found that pain responses to local palpation of the scrotum were significantly stronger in lambs castrated with the Burdizzo device compared to the rubber ring method, though lasted for only a few days post-castration.

Long-term differences in pain response to clamp castration compared to rubber ring castration were identified by Mellema et al. (2006), who recorded activity levels of castrated lambs between 9-90 days after treatment. Those castrated using the clamp technique had similar activity levels to handled controls, while those castrated with rubber rings were significantly less active (Mellema et

al., 2006), which suggests that clamp castration does not cause a long-term pain response as pronounced as that observed with rubber ring castration.

Power-assisted clamps have been trialled in the past, making it easier for the user by automatically applying the pressure required for the procedure to work. However, when studied, these devices appeared to cause more pain to the animals, likely due to applying greater force than is necessary (Molony et al., 1997).

When a clamp is used without anaesthesia (the loss of sensation/feeling for medical purposes) or analgesia (pain relief medication), an increased sensitivity to pain can be observed. Melches et al. (2007) found that neither anaesthetic used in their study completely eliminated acute pain, though the cortisol (stress hormone) levels post-castration remained similar to handled control lambs. Mellema et al. (2006) found cortisol concentrations remained at an intermediate level in the first few hours post-castration, despite the use of local anaesthetic pre-castration. However, it was identified within this study that the short time period between administration of anaesthetic and castration could account for diminished anaesthetic effect (Mellema et al., 2006).

Overall, it is accepted the pre-castration treatment with local anaesthetic is likely to reduce acute pain caused by clamp castration. However, it should also be noted that pain from clamp castration can be alleviated through correct technique. Mellema et al. (2006) draws on evidence from Steiner et al. (2003) who found post-castration pain was worse in clamp castrated lambs which was done by inexperienced students compared to experienced veterinarians.

### 5.3.3 What is the impact of clamp castration on productivity?

It is difficult to ascertain the direct impact of clamp castration on profitability, due to the ambiguity of feed efficiency and growth rates of castrated lambs compared to entire lambs, regardless of castration method.

Incomplete castration is a concern in on-farm implementation, where the number of animals castrated may be much greater, and success rates may fall. A ram lamb left with functioning sexual organs can impact productivity and profitability, either by requiring castration at a more advanced age, or if the issue is not detected and unwanted pregnancy occurs. Studies have demonstrated as little as 12% success rates (Farm Animal Welfare Council, 2008) though other have shown more consistent positive results. Correct operator training can reduce the likelihood if incomplete castration (Farm Animal Welfare Council, 2008). The possibility of incomplete castration and its consequences may represent a barrier to uptake of this castration method.

### 5.3.4 What is the impact of clamp castration on profitability?

Although no papers were identified directly measuring the impact of clamp castration on profitability, higher feed intake coupled with poorer feed efficiency could have a negative impact on profitability.

Clamp castration allows ewes and rams to be run together, thereby decreasing the management and labour requirements, compared to managing ewes and rams separately. However, it should be noted that failed castration cannot be identified through physical examination, thus there remains a risk that unwanted pregnancies could occur.

### 5.3.5 What is the impact of clamp castration on environmental sustainability?

Environmental sustainability could be negatively affected by decreased efficiency of castrated lambs in comparison to entire ram lambs, due to decreased feed efficiency, possible lower growth rates, and predisposition to disease caused by lack of colostrum intake (Collins et al., 1985; Henderson, 1990; Fisher et al., 2010; Haddad et al., 2006; Kent et al., 1998; Mellor and Stafford, 2004. However, there is a lack of evidence at this time specifically related to clamp castration to provide a detailed comparison.

It should be noted that other than the one-off purchase of a suitable clamp no additional consumables (i.e., rubber rings) are required for this practice.

### 5.3.6 Where does clamp castration work?

Clamp castration can be used effectively in hill, upland, and lowland systems.

The Mutilations (Permitted Procedures) (England) Regulations 2007 permits the use of clamp castration without anaesthetic up to three months of age. This makes clamp castration a viable castration method for use on extensive systems, where gathering of lambs for castration typically occurs when lambs are over seven days old, and legislation inhibits the use of rubber rings. Where male lambs are aged over three months of age, a veterinary surgeon must carry out any castration procedure in accordance with the Veterinary Surgeons Act (1966).

### 5.3.7 How much does clamp castration cost?

Clamp castration requires the purchase of a suitable clamp. Castration clamps are widely available from many agricultural suppliers, with prices ranging from around £50-£150. It is important that the correct size is selected for lambs (9-12 inches), as larger devices designed for cattle will not be

suitable. Operator training is a leading determinant for both animal welfare outcomes and castration success rate, but implementing this incurs an additional investment cost, which is a potential barrier to uptake. Suitable practical courses related to livestock stockmanship skills are available from agricultural colleges, independent training providers or veterinary practices. In some case these can lead to recognised qualifications from Lantra and City and Guilds.

The cost of a failed clamp castration should also be taken into consideration. This could result in the need for surgical castration at an older age, or unwanted pregnancies. These are significant potential barriers to uptake.

Clamp castration is more time-consuming castration method than rubber ring castration, as the applicator must be applied twice, with each application taking a minimum of ten seconds (Farm Animal Welfare Council, 2008). As such, it is possible that labour costs for clamp castration would be higher than those associated with rubber ring methods. However, the time spent gathering and handling lambs would be similar, thus it is likely to only be impactful to those with larger flocks.

### 5.3.8 How can clamp castration be done well?

The correct application of the clamp requires that each spermatic cord be clamped individually. Each cord is clamped twice, with the second application applied below the first (Farm Animal Welfare Council, 2008). It is important that the operator can feel the spermatic cord between the jaws of the clamp for the duration of each application. The clamp site on each spermatic cord should be staggered to prevent complications from a complete loss of blood supply to the scrotum. The clamp should be held in place for ten seconds on each cord to ensure that the relevant tissues are adequately destroyed (Farm Animal Welfare Council, 2008).

Clamp castration can be difficult to carry out effectively, especially on very small lambs. There is no obvious visual indication of effective or ineffective castration as the testes atrophy within the scrotum, which does not fall off. Incorrect application of the clamp can result in incomplete castration therefore adequate training is required to ensure the practice is being carried out correctly, and to minimise pain and discomfort to the animal (Farm Animal Welfare Council, 2008; Mellema et al., 2006).

The clamp device must be maintained in good condition. Checks should be carried out at the beginning of each lambing season and periodically throughout the season. The device should always be checked before use to ensure the jaws of the clamp are parallel allowing them to close uniformly across their width (Mellor and Stafford, 2000).

If power assisted clamps could be developed to apply the correct pressure without increasing pain, they may improve welfare by making the process physically easier to carry out, reducing operator fatigue and error (Molony et al., 1997).

### 5.3.9 What are the legal implications of clamp castration?

According to the Animal Welfare Act 2006, The Mutilations (Permitted Procedures) (England) Regulations 2007 and Veterinary Surgeons Act 1966, clamp castration can be carried out by anyone 'reasonably competent and humane' over the age of 18, without anaesthetic, up to an age of three months, after which time an anaesthetic is required. Besides this, there are relatively few legal restrictions on using a clamp method for castration of rams.

### 5.3.10 How do farm assurance standards manage clamp castration?

Clamp castration is one of only three permitted techniques in the RSPCA assurance scheme, permitted only between 24 hours and eight weeks of age, and only in the case of a failed rubber ring. Both RSPCA and Soil Association standards require the use of pain relief with all castration methods. Red Tractor and RSPCA standards both require that any planned castrations are documented in a health plan, reviewed by a veterinary surgeon. RSPCA standards additionally require that permission to castrate is sought annually from their Farm Animals Department.

### 5.3.11 How strong is the evidence for clamp castration?

A range of studies were identified that explored the effects of clamp castration on animal welfare. All studies identified were experimental papers, largely comparing the effects of clamp, ring, and surgical castration against handled controls. Cortisol levels and behavioural assessments were common metrics (indicators) used to determine welfare, however there were discrepancies in findings between papers. Clamp castrated lambs experience acute pain for a short period of time, at the time of clamp application, however, the lambs tend to recover quicker than rubber ring or surgical castrated lambs (Mallema et al. 2006). Where local anaesthetics were used during clamp application, pain behaviour responses were not eradicated completely by either lidocaine or bupivacaine (neither of which are licensed in England), though there is a lack of evidence evaluating the use of procaine (Melches et al. 2007).

### 5.3.12 How the 3 Rs (Replace, Reduce, Refine) can be applied

**Strategies for reduction:** Like other castration practices, there is scope to reduce the number of lambs that are castrated using the clamp castration practice by ensuring that the right management tools and the right infrastructure are in place to allow ram lambs to be kept entire (see chapter 5.1).
**Strategies for refinement:** Clamp castration can be refined by ensuring that the operator performing the castration has refresher training sessions on a regular basis and the clamp is regularly inspected and maintained. The practice can be further refined by providing pre-castration local anaesthetic and analgesia, and pain management after the procedure.
**Strategies for replacement:** Clamp castration should ideally be replaced with leaving males entire, provided this is a feasible option for the producer.

### 5.3.13 Where can I find further information?

- SRUC Technical Note TN679 https://www.sruc.ac.uk/media/urenl4or/tn679.pdf

- FAWC report on the Implications of Castration and Tail Docking for the Welfare of Lambs https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/325125/FAWC_report_on_the_implications_of_castration_and_tail_docking_for_the_welfare_of_lambs.pdf

- BVA Policy Statement – Sheep castration, tail docking and pain management https://www.bva.co.uk/take-action/our-policies/sheep-castration-tail-docking-and-pain-management/

- Animal Welfare Committee (2022). Opinion of the Implications of Castration and Tail Docking for the Welfare of Lambs. https://www.gov.wales/sites/default/files/publications/2023-09/animal-welfare-committee-opinion-implications-castration-and-tail-docking-welfare-lambs.pdf

## 5.4 Narrative Summary – Rubber ring and clamp (Burdizzo) combined

*Table 13 Narrative summary table – Combined castration (rubber ring and Burdizzo device)*

| **Practice impact on:** | | | | | |
|---|---|---|---|---|---|
| **Welfare** | **Productivity** | | **Profitability** | **Environmental sustainability** | |
| Relative to entire lambs | Increased outputs | Decreased inputs | Added value | Soil and Water | GHG<br>Air and climate<br>Biodiversity |
| **-** | **-** | **N/A** | **+** | **N/A** | **-** |
| | | | | | |
| **Evidence base** | | | | | |
| Quality | ●●●○○ | | **Cost to implement** | £ | |
| Relevance | ●●●○○ | | **Speed of change** | Fast | |
| Overall | ●●●○○ | | **Production system** | Any system where lambs are routinely handled at ≤7 days of age | |

### 5.4.1 What is combined castration?

Combined castration method uses both the rubber ring castration method and the clamp castration method simultaneously. This method attempts to unify the efficacy of rubber ring castration with the reduced level of pain experienced during clamp castration, through crushing nerves that would otherwise conduct pain signals while maintaining the complete castration of the lamb (Masłowska et al., 2020). A rubber ring is applied in the same way as it would be for rubber ring castration - to the neck of the scrotum with the testicles below – whilst a clamp device is then used to crush the neck of the scrotum just to the outer edge of the rubber ring (Molony et al., 1993). Operators must be appropriately trained in the correct application of the clamp technique to ensure the clamp is applied correctly, and for the correct amount of time (see 5.3).

### 5.4.2 What is the impact of combined castration on animal welfare?

The combined castration method has been proven to reduce acute pain in comparison with rubber ring castration or surgical castration, with a demonstrated reduction in cortisol (stress hormone) response in lambs less than 7 days old (Kent et al., 1998; Molony et al., 1993; Thornton and Waterman-Pearson, 1999). Kent et al. (1998) found the application of a clamp alongside the rubber ring significantly reduced time spent in abnormal postures from 86 minutes for rubber ring alone, to 28 minutes for the combined method. Thornton & Waterman-Pearson (1999) also identified reduced pain behaviours, such as kicking, rolling and foot stamping, in lambs castrated using the combined method. The Farm Animal Welfare Council (2008) considered combined castration to be less painful than clamp castration alone.

Thornton and Waterman-Pearson (1999) found that pre-castration treatment with a local anaesthetic agent reduced scrotal and testicular pain in lambs to levels similar to those seen in control lambs. This was corroborated by Mellema et al. (2006) who found that ongoing signs of pain or distress in lambs castrated with local anaesthesia were reduced by up to one week compared to those castrated without. Molony et al. (1997) found that an intramuscular injection of non-steroidal anti-inflammatory drugs 20 minutes before the application of the clamp significantly reduced cortisol response and following abnormal behaviours.

### 5.4.3 What is the impact of combined castration on productivity?

In lambs younger than 48 hours old, acute pain may incapacitate neonatal lambs in such a way that they fail to ingest adequate amount of colostrum, which can reduce the passive immunity passed from ewe to lamb. This can cause a predisposition to a variety of diseases, which ultimately impacts a lamb's productivity (Collins et al., 1985; Henderson, 1990; Kent et al., 1998; Mellor and Stafford, 2004). HCC (2004) reported consistently lower growth rates (estimated to be approximately 10% lower than entire lambs), and poorer feed conversion in castrated lambs from a range of trials although the castration method was not specified.

### 5.4.4 What is the impact of combined castration on profitability?

It is difficult to ascertain the direct impact of combined castration on profitability, due to the ambiguity of feed efficiency and growth rates of castrated lambs compared to entire lambs, regardless of castration method. However, there is a consensus that castrated lambs grow more slowly and have poorer feed conversion which negatively impacts on profitability.

Despite evidence that castrated lamb meat is more favourable, Rousset-Akrim et al. (1997) found that seven-month-old lambs castrated with the clamp (Burdizzo) method still had undesirable meat. This could be identified as a barrier to uptake. This highlights that castration decisions should be system-specific, depending on the production system, finishing age, and breed of lamb.

### 5.4.5 What is the impact of combined castration on environmental sustainability?

Environmental sustainability could be negatively affected by decreased efficiency of castrated lambs in comparison to entire ram lambs, due to decreased feed efficiency, lower growth rates, and predisposition caused by lack of colostrum intake (Collins et al., 1985; Fisher et al., 2010; Haddad et al., 2006; Henderson, 1990; Kent et al., 1998; Mellor and Stafford, 2004). However, there is a lack of evidence at this time specifically related to combined castration to provide a detailed comparison.

The use of consumables (rubber rings) in rubber ring castration should be considered to have a lifecycle impact on the environmental sustainability of the practice. The environmental impact of rubber is complex and dependent on multiple factors (country of production, manufacturing method, natural or synthetic, etc.).

### 5.4.6 Where does combined castration work?

Combined castration must be carried out within the first 7 days of life to comply with The Mutilations (Permitted Procedures) (England) Regulations 2007; thus, this technique can only be used where lambs are routinely handled within the first week. This may render the practice impractical on many hill and upland farms, where lambs from outdoor lambing flocks would have already exceeded the legal age limit at time of gathering.

### 5.4.7 How much does combined castration cost?

Combined castration requires the purchase of equipment which is suitable for both clamp castration and rubber ring castration. The purchase of a suitable clamp is required, which can cost anywhere from £50-£150. Suitable castration pliers for the application of rubber rings cost in the region of £5-15, as well as a supply of rubber rings which cost 1-2 pence per ring.

There may be increased labour costs related to combined castration, though this will vary according to flock size and production system. Operator training is essential for clamp use and may incur an additional cost if this is supplied by an external agency. These additional costs are possible barriers to uptake.

### 5.4.8 How can combined castration be done well?

Combined castration should be regarded in the same manner as rubber ring castration and should not be used within the first 24 hours of a lamb's life, as the associated pain and discomfort could discourage lambs from suckling, resulting in insufficient uptake of colostrum (Collins et al., 1985; Henderson, 1990; Kent et al., 1998; Mellor and Stafford, 2004).

Combined castration should be carried out within 7 days of the lamb's birth to comply with The Mutilations (Permitted Procedures) (England) Regulations 2007. Research also suggests combined castration is least painful at this age (Gascoigne et al., 2021).

When using a clamp device in conjunction with rubber ring, the full width of the scrotum should be clamped. Mellor and Stafford (2000) highlighted how the combined use of the clamp and rubber rings would be beneficial, with a full width approach reducing the pain of ring castration.

Operators of clamp devices or clamps should be adequately trained, as correct use of equipment and technique can considerably reduce the level of pain for the lamb (Mellema et al., 2006). Clamp devices should be well maintained and in good condition, with checks carried out at the beginning of each lambing season and periodically throughout the season. The device should always be checked before use to ensure the jaws of the clamp are parallel allowing them to close uniformly across their width (Mellor & Stafford, 2000).

The use of local anaesthetics and analgesic (pain relief) treatments pre-castration can significantly reduce the pain and suffering of lambs at the time of castration and in following days/weeks (Kells et al., 2020; Molony et al., 1997; Thornton and Waterman-Pearson, 1999).

### 5.4.9 What are the legal implications of combined castration?

As a rubber ring is involved in the procedure, this technique is subject to the Mutilations (Permitted Procedures) (England) Regulations 2007, which permits the use of a rubber ring in castration only up to an age of seven days, despite the additional use of a clamp in the procedure, which on its own may be used up to an age of three months without anaesthetic. Given the early age at which this procedure must be carried out and the need to work within a code of practice (as per the Animal Welfare Act 2006), the Defra Code of Recommendations for the Welfare of Livestock will also apply. This states that castration should not be performed until the ewe/lamb bond has become established. This narrows the window in which rubber ring castration can be carried out further still, and hence may make it impractical for some farms. According to the Veterinary Surgeons Act 1966, anyone over the age of 18 is permitted to carry out the procedure, so long as they fulfil any subsequent legal requirements, such as that in the Animal Welfare Act 2006 that any operative is 'reasonably competent and humane'. Since a wound is created by this method, Council Regulation (EC) No 1/2005 applies; castrated males may not be transported until any wounds produced by the procedure have fully healed.

### 5.4.10 How do farm assurance standards manage combined castration?

No farm assurance scheme specifically mentions any restrictions surrounding combined castration. RSPCA is the only scheme to have a prescriptive list of permitted techniques, and combined castration is not a part of it. So, it can be assumed that combined castration is disallowed under the RSPCA assurance scheme. Red Tractor standards require that any method other than rubber ring or

clamp castration is only to be undertaken by a licenced veterinary surgeon but does not clarify whether a combined ring/clamp method is permitted to be used by trained stock keepers. Soil Association standards require the use of pain relief with all castration methods. Red Tractor requires that any planned castrations are documented in a health plan, reviewed by a veterinary surgeon.

### 5.4.11 How strong is the evidence for combined castration?

A range of studies which explore the use and effects of combined castration on animal welfare were identified. These studies were largely experimental papers, comparing the effects of combined castration, ring only and Burdizzo/clamp only castration. Cortisol levels and behaviour assessments were common metrics (indicators) used to determine welfare.

Overall, the evidence suggests that combined castration is less painful than the use of rubber rings and/or clamp alone (Farm Animal Welfare Council, 2008; Kent et al., 1998; Thornton & Waterman-Pearson, 1999), though the evidence was not strong enough to make any further definitive conclusions.

### 5.4.12 How the 3 Rs (Replace, Reduce, Refine) can be applied

**Strategies for reduction:** Like other castration practices, there is scope to reduce the number of lambs that are castrated by ensuring that the right management tools and the right infrastructure are in place to allow rams to be kept entire (see chapter 5.1).

**Strategies for refinement:** Combined clamp and rubber ring castration could be seen as a refinement for rubber ring castration. This practice could be further refined using a pre-castration local anaesthetic, providing analgesia during the procedure, and pain management for after the procedure. The practice can be further refined by ensuring that the operator performing the castration has refresher training sessions on a regular basis and the equipment is regularly inspected and maintained.

**Strategies for replacement:** Combined castration should ideally be replaced with leaving males entire, providing this is a feasible option for the producer.

### 5.4.13 Where can I find further information?

- SRUC Technical Note TN679 https://www.sruc.ac.uk/media/urenl4or/tn679.pdf

- FAWC report on the Implications of Castration and Tail Docking for the Welfare of Lambs https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/325125/FAWC_report_on_the_implications_of_castration_and_tail_docking_for_the_welfare_of_lambs.pdf

- BVA Policy Statement – Sheep castration, tail docking and pain management https://www.bva.co.uk/take-action/our-policies/sheep-castration-tail-docking-and-pain-management/

- Animal Welfare Committee (2022). Opinion of the Implications of Castration and Tail Docking for the Welfare of Lambs. https://www.gov.wales/sites/default/files/publications/2023-09/animal-welfare-committee-opinion-implications-castration-and-tail-docking-welfare-lambs.pdf

## 5.5 Narrative Summary – Short scrotum castration

*Table 14 Narrative summary table – Short scrotum castration*

| **Practice impact on:** | | | | | |
|---|---|---|---|---|---|
| **Welfare** | **Productivity** | | **Profitability** | **Environmental sustainability** | |
| Relative to entire lambs | Increased outputs | Decreased inputs | Added value | Soil and Water | GHG<br>Air and climate<br>Biodiversity |
| **-** | **+*** | **N/A** | **+** | **N/A** | **-** |
| | | | | | |
| **Evidence base** | | | | | |
| Quality | ●●●○○ | | **Cost to implement** | £ | |
| Relevance | ●●●○○ | | **Speed of change** | Fast | |
| Overall | ●●●○○ | | **Production system** | Any system where lambs are routinely handled at ≤7 days of age | |

* Productivity e.g., growth rates superior to most other castration techniques

### 5.5.1 What is short scrotum castration?

The short scrotum castration method uses a thick rubber ring applied to the scrotum, with the testicles above the ring and close to, or within, the inguinal canal. The rubber ring has a small internal circumference which applies sufficient pressure to cut off blood supply, which causes the entirety of the empty scrotum to wither away and drop off. The ring is left in place until castration is achieved, usually 2-4 weeks. The removal of the scrotum prohibits testicle thermoregulation, meaning the testicles are well insulated by the lamb's body heat, and thus negatively impacts on the production of viable sperm (Clements and Bright, 2010; Lester et al., 1991). This method is routinely used in New Zealand and Australia, though uptake is limited in the UK at this time.

### 5.5.2 What is the impact of short scrotum castration on animal welfare?

The short scrotum castration method should not contribute any significant sources of pain, due to the testicles and their nerve supply being left intact (Clements and Bright, 2010). Clements and Bright (2010) refer to a study conducted by Molony et al. (2002) that found acute pain was less severe in lambs castrated using the short scrotum technique compared to those castrated using the rubber ring method. This reduction in acute pain reduces the likelihood of negative effects on lambs (Clements and Bright, 2010).

In a study conducted by Masłowska et al. (2020), lambs castrated using the short scrotum method showed stronger teat-seeking behaviour than those castrated with alternative methods, reducing the risk of insufficient colostrum intake. Clements and Bright (2010) support this, suggesting that

short scrotum castration can reduce the risk of mismothering because it is less painful. Short scrotum castrated lambs demonstrated less pain behaviour than lambs castrated using the rubber ring method, but greater pain behaviours than lambs castrated using the clamp or combined methods (Masłowska et al., 2020).

### 5.5.3 What is the impact of short scrotum castration on productivity?

It is expected that lambs castrated using the short scrotum method produce a higher-grade carcase, which is more in line with that produced by an entire ram lamb (Clements and Bright, 2010). Advantages of short scrotum castration on daily liveweight gain and feed efficiency are reported due to the testosterone and androgen (male hormones) secretion (Clements and Bright, 2010; Wellington et al., 2003).

As with clamp castration, there is a risk that a ram lamb could be left with functioning sexual organs (British Veterinary Association, 2020), requiring castration at a more advanced age, or if the issue is not detected, unwanted pregnancy could occur (Gascoigne et al., 2021).

There is anecdotal evidence to suggest that lambs castrated using the short scrotum method have a higher daily liveweight gain, with a heavier weaning weight than that of fully castrated lamb (Johnson et al., 2007; Priestley, 2023). Further anecdotal evidence of this has been reported by SAC Consulting (SAC Consulting Sheep and Beef News, February 2022).

### 5.5.4 What is the impact of short scrotum castration on profitability?

There is limited evidence available on the profitability of short scrotum castration. However, benefits to profitability could be expected based on improved weight gain and feed efficiency.

It is expected that lambs castrated using the short scrotum method produce a leaner carcase, which is more in line with that produced by an entire ram lamb (Clements and Bright, 2010). The carcase trait advantages are the result of circulating androgens (male hormones) which result in improved carcase weight and confirmation, but without the need for specific management techniques (Gascoigne et al., 2021).

It has been argued that meat from short scrotum rams is unlikely to be at risk of ram taint, as the rams are slaughtered before reaching maturity, which is when the effects of the androgens (male hormones) on meat quality would become evident (Farm Animal Welfare Council, 2008). Taste trials have confirmed entire ram meat is acceptable up to the age of puberty, however, no taste trials

have specifically included short scrotum castrated lambs (Clements and Bright, 2010). There remains a lack of evidence assessing the impact of age and slaughter weight on meat quality and taste.

### 5.5.5 What is the impact of short scrotum castration on environmental sustainability?

Short scrotum castration could have positive impacts on environmental sustainability due to expected improved feed efficiency and higher daily liveweight gains (Fisher et al., 2010; Haddad et al., 2006; Wellington et al., 2003). In addition, reduced risk of mismothering could contribute to improved survival rates in neonatal lambs, further strengthening the environmental sustainability of lamb production (Clements and Bright, 2010).

The use of consumables (rubber rings) in short scrotum castration should be considered to have a lifecycle impact on the environmental sustainability of the practice. The environmental impact of rubber is complex and dependent on multiple factors (country of production, manufacturing method, natural or synthetic, etc.).

### 5.5.6 Where does short scrotum castration work?

Although short scrotum castration is legal in the UK, the method is not widely used. According to the British Veterinary Association (2020) short scrotum castration has no distinct advantage over standard rubber ring castration, and may even be less effective, as there is no easy way to ensure the ram is infertile. Test mating can be carried out when the ram reaches sexual maturity (Clements and Bright, 2010), however, the risk of unwanted pregnancy would require the producer to keep ram lambs and ewes separate until infertility had been confirmed.

In accordance with The Mutilations (Permitted Procedures) (England) Regulations 2007, short scrotum castration must be completed within the first 7 days of life, as the method restricts blood flow to the scrotum. This may render the practice impractical on many hill farms, where lambs from outdoor lambing flocks are typically gathered for castration above this age.

### 5.5.7 How much does short scrotum castration cost?

Short scrotum castration is considered inexpensive, requiring suitable castration pliers to apply the rubber rings, and a supply of rubber rings. Castration pliers cost in the region of £5-£15, while rubber rings cost 1-2pence per ring.

As with all castration methods, there is an associated labour requirement. However, this method is typically carried out quickly along with other routine health checks. Short scrotum castration is simple

to carry out and requires no specialist training. However, care must be taken with application of the ring, as inaccurate placement can result in retained fertility, which could result in unwanted pregnancies if ewes and rams are run together (Gascoigne et al., 2021).

### 5.5.8 How can short scrotum castration be done well?

Short scrotum castration should not be used within the first 24 hours of a lamb's life. Using the practice on lambs below this age can lead to mismothering and can also discourage lambs from suckling (due to discomfort), which can result in insufficient uptake of colostrum if this takes place within the critical hours after the lamb is born (Collins et al., 1985; Henderson, 1990; Kent et al., 1998; Mellor and Stafford, 2004).

Although no specialised training is required for this method of castration, care must be taken with application of the ring, as inaccurate placement can result in retained fertility, which could result in unwanted pregnancies if ewes and rams are run together (Gascoigne et al., 2021).

### 5.5.9 What are the legal implications of short scrotum castration?

Since a rubber ring is involved in the process, this technique is subject to the Mutilations (Permitted Procedures) (England) Regulations 2007, which permits the use of a rubber ring only up to an age of seven days; the law does not distinguish between this method and conventional rubber ring castration. Given the early age at which this procedure must be carried out and the need to work within a code of practice (as per the Animal Welfare Act 2006), the Defra Code of Recommendations for the Welfare of Livestock are likely to also apply, which states that castration should not be performed until the ewe-lamb bond has become established. This narrows the window in which rubber ring castration can be carried out further still, and hence may make it impractical for some farms. According to the Veterinary Surgeons Act 1966, anyone over the age of 18 is permitted to carry out the procedure, so long as they fulfil any subsequent legal requirements, such as that in the Animal Welfare Act 2006 that any operative is 'reasonably competent and humane'. Since a wound is created by this method, Council Regulation (EC) No 1/2005 applies; castrated males may not be transported until any wounds produced by the procedure have fully healed. Since there is also a chance that this technique will not render a ram completely infertile, further paragraphs of Council Regulation (EC) No 1/2005 may also apply, as it states that sexually mature male and female animals may not be transported together, and heavily pregnant or recently lambed ewes are not permitted to be transported. For these reasons, short scrotum castration may prove logistically challenging for some farms.

### 5.5.10 How do farm assurance standards manage short scrotum castration?

No farm assurance scheme specifically mentions any restrictions surrounding short scrotum castration. RSPCA is the only scheme to have a prescriptive list of permitted techniques, and short scrotum castration is not a part of it, so it can be assumed that short scrotum castration is disallowed under the RSPCA assurance scheme. Red Tractor standards require that any method other than rubber ring or clamp castration is only to be undertaken by a licenced veterinary surgeon. Soil Association standards require the use of pain relief with all castration methods. Red Tractor requires that any planned castrations are documented in a health plan, reviewed by a veterinary surgeon. However, due to the possibility of incomplete infertility, some of the additional requirements regarding transport of animals may also apply – Red Tractor do not permit sexually mature entire males to be transported with other males they are unfamiliar with, and the Soil Association suggests not transporting any ewes over three months in lamb. These restrictions could affect the logistics of some farmers at the end of the finishing period.

### 5.5.11 How strong is the evidence for short scrotum castration?

A limited range of studies which explore the use and effects of short scrotum castration were identified. Whilst the majority of evidence demonstrates a clear welfare benefit (Clements and Bright, 2010; Masłowska et al., 2020), there remains a lack of literature assessing chronic pain in lambs castrated with this method.

Where the castration technique does not render the ram completely infertile, the practice undermines any initial welfare advantages (Gascoigne et al., 2021).

### 5.5.12 How the 3 Rs (Reduce, Refine, Replace) can be applied

**Strategies for reduction:** There is scope to reduce the number of lambs that are castrated using short scrotum castration by ensuring that the right management tools and the right infrastructure is in place to allow ram lambs to remain entire (see chapter 5.1).

**Strategies for refinement:** Short scrotum castration could be refined by providing local anaesthetic pre-castration, analgesia during the procedure, and pain management after the procedure.

**Strategies for replacement:** Short scrotum castration should ideally be replaced with leaving males entire, providing it is a feasible option for the producer.

### 5.5.13 Where can I find further information?

- SRUC Technical Note TN679 https://www.sruc.ac.uk/media/urenl4or/tn679.pdf

- FAWC report on the Implications of Castration and Tail Docking for the Welfare of Lambs https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/325125/FAWC_report_on_the_implications_of_castration_and_tail_docking_for_the_welfare_of_lambs.pdf

- BVA Policy Statement – Sheep castration, tail docking and pain management https://www.bva.co.uk/take-action/our-policies/sheep-castration-tail-docking-and-pain-management/

- FAI – The short scrotum method of castration in lambs: a review https://projectblue.blob.core.windows.net/media/Default/Research%20Papers/Beef%20&%20Lamb/theshortscrotummethodofcastrationinlambs_210710_final_report.pdf

- Animal Welfare Committee (2022). Opinion of the Implications of Castration and Tail Docking for the Welfare of Lambs. https://www.gov.wales/sites/default/files/publications/2023-09/animal-welfare-committee-opinion-implications-castration-and-tail-docking-welfare-lambs.pdf

## 5.6 Narrative Summary – Surgical castration

*Table 15 Narrative summary table – Surgical castration*

| **Practice impact on:** | | | | | |
|---|---|---|---|---|---|
| **Welfare** | **Productivity** | | **Profitability** | **Environmental sustainability** | |
| Relative to entire lambs | Increased outputs | Decreased inputs | Added value | Soil and Water | GHG<br>Air and climate<br>Biodiversity |
| **-** | **-** | **N/A** | **+** | **N/A** | **-** |
| | | | | | |
| **Evidence base** | | | | | |
| Quality | ●●●○○ | | **Cost to implement** | ££ | |
| Relevance | ●●●○○ | | **Speed of change** | Fast | |
| Overall | ●●●○○ | | **Production system** | All systems | |

### 5.6.1 What is surgical castration?

Surgical castration involves complete removal of the testicles via an incision in the scrotum with or without cutting or clamping of the spermatic cords. The practice was widely practised before rubber ring castration became available but is now performed less often. The British Veterinary Association (2020) recommends that surgical castration at any age should only be carried out by a veterinary surgeon, as do many farm assurance schemes. The Veterinary Surgeons Act (1966) states that all rams over the age of three months must be castrated by a veterinary surgeon and must be done under anaesthesia in order to comply with the Mutilations (Permitted Procedures) (England) Regulations 2007.

### 5.6.2 What is the impact of surgical castration on animal welfare?

The Farm Animal Welfare Council (2008) reiterated the position of their earlier report from 1994, that surgical castration caused significantly more distress than other methods. The report concluded that in addition to the acute and chronic pain associated with the procedure, there is a significant increased risk of infection in comparison to bloodless castration techniques. There is also the risk of severe haemorrhage, and risk of prolapse of intestinal loops (Farm Animal Welfare Council, 2008).

Mellor and Stafford (2000) ranked various castration methods based on the cortisol (stress hormone) response of lambs, which found surgical castration produced the greatest response. Melches et al. (2007) assessed the effects of castration in lambs over 10 weeks of age, comparing clamp (Burdizzo), rubber rings and surgery with a control (handled only) group. In this study the surgically castrated lambs exhibited significantly more immediate and frequent behavioural pain response than lambs in all other groups.

### 5.6.3 What is the impact of surgical castration on productivity?

In common with the majority of other castration techniques, productivity may be reduced in surgically castrated lambs compared to entire lambs. Gravador et al. (2018) reported growth rates of castrates of 290g/day compared to entire rams (400g/day). Feed intakes were similar resulting in significantly poorer feed conversion in castrated lambs. In addition, castrated lambs have higher fat depths at slaughter, which may not fit well with current consumer preference.

### 5.6.4 What is the impact surgical castration on profitability?

Although no papers were identified directly quantifying the impact on profitability, the higher feed intake and poorer feed conversion efficiency of castrated lambs may have a negative effect on profitability. Furthermore, the potential for surgical complications or infection post-surgery may result in higher veterinary and medicine costs. Where the procedure is carried out by a veterinary surgeon, it will increase costs compared to less invasive castration methods. In addition, castrated lambs have higher fat depths at slaughter, which may not fit well with current consumer preference.

The time taken to carry out the procedure was reported by Melches et al. (2007) for lambs over 10 weeks old and was found to be around 14 minutes, compared to 5 minutes for a clamp castration technique and 0.7 minutes for the rubber ring method, highlighting the likely additional labour cost associated with the technique.

### 5.6.5 What is the impact of surgical castration on environmental sustainability?

None of the literature directly reported on the impact of surgical castration on environmental sustainability. Sustainability could be negatively affected by decreased efficiency of castrated lambs compared to intact lambs due to decreased feed efficiency and lower growth rates (Fisher et al., 2010; Haddad et al., 2006; Kent et al., 1998).

Due to the increased risk of infection, it is possible that treatment with antibiotics will be required post-surgery. This could be seen as negatively aligned with the One Health approach to combatting antimicrobial resistance where an alternative technique with less risk of infection could be used.

Additional considerations in relation to environmental impact are those in relation to disposal of consumables e.g. surgical gloves, scalpel blades and drug disposal

### 5.6.6 Where does surgical castration work?

Surgical castration can be applied in any situation, though is unlikely to be a first-choice option due to the potentially detrimental animal health and welfare impacts.

### 5.6.7 How much does surgical castration cost?

None of the studies commented on the cost of surgical castration but where the procedure is carried out by a veterinary surgeon the cost is likely to be significant. Post-treatment medicine costs are variable and will depend on how well the animal responds to surgery and their recovery time. Additional labour will be required, but this is largely system specific (see also 5.6.4). The additional costs and time required to apply the technique means surgical castration is unlikely to be used routinely.

### 5.6.8 How can surgical castration be done well?

The procedure should be carried out by a veterinary surgeon with appropriate use of anaesthetic and analgesics (British Veterinary Association, 2020). Where the animal is aged over three months, this is a legal requirement under The Veterinary Surgeons Act (1966) and The Mutilations (Permitted Procedures) (England) Regulations (2007) to use an anaesthetic.

### 5.6.9 What are the legal implications of surgical castration?

Despite the recommendations of farm assurance schemes and industry codes of practice, according to the Veterinary Surgeons Act 1966 it is not actually illegal for anybody over the age of 18 to carry out castration of animals by any method, as it is exempted from the list of procedures that must be carried out by a licenced veterinary surgeon. However, subsequent legislation such as the Animal Welfare Act 2006 requires that anyone carrying out such a procedure should be 'reasonably competent and humane' and working within the parameters of an established code of conduct, which for practical purposes means that only veterinary surgeons should carry out the procedure to avoid legal consequences. As per The Mutilations (Permitted Procedures) (England) Regulations 2007, anaesthetic is a legal requirement if the procedure is done over an age of three months. Since a wound is created by this method, Council Regulation (EC) No 1/2005 applies; castrated males may not be transported until any wounds produced by the procedure have fully healed.

### 5.6.10 How do farm assurance standards manage surgical castration?

Surgical castration is one of only three permitted techniques in the RSPCA assurance scheme, permitted only for use by a licenced veterinary surgeon, with both pre- and post-operative pain relief. Red Tractor standards require that any method other than rubber ring or clamp castration is

only to be undertaken by a licenced veterinary surgeon. Both RSPCA and Soil Association standards require the use of pain relief with all castration methods. Red Tractor and RSPCA standards both require that any planned castrations are documented in a health plan, reviewed by a veterinary surgeon. RSPCA standards additionally require that permission to castrate is sought annually from their Farm Animals Department.

### 5.6.11 How strong is the evidence for surgical castration?

A limited number of studies which explore the use and effects of surgical castration on lamb welfare were identified. One review paper and one experimental paper compared the technique with other castration methods. The studies that did discuss the impact in comparison to other techniques agreed that it caused more distress than rubber ring or clamp (Burdizzo) castration. Cortisol levels and behaviour assessments were common metrics (indicators) used to determine welfare.

### 5.6.12 How the 3 Rs (Reduce, Refine, Replace) can be applied

**Strategies for reduction:** There is scope to reduce the number of lambs that are castrated using surgical castration by ensuring that the appropriate management tools and suitable infrastructure are in place to allow ram lambs to remain entire (see chapter 5.1).
**Strategies for refinement:** Surgical castration should only be carried out by a vet. Anaesthetic must be used over 3 months of age, though analgesia and pain relief medication could constitute a refinement in practice.
**Strategies for replacement:** Surgical scrotum castration should ideally be replaced with leaving males entire, providing it is a feasible option for the producer.

### 5.6.13 Where can I find further information?

- SRUC Technical Note TN679 https://www.sruc.ac.uk/media/urenl4or/tn679.pdf

- FAWC report on the Implications of Castration and Tail Docking for the Welfare of Lambs https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/325125/FAWC_report_on_the_implications_of_castration_and_tail_docking_for_the_welfare_of_lambs.pdf

- BVA Policy Statement – Sheep castration, tail docking and pain management https://www.bva.co.uk/take-action/our-policies/sheep-castration-tail-docking-and-pain-management/

- Animal Welfare Committee (2022). Opinion of the Implications of Castration and Tail Docking for the Welfare of Lambs. https://www.gov.wales/sites/default/files/publications/2023-09/animal-welfare-committee-opinion-implications-castration-and-tail-docking-welfare-lambs.pdf

# 6 Practices requiring further research

This section presents summaries for practices that have limited evidence to determine the impact of the practice on animal welfare, productivity, profitability and/or environmental sustainability. For these practices, there may be heavy reliance on a single published paper, evidence taken from other species or evidence from recent trials that are awaiting publication. The summaries below present the practice, provide information on where it may be applicable and the potential direction of impact, as well as any specific gaps in the evidence base. Recommendations are given for each practice describing specific steps that could be taken to address these gaps and provide robust data in order to support farmer decision making. As these procedures are not yet approved for use in the UK, no comments on the legislation or farm assurance implications have been made.

## 6.1 Immunocastration by vaccination against GnRH

### 6.1.1 Summary

Gonadotrophin-releasing hormone (GnRH) is required for the development of sexual maturity. Immunocastration involves the administration of a vaccine to prevent the release of GnRH, depressing testicular activity to achieve infertility. Immunocastration vaccines are licensed for use in pigs and have been used in cattle but are not currently licensed for use in sheep in the UK. However, there are a small number of reviews and trial works conducted globally which have highlighted the potential for immunocastration to improve welfare, performance, and meat quality of ram lambs (Needham et al., 2018; Rocha et al., 2021; Zeng et al., 2022).

In the UK, the most extensive evidence for immunocastration of ram lambs was the focus of a PhD (Masłowska, 2016), showing that immunisation against GnRH is a viable alternative to traditional physical castration techniques. Immunocastration provides similar fertility control and behavioural management to castration, but with productivity levels more akin to entire males. Additional global resources are available, but remain limited, with the most recent studies coming from the United States (Zeng et al. 2022).

The procedure of immunocastration was considerably less painful than other castration techniques and it did not negatively impact on normal lamb behaviour (Maslowska, 2016; Needham et al., 2018; Zeng et al., 2022). The administration of the vaccine is safe in animals from 6 weeks of age (Maslowska, 2016), which does pose a risk where failed vaccination occurs, as the lamb would potentially require physical castration with reduced legal options due to the age of the animal. As with other vaccination programmes (e.g., for disease control), the practice requires the

administration of a primary dose, followed by a booster vaccination (Maslowska, 2016). The infertility achieved by vaccination is reversible and the duration of infertility is likely to depend on the interval between primary and booster vaccination. Given the experimental nature of the research, there is no set booster interval as it varies between vaccinations and how long immunisation lasts in each animal (Maslowska, 2016; Zeng et al., 2022).

Masłowska (2016) cited previous work using the IMPROVAC® vaccine in sheep (vaccine is licensed for pigs) that showed persistence for at least 12 weeks following the second vaccination. Masłowska (2016) showed that giving the primary dose at weaning was the most effective time to administer the first dose and that an extended interval between primary and booster vaccinations prolonged the immunity period.

Analysis of carcase and meat quality measures showed no negative impact of immunisation on carcase and meat quality attributes. The key conclusion from the programme of work confirmed that an anti-GnRH vaccine for ram lambs is effective, more welfare friendly than traditional physical methods of castration and an efficient method of fertility control.

Potential benefits over more traditional castration techniques such as the rubber ring technique or leaving lambs entire include easier management, less labour, welfare benefits such as reduced injuries, and the flexibility in timing for administering the vaccine which means it can be used across a range of management systems including those that do not routinely handle young lambs. This flexibility may enable producers to capitalise on the improved growth rates of entire lambs until reaching sexual maturity.

### 6.1.2 Cost

The literature did not provide any indication of the costs of using immunocastration in lambs but an online retail cost (March 2023) for the pig vaccine IMPROVAC® quoted £90.33 excl. VAT for 100ml bottle. Allowing for two doses of 2ml to achieve full vaccination status, the cost is £3.61 per pig treated, though this could differ for lambs. More in depth analysis of costs would be required before consideration for widespread use at commercial level. The technique would also require a supply of needles and syringes or dosing injector to administer the vaccine.

### 6.1.3 Recommendations

This summary highlights the potential benefits of using vaccination against GnRH to achieve infertility in lambs. Immunocastration is a welfare friendly, safe, and effective method of castration with

applicability across a wide range of systems. However, there are not currently any commercial vaccines licensed for use in sheep, and there are no standard protocols in place for their use.

Maslowska (2016) argues that testing of the procedure in a commercial farm setting is necessary, to assess farmer experience and likely willingness to use this technique. Although the welfare benefits have been well studied (Maslowska, 2016; Needham et al., 2018; Zeng et al., 2022), further research is required to assess lamb performance, meat quality, and carcase attributes in a commercial farm setting. There may be concerns around consumer perceptions and acceptability of meat from immunised lambs. The technique appears to offer a practical solution to sheep farmers, subject to costs, although the support of industry bodies, farm assurance and the wider supply chain may be necessary to drive further development and promotion.

For this practice to be adopted by the industry it is essential that practical protocols are developed, which balance effective immunocastration timing against the cost of repeated booster doses. A single dose vaccine providing long lasting castration effect would likely be more widely accepted and adopted by sheep producers. Zeng et al. (2022) suggest the development of a GnRH vaccine, which binds with a form of hemocyanin (an immunogenic protein antigen which encourage a protective immune response) could achieve efficiency and multi-year contraception (Zeng et al. 2022). However, no trials have yet been conducted on combining the GnRH vaccination with such compounds, thus its efficacy cannot be corroborated. Further research into how immunocastration vaccinations could be developed to provide long lasting castration effects could be key to achieving licencing and routine use within UK sheep production.

## 6.2 Chemical castration

### 6.2.1 Summary

Chemical castration involves injection of corrosive chemicals directly into the testes. Examples of substances that have been used include lactic acid, zinc gluconate, and zeranol implants (Cohen et al., 1991; Oliveira et al., 2012). However, these studies were carried out on other species, not sheep. These chemicals cause inflammation of the testicular tissue, destroying testicular function and causing infertility. Although this castration technique effectively inhibits fertility, serious side effects associated with it have been reported, including muscle wastage, anaemia, and osteoporosis (Oliveira et al., 2012).

### 6.2.2 Recommendations

The lack of evidence for the use of chemical castration in sheep and the reported side-effects seen in other species suggest that this is unlikely to be seen as a viable alternative to existing and/or newly emerging techniques.

## 6.3 Castration with use of anaesthetic simultaneously (NumNuts®)

### 6.3.1 Summary

The NumNuts® tool integrates an anaesthetic applicator into a rubber ring applicator to enable administration of pain relief at the time of castration. The technique intends to offer a refinement over the standard rubber ring technique by use of a local anaesthetic. It was developed in Australia and has been in use there since 2019 and was subsequently launched in New Zealand in 2021.

The method has not been approved for use in England but has been trialled by Scotland's Rural College (SRUC) in Scotland in a Defra funded study during 2022. This study assessed the use of NumNuts® for castration and/or tail docking in lambs under seven days of age. The study compared the pain-related behaviours exhibited by lambs in the first hour after application in three treatment groups; NumNuts®, standard rubber ring and handled only controls. The full results of the study were not available at the time of this report, but preliminary results suggest that the NumNuts® technique was effective at eliminating the pain response associated with tail docking. However, there was no difference seen in pain related behaviours in lambs castrated with NumNuts® or rubber ring castration. Once the full results are available, they will be considered by Animal Welfare Committee (AWC; formerly FAWC).

There are few peer-reviewed papers available covering the procedure. Small et al. (2020) reported on a study assessing the efficacy of lignocaine to alleviate pain responses in lambs 4-10 weeks old at castration. This has limited relevance to England where rubber rings may only be applied up to seven days of age. The study compared leaving lambs entire with traditional rubber ring castration or use of the NumNuts® tool. The NumNuts® group tended to mother up faster post-treatment than rubber ring lambs. Acute pain behaviour was less frequent in the NumNuts® group than the rubber ring group at 5- and 20-minutes post-castration but no difference was seen between the groups at 35 or 50 minutes (Small et al., 2020). The use of the NumNuts® tool appeared to be an effective way to deliver the lignocaine and improved the welfare outcomes during the acute pain phase (5- and 20-minutes post application) but did not eliminate pain behaviours completely.

Small et al. (2020) noted that there may be greater opportunities to improve efficacy of pain relief with a longer acting anaesthetic. In later work Small et al. (2021) evaluated lidocaine, bupivacaine or procaine to reduce pain-related behaviours following ring castration in three separate studies (only procaine is licensed for use in England). In these studies, the effects of procaine appeared to last longer than lidocaine. Bupivacaine was slower to take effect but appeared to provide longer lasting relief. Small et al. (2021) suggest a simultaneous comparison would be required to confirm the relative effectiveness of procaine, lidocaine, and bupivacaine. This study also noted that in general the duration of action of local anaesthetics is short in sheep (Small et al., 2021).

There are few local anaesthetic products licenced for use in sheep in the UK. However, Pronestesic is available in England, which is a procaine product containing 40mg/ml procaine hydrochloride and 0.036mg/ml epinephrine tartrate as a POM-V medicine. Adrenacaine, which is licensed for use in cattle, can be prescribed by a veterinary surgeon under the Cascade. Gascoigne et al. (2021) reported procaine (or lidocaine, where procaine is unavailable) can be used at a rate of 1ml for a 4kg lamb.

### 6.3.2 Cost

The likely costs associated with use of the NumNuts® tool have not been published for UK producers. However, the manufacturer's website quotes a cost of $360 (Australian) for the applicator, which is equivalent to approximately £193 (figures from December 2023). If the procedure is approved for use in England, it could potentially be considered for inclusion in the Animal Health and Welfare (AHW) Pathway Equipment and Technology grant.

Additional costs for anaesthetic at approximately £11 exc. VAT per 100ml; (at 1ml per lamb this is sufficient for 100 4kg lambs) and a supply of needles, which cost up to £1 each depending on size and whether single or multi use (prices obtained from a range of online suppliers). A supply of rubber rings will also be needed as a cost of approximately 1-2 pence per ring.

### 6.3.3 Recommendations

Once the SRUC trials are complete and final report submitted the results will be assessed by AWC. If NumNuts® is recommended for use in England, The Mutilations (Permitted Procedures) (England) Regulations (2007) currently prohibits the use of rubber rings, with or without anaesthetic on animals older than 1 week. This legislation would need to be updated and clarified if the method is intended for use in lambs over 7 days of age.

## 6.4 Castration clip - ClipFitter

### 6.4.1 Summary

The ClipFitter system is a new method for castration and tail docking of lambs. The absence of peer reviewed literature means that a full narrative summary cannot be provided for this practice, but the following summarises the current knowledge and understanding.

The method was trialled by SRUC in 2022 and has now been authorised by the Scottish Government for use in lambs up to 3 months of age without anaesthetic. The technique has not yet been approved for England. The technique combines aspects of both rubber ring castration and the clamp technique. The ClipFitter system uses a plastic clip clamped around the scrotum, which can only be applied using a specialised ClipFitter tool, similar to a set of pliers. During the application process the force applied by the clip crushes the nerve and spermatic cords almost instantly and the blood supply is subsequently cut off. The clip is applied in a similar position to a rubber ring/clamp and remains on the animal until it is shed with the atrophied scrotum from around three weeks after application. The manufacturers have developed a range of applicators and clips to accommodate lambs of different sizes from small (5kg live weight), to standard (15kg) and large (20kg).

Defra-funded trials carried out by SRUC in 2022 involved two studies using the ClipFitter tool for castration or tail docking: the first in lambs less than seven days old and the other in older lambs (4 – 5 weeks old). At the time of this report the full results had not been released but some preliminary findings were available. In the first study, the ClipFitter technique was used for castration or tail docking and compared to standard rubber ring, rubber ring plus anaesthetic and pain relief or handling alone. Preliminary results suggest that the pain responses seen in young lambs castrated with ClipFitter were similar to uncastrated lambs. For older lambs the trial compared ClipFitter to Burdizzo plus pain relief (for castration) rubber ring plus pain relief (tail docking) or handled controls. ClipFitter caused an increased pain response in castrated lambs shortly after application (first six minutes) compared to Burdizzo plus pain relief but was similar thereafter. A full report of the trial findings is expected in 2024. Anecdotal comments suggest that the technique is easier to apply than using a clamp. It is unlikely that specialist training would be required for those already familiar with the rubber ring method, however, it may take time to perfect the technique.

### 6.4.2 Cost

The following indicative costs are based on information obtained from the ClipFitter website (accessed March 2023). The ClipFitter tool ranges in price from £125 - £250 exc. VAT, depending on the size required. Clips are supplied in packs of 100 and the packs cost in the range of £30-40.

Water-soluble clips are also available which are completely biodegradable, and cost in the region of £37-50 for 100 clips.

### 6.4.3 Recommendations

The full results of the work in Scotland are due in 2023 and will be reviewed by the AWC. If England follows the decision made in Scotland, the technique could be approved for use in future lamb crops. If ClipFitter is acceptable for use without anaesthetic in lambs up to three months of age, the device could be used across a range of production and management systems, including those where lambs are not routinely handled in the first 7 days of life.

The cost of purchasing the applicator and clips is a potential barrier to uptake, compared to the relatively inexpensive rubber ring method. However, it is possible that ClipFitter equipment could qualify for the Animal Health and Welfare (AHW) Pathway Equipment and Technology grant, should the technique be approved in England.

# 7 Discussion

The aim of this review was to evaluate the impact of various lamb castration techniques on lamb productivity and welfare, and how these relate to replacing, reducing, and refining (the 3Rs) the practices on English farms. The report outlines the evidence landscape for practices applicable to castration in lambs across hill, upland, and lowland systems. These systems cover extensive systems selling predominantly store lambs, forage-based systems finishing most lambs at grass, and intensive systems that aim to sell finished lambs from creep-fed systems at a young age.

## 7.1 Animal welfare

Leaving males entire is the practice with fewest detrimental animal welfare effects. Castration exposes lambs to short-term acute, and/or long-term chronic pain. Leaving ram lambs entire means the animals are not exposed to any castration procedures that could impact their freedom from pain, injury, and disease, and their freedom from discomfort.

Pain responses, whether to acute or chronic pain, have been observed for all castration practices within this report. However, some castration methods cause more pain than others, for example, rubber ring castration causes a smaller peak in plasma cortisol responses compared to surgical castration. Clamp castration appears to cause fewer pain responses than other methods currently approved for use England. Wound healing may also be significantly impacted by choice of castration method, with healing for some practices being slower than others. Lambs demonstrate their feeling of pain through pain behaviours, such as foot stamping, kicking, licking, and restlessness (Mellema et al., 2006). Gascoigne et al. (2021) argue that some behaviours can persist for up to 6 weeks post-castration, such as lambs turning to look at their scrotum. Pain responses to local palpation were also considered key metrics (indicators) for assessing pain, specifically for rubber ring and clamp castration methods (Melches et al., 2007).

The use of new techniques (NumNuts® and ClipFitter) to improve the welfare of castrated (and tail docked) lambs have been trialled in Scotland during 2022 with the full results of the studies expected in 2024. The ClipFitter method appears to virtually eliminate pain behaviours in young, castrated lambs (<7 days old) and reduces the pain response in older lambs (4-5 weeks old).

It has been suggested that the use of anaesthetic agents and/or analgesic drugs, prior to castration, may lead to a reduction in scrotal pain and pain behaviours (Molony et al., 1997; Thornton and Waterman-Pearson, 1999), however there is no evidence suggesting that pain will be completely eliminated. Preliminary results from the NumNuts® trial carried out in Scotland appear to suggest

that the technique did not reduce the level of pain behaviours seen compared to the use of a standard rubber ring (Defra, 2022). The implementation of pain management post-castration is however considered to have a positive impact on lamb welfare (Kells et al., 2020; Molony et al., 1997; Thornton and Waterman-Pearson, 1999). Therefore, it is recommended that the use of such drugs (e.g. non-steroidal anti-inflammatory drugs (NSAIDS)) be considered a viable refinement option for currently accepted practices in the UK.

The lamb-ewe bond should always be taken into consideration when considering castration. Castration should never be performed on lambs until the ewe-lamb bond is established, ensuring the lamb(s) receive enough colostrum (British Veterinary Association, 2020). In lambs younger than 48 hours old, acute pain may incapacitate them, leading to mismothering and inadequate ingestion of colostrum. This reduced the efficacy of protective properties which are passed from ewe to lamb, causing greater risk to disease and infection (Collins et al., 1985; Henderson, 1990; Kent et al., 1998; Mellor and Stafford, 2004).

Allowing ram lambs to remain entire is the preferred option, though only where it is a feasible option for the producer. Potential adverse welfare impacts include frustration, fighting, and potential unwanted pregnancies, should rams reach sexual maturity whilst running with ewes. As such, it is important that producers have adequate infrastructure and fencing, sufficient space, and management procedures in place to mitigate the risks. Forward planning to ensure that ram lambs would be off farm before sexual maturity is reached is a feasible approach, though contingencies should always be in place in case of events which are out of the producer's control.

### 7.1.1 Productivity

Productivity has a complex relationship with profitability and environmental sustainability. In lambs younger than 48 hours old, the acute pain experienced with various castration practices may incapacitate neonatal lambs in such a way that they fail to ingest adequate amount of colostrum, which can increase the risk of failure of passive transfer, where insufficient maternal antibodies (IgG) are passed from ewe to lamb. This can cause a predisposition to a variety of diseases, which ultimately impacts a lamb's productivity and increase the risk of mortality (Collins et al., 1985; Henderson, 1990; Kent et al., 1998; Mellor and Stafford, 2004).

### 7.1.2 Daily liveweight gain

The literature indicates that entire lambs tend to have the highest daily liveweight gain in comparison to castrated lambs. Although there is evidence to suggest that weight and growth performance are not affected by castration, numerous studies suggest that males with circulating androgens (male

hormones) display more rapid weight gain, resulting in higher daily and total weight gains. Thus, entire males are likely to reach target slaughter weight more rapidly than castrates.

Different castration methods are found to impact weight gain differently; for example, the use of local anaesthetics has been found to have a positive impact on lamb productivity. Gascoigne et al. (2021) draw on evidence from Kent et al. (2004) who found a 20g/day weight gain advantage over a period of 32 days in lambs castrated using local anaesthetic, compared to unanaesthetised control lambs. There is anecdotal evidence suggesting lambs castrated using the short scrotum method have a higher daily liveweight gain, with a heavier weaning weight than that of fully castrated lamb (Priestley, 2023). In contrast, some evidence suggests that specific castration methods (e.g., rubber ring) do not affect growth performance at all (Haddad et al., 2006). Overall, the evidence suggests that entire ram lambs have higher weight gain compared to castrates (Fisher et al., 2010).

### 7.1.3 Feed conversion

Evidence suggests that feed intake is greater and feed conversion efficiency poorer in castrated lambs. Haddad et al. (2006) found the feed to gain ratio of castrated lambs can be 0.51 greater compared to entire ram lambs. Some evidence points at specific castration methods resulting in greater feed intake and improved feed conversion efficiency (Clements and Bright, 2010; Wellington et al., 2003); for example, there is some evidence that short scrotum males produce a higher-grade carcase compared to wethers, which is more in line with that produced by an entire ram lamb.

## 7.2 Profitability

Profitability is directly related to productivity. A heavier lamb indicates better feed conversion efficiency, indicating better meat quality and ultimately, a better income. By reducing inputs such as labour and feed, producers could see increased profitability from cost savings.

### 7.2.1 Feed intake and conversion

Allowing ram lambs to remain entire could yield benefits to profitability as a result of improved weight gain and better feed conversion efficiency in comparison to castrated lambs. Castrates generally have higher feed intakes, but poorer feed conversion efficiency which results in higher feed costs but a lower monetary gain at time of sale or slaughter.

### 7.2.2 Meat quality

Ram lamb meat is generally considered inferior in quality to meat from castrated rams due to the lower fat content and the potential for ram taint. Generally, consumers prefer the meat from

castrated lambs (Gravador et al., 2018; Hybu Cig Cymru, 2021). However, some consumers may prefer the leaner meat of entire ram lambs, which reportedly contains less saturated fat than meat of castrates (Gravador et al., 2018).

It cannot be ignored that age, weight, and season can have an impact on the flavour, tenderness, and dressing percentage of lambs. Entire ram lambs are often considered to have a stronger flavour and less tenderness to their meat, though these characteristics can also be seen in older and heavier lambs. Clements and Bright (2010) argue there is no difference in the meat quality of entire ram lambs slaughtered before reaching sexual maturity compared to castrated lambs. Lambs slaughtered at an older age, or a heavier weight, typically have lower water holding capacities, resulting in drier and less juicy meat. The diet of a lamb has also been found to influence the taste and quality of lamb meat, with grass-fed lambs tending to be juicier and more flavoursome (Clements and Bright, 2010).

### 7.2.3 Labour and practice costs requirements

Castrating ram lambs allowed ewes and rams to run together, creating an easy to manage production system. The main costs associated with castration are equipment costs, short-term labour costs, veterinary input, and medicines (where required). There may also be operator training costs to consider, depending on the castration method used.

In contrast, allowing ram lambs to remain entire will incur additional labour and infrastructure costs, to safeguard against the occurrence of any unwanted/unplanned pregnancy. Entire rams and ewes require separate handling and management, which is likely to require additional staffing due to the increased handling time. It is also pertinent that on-farm infrastructure must be adequate to keep rams and ewes separate; the installation and/or maintenance of such infrastructure (e.g., adequate fencing) will incur additional costs. In addition to this, producers must have adequate space for ewes and rams to be managed effectively and without any welfare impacts.

## 7.3 Environmental sustainability

Overall, environmental sustainability (specifically GHG emissions) could be negatively affected by decreased efficiency of castrated lambs compared to intact lambs. Decreased feed conversion efficiency and lower growth rates result in increased GHG emission volume per animal (Haddad at al., 2006). Reduced colostrum intake caused by exposure to acute and/or chronic pain in castrates is likely to cause a predisposition to disease and infection, resulting in decreased efficiency of the growing animal (Collins et al., 1985; Henderson, 1990; Fisher et al., 2010; Kent et al., 1998; Mellor and Stafford, 2004). This is compounded by the potential for mismothering caused by some

castration methods, which significantly increases mortality rates in neonatal lambs (Clements and Bright, 2010). Mitigating or minimising this risk would significantly improve the environmental sustainability of lamb production.

The use of consumables in rubber ring castration should also be considered to have a lifecycle impact on the environmental sustainability of the practice. There is a lack of literature pertaining to environmental impact of rubber use in lamb castration specifically. The environmental impact of rubber is complex and dependent on multiple factors (country of production, manufacturing method, natural or synthetic, etc); in addition, conclusive figures for the number of rubber rings used during lamb castration within England are lacking. Environmental sustainability of plastics used in the ClipFitter method has been addressed by including a water-soluble version that is completely biodegradable.

Consideration will also need to be given to the increased use of consumables where anaesthetic and/or analgesic drugs are used. This will include the use of needles and syringes plus the need for medicine disposal. The requirement for antibiotic to treat infections following castration will vary with castration technique, with use more likely where castration leaves an open wound (especially relevant for surgical castration). Supporting a 'One Health' approach to responsible antibiotic use will contribute to slowing the development of antimicrobial resistance (AMR) and reduce release of antibiotics into the environment.

## 7.4 The 3 Rs

The 3 Rs - reduce, refine, and replace - were initially developed to be used in laboratory scenarios. These were then adapted to other areas of animal production, such as the castration of male lambs. Throughout this report, the 3 Rs have been defined as:

- Reduce – Reducing the number of animals exposed to the current practice
- Refine – Modifying the existing practice on an individual farm to improve the welfare outcome associated with the process
- Replace – Switch to a different castration practice

Generally, there is scope to reduce the number of castrated lambs in England by ensuring that producers have the means (in terms of space and labour) to allow ram lambs to remain entire. It is also necessary that producers are knowledgeable about the pros and cons of keeping males entire and have adequate contingency plans in place.

The ideal would be to eliminate the need for castration; however, this blanket approach is not possible due to various factors. Leaving males entire requires the provision of enhanced management practices to ensure that unwanted pregnancies do not occur, to minimise frustration and mitigate fighting among rams. Motivations for farmers to allow ram lambs to remain entire may also depend on factors associated with a loss of profitability due to consumer preference for meat from castrated lambs. However, there are profitability gains associated with improved growth rates and better feed conversion efficiency in entire ram lambs.

*Table 16 Summary of the 3 Rs in relation to each of the castration practices*

<table>
<tr><th></th><th>REDUCE</th><th>REFINE</th><th>REPLACE</th></tr>
<tr><td>LEAVING LAMBS ENTIRE</td><td>No scope for reduction</td><td>The practice of keeping male lambs entire can be refined by ensuring that the right management tools and infrastructure are in place when ram lambs reach sexual maturity</td><td>This practice should only be replaced where producers are not able to ensure separation of entire rams and ewes</td></tr>
<tr><td>RUBBER RING</td><td rowspan="10">Number of lambs castrated can be reduced by allowing ram lambs to remain entire.<br><br>This should only be done where producers have the necessary management procedures and adequate infrastructure in place, with appropriate contingency plans.<br><br>See Chapter 5.1 for further information</td><td rowspan="4">These practices could be refined by using anaesthetics, analgesics, and post-castration pain management, and by ensuring that the operator is correctly trained, attends regular refresher training with equipment regularly inspected and maintained</td><td rowspan="10">Castration should be replaced with allowing ram lambs to remain entire.<br><br>This should only be done where producers have the necessary management producers and adequate infrastructure in place.<br><br>See Chapter 5.1 for further information</td></tr>
<tr><td>CLAMP/ BURDIZZO</td></tr>
<tr><td>COMBINED</td></tr>
<tr><td>SHORT SCROTUM</td></tr>
<tr><td>SURGICAL</td><td>Surgical castration should only be carried out by qualified veterinarians. This procedure could be refined by good implementation of pre- and post-surgery pain management</td></tr>
<tr><td>IMMUNOCASTRATION</td><td rowspan="4">The practice can be refined by ensuring that the operator is correctly trained and attends regular refresher training with equipment regularly inspected and maintained</td></tr>
<tr><td>CHEMICAL</td></tr>
<tr><td>NUMNUTS®</td></tr>
<tr><td>CLIPFITTER</td></tr>
</table>

## 7.5 Practice wide evidence gaps

The research underpinning this report highlighted many common themes and trends across the varying lamb castration methods, which provided an opportunity to extract and identify areas within the literature where further research is required.

### 7.5.1 Current levels of use and trends in lamb castration

There does not appear to be any data available that estimates the proportion of male lambs that are castrated in England (or the wider UK) and similarly no data indicating the relative popularity of existing techniques.

Several practices explored in this REA have the potential to offer improved animal welfare outcomes, however, the uptake of these practices is largely dependent on production system and management styles (e.g., lowland versus upland, intensive versus extensive). Anecdotally sheep producers are increasingly willing to consider alternatives to traditional castration techniques (personal communication), though the lack of data at country-level means it is not currently possible to track any trends in numbers of castrates or methods used.

Further research into the popularity of the various castration methods and alternatives that producers might consider, through the use of periodic industry surveys, could be a viable option for the future.

### 7.5.2 Availability and approval of anaesthetic and analgesia products

Lamb welfare during, and following, the castration process is a significant concern. The use of local anaesthetics and/or analgesia can reduce the pain behaviours seen in lambs post-castration, thus indicating an improved welfare state. Small et al. (2020) also found that lambs castrated using local anaesthetic were able to mother-up quicker than lambs castrated without. There is currently only one licensed product for use in sheep – procaine - though other medications can be prescribed by a veterinary surgeon through the cascade system. Preliminary results on the use of procaine in the NumNuts® trial show beneficial results when used for tail docking but it did not reduce pain behaviours compared to the rubber ring techniques when castrating young lambs. The full report, which was not available at the time of writing, may comment on the reasons for this and highlight where further research would be helpful.

Although the use of local anaesthetics and analgesics such as NSAIDs for pain relief constitutes a refinement of traditional techniques, further research is required to ascertain the most effective products and timings. Mellema et al. (2006) found local anaesthetics to be more effective for rubber ring castration than for clamp (Burdizzo) castration, though accepted that this was likely down to the short time period between anaesthetic administration and castration. A longer time delay between administering the local anaesthetic and castration would likely improve the efficacy of the anaesthetic (Mellema et al., 2006). Melches et al. (2007) found lower signs of pain and distress and lambs castrated using bupivacaine compared to those castrated using lidocaine (note that neither of these products are currently licensed for sheep in England). In a series of three experiments Small et al. (2021) evaluated the efficacy of local anaesthetics delivered using the Numnuts® device in terms of speed of onset and duration of action. The results found bupivacaine to be the longest lasting anaesthetic although onset of pain relief was delayed when compared to procaine and lidocaine. Small et al. (2021) commented that there were marked differences in both onset and duration of local anaesthetics which may be due to the pharmacokinetics of the agents and the formulation (for example the procaine product contained adrenalin) as well as the effective dose and administration route. This makes comparison of results with earlier studies challenging. In addition, the papers reviewed for this report were often for older lambs and therefore of limited relevance to UK systems when looking at rubber ring castration.

There are opportunities to improve the efficacy of pain relief in lambs with further research. Further comparative studies have been suggested (Small et al., 2021) to directly compare anaesthetic timings and durations and trialling of combination formulations that can provide rapid onset and sustained pain relief. Further research is also required into post-castration pain management including the administration of analgesics for pain relief.

### 7.5.3 Evidence on failure rates

No evidence on failure rates of castration methods were found from this research. Some methods produce visible success results, such as the rubber ring method where the testes drop off with the withered scrotum, or surgical castration where they are surgically removed. It is possible that a rubber ring could physically fail, or that both testicles are not present in the scrotum at the time of castration, which could result in retained fertility.

Clamp castration requires the spermatic cords to be crushed and the testicles to atrophy within the scrotum, thus requiring closer physical examination to confirm whether castration has been successful. It is possible that incorrect application of the clamp does not effectively crush the

spermatic cords, though correct operator training and regular refresher courses should mitigate this risk.

Short scrotum castration is the most controversial castration method, as the testicles are retained. The testicles are pushed up, closer to the body, preventing the production of viable sperm. Although the scrotum itself drops off, it is possible that the method fails, and the lamb continues to produce viable sperm, which causes great concern for many producers. Test matings have been used to assess the fertility of short-scrotum lambs in some studies, though this is not a viable assessment method on-farm. Producers would need to handle short scrotum lambs in the same manner as entire rams unless infertility is confirmed, nullifying the need for castration in the first place.

Similar concerns have been raised about immunocastration, where infertility is achieved by vaccination against GnRH. This vaccination is reversible, and the duration of infertility is dependent on the interval between primary and booster vaccinations. As with short scrotum lambs, there is currently no viable on-farm way to confirm infertility, thus producers would need to handle immunocastrates as they would entire rams. Further research is required to ascertain a viable way of assessing infertility, and to develop definitive answers to the number, and spacing, of booster vaccinations to maintain infertility.

### 7.5.4 Potential barriers to uptake of practices

Although many of the castration methods in this review have the potential in improve welfare outcomes, there are also potential barriers to uptake which include:

- Effectiveness (see Section 7.6.3)
- Practicality
- Labour requirements
- Legislation
- Consumer perception
- Cost

In general, there was a lack of evidence focussing specifically on profitability or environmental aspects of the individual methods, therefore these have been inferred from productivity indicators and cost data.

The practicality of higher-welfare castration methods is likely one of the biggest challenges for producers. Labour requirements and general on-farm practicalities may negatively influence refinement techniques. The application of anaesthetics pre-castration to large groups of lambs could

be considered challenging, as could large-scale pain relief management post-castration. Although there are devices available which would mitigate these additional practicality concerns (e.g., NumNuts®) they are not yet licensed for use in England and the effectiveness of the pain relief is uncertain.

NumNuts®, or any other device using a rubber ring, would still need to be carried out within the first 7 days of life under the Mutilations (Permitted Procedures) (England) Regulations 2007. This precludes the use of any such device in systems where lambs are not routinely handled in the first 7 days (e.g., extensive hill and/or upland systems).

Immunocastration offers a welfare friendly and effective castration technique, however, it is not yet licensed for use in England. Immunocastration would need to be legally accepted and approved in England for it to become a viable option in the future. Practical aspects mean this method is likely more applicable to farms that sell lambs finished, as there is greater control over timings. Where lambs are sold as stores, vaccination status may not be known, which could cause difficulty in integrating with other lamb groups. Vaccination uptake would likely depend on cost, as vaccinations are unlikely to be cheap and lambs will require more than one dose. IMPROVAC® for pigs is priced at £90.33 excl. VAT for 100ml bottle, allowing for two doses of 2ml to achieve full vaccination status, the cost is approximately £3.61 per animal. These figures show an estimate of total cost for immunocastration in lambs.

### 7.5.5 Uptake enablers

Most castration methods currently legal and licensed in England are fairly low in cost, with the exception of surgical castration. However, NumNuts® and ClipFitter require the purchase of specific applicator tools, which is likely to impact uptake. Should these techniques by approved for use in England in the future, the applicator tools could be made eligible for the Animal Health and Welfare (AHW) Pathway Equipment and Technology grant. This would likely encourage the uptake of these practices, subject to confirmation of improved welfare outcomes and castration success.

As farm assurance schemes and consumers place a growing emphasis on farm animal welfare, the demand for more welfare friendly castration techniques is likely to drive changes in farm management practices and/or legislation. This may drive opportunities for new technologies and emerging techniques to be licensed for use in England. Where regular reviews of both the need for castration and use of welfare friendly castration practices are a requirement of farm assurance schemes, high-welfare outcomes are likely to be achieved in assured enterprises as part of routine audits. It is noted however that a significant proportion of England's sheep flocks are non-assured.

For these flocks, the Animal Health and Welfare Pathway Annual Health and Welfare Review could present an opportunity for vets and farmers to explore different options to suit individual farm needs, and apply the 3Rs to castration, to enhance welfare, farm profitability and sustainability.

### 7.5.6 Meat quality and evidence of ram taint in entire (uncastrated) lambs

This review has predominantly focused on welfare and production, though effects of castration on meat quality were evident. The relationship between ram taint and castration is difficult to ascertain, as age, weight and season can all have an impact on meat quality. Further research and trials would be needed, using the meat from entire lambs and castrated lambs, of the same age and similar weights, to yield a direct comparison. Further research could also assess castration method on meat quality, comparing meat from lambs of the same age and weight, castrated using various castration methods. Depending on the outcome, this research would have the potential to enable uptake of welfare-friendly castration methods, by promoting productivity and profitability benefits to producers.

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**Links to relevant legislation (accessed December 2023)**

Animal Welfare Act 2006 https://www.legislation.gov.uk/ukpga/2006/45/contents

Council Regulation (EC) No 1/2005 of 22 December 2004 on the protection of animals during transport and related operations and amending Directives 64/432/EEC and 93/119/EC and Regulation (EC) No 1255/97 https://www.legislation.gov.uk/eur/2005/1/contents

The Mutilations (Permitted Procedures) (England) Regulations 2007
https://www.legislation.gov.uk/ukdsi/2007/9780110757797/contents

The Welfare of Animals (Transport) (England) Order 2006
https://www.legislation.gov.uk/uksi/2006/3260/article/2/made

The Welfare of Livestock (Prohibited Operations) Regulations 1982
https://www.legislation.gov.uk/uksi/1982/1884/pdfs/uksi_19821884_en.pdf

Veterinary Surgeons Act 1966. https://www.legislation.gov.uk/ukpga/1966/36/contents

Defra Code of Recommendations for the Welfare of Livestock. Sheep
https://assets.publishing.service.gov.uk/media/63d298018fa8f53fead8ee8c/Code_of_recommendations_for_the_welfare_of_livestock_-_sheep.pdf

## Appendix 1: Excerpts from relevant law and their implication for castration of lambs.

| Legislation | Relevant Wording | Implication for Castration Practices |
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| **Animal Welfare Act 2006** | **Section 4 – Unnecessary suffering**<br>"A person commits an offence if … [any] suffering is unnecessary. … The considerations to which it is relevant to have regard when determining … whether suffering is unnecessary include whether the suffering could reasonably have been avoided or reduced; whether the conduct which caused the suffering was in compliance with any relevant enactment or any relevant provisions of a licence or code of practice issued under an enactment; whether the conduct which caused the suffering was for a legitimate purpose, such as the purpose of benefitting an animal or the purpose of protecting a person, property or another animal; whether the suffering was proportionate to the purpose of the conduct concerned; whether the conduct concerned was in all the circumstances that of a reasonably competent and humane person."<br><br>**Section 5 - Mutilation**<br>"[It is an offence to carry out] a procedure which involves interference with the sensitive tissues or bone structure of an animal, otherwise than for the purpose of its medical treatment." | • Farmers should not castrate if it can reasonably be avoided.<br>• Castration should only be carried out for the legitimate interest of the animals/farmer.<br>• Castration should only be carried out by 'reasonably competent and humane' persons.<br>• Farmers should be working within the framework of a code of practice (such as Defra Code of Recommendations) or specific licence when carrying out castrations.<br>• It is illegal to carry out any kind of procedure that interferes with the tissues of an animal, other than for medical treatment (with exemptions made for some procedures in subsequent legislation, such as The Mutilations (Permitted Procedures) (England) Regulations 2007). |
| **Council Regulation (EC) No 1/2005** | **Annex 1, Chapter 1 – Fitness for transport**<br>"Animals that are injured or that present physiological weaknesses or pathological processes shall not be considered fit for transport and in particular if … they are pregnant females for whom 90% or more of | • In the case of flocks with intact males, or where there is a risk of continued fertility, farmers may fall foul of the law if they allow heavily pregnant or recently lambed ewes to be transported. |

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| | the expected gestation period has already passed, or females who have given birth in the previous week … However, sick or injured animals may be considered fit for transport if they are … animals that have been submitted to veterinary procedures in relation to farming practices such as dehorning or castration, provided that wounds have completely healed."<br><br>**Annex 1, Chapter 3 – Transport practices**<br>"Animals shall be handled and transported separately in [the case of] … sexually mature males from females." | • Castrated males may not be transported until any wounds produced by the procedure have fully healed.<br>• Sexually mature males and females are not permitted to be transported together. |
| **The Mutilations (Permitted Procedures) (England) Regulations 2007** | Schedule 5 – Sheep: Requirements when carrying out certain permitted procedures.<br><br>"Castration: When the method used is the application of a rubber ring or other device to constrict the flow of blood to the scrotum, the procedure may only be carried out on an animal aged not more than 7 days. When any other method is used, an anaesthetic must be administered where the animal is aged 3 months or over." | • Rubber ring castration (and similar techniques) may only be carried out in lambs aged ≤ seven days.<br>• Anaesthetic must be used on animals castrated beyond an age of three months. |
| **The Welfare of Animals (Transport) (England) Order 2006** | No specific wording relating to castration of ovine species, but relevant inasmuch as this legislation makes it an offence not to comply with Council Regulation (EC) No 1/2005, relating to transport | |
| **The Welfare of Livestock (Prohibited** | No specific wording relating to castration of ovine species, but relevant inasmuch as lamb castration is not present in the list of prohibited practices laid out in Section 3. | • Castration of lambs is permitted by law as a legitimate husbandry practice. |

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| **Operations) Regulations 1982** | | |
| **Veterinary Surgeons Act 1966** | Schedule 3 – Exemptions from restrictions on practice of veterinary surgery.<br><br>"Part 1: Treatment and operations which may be given or carried out by unqualified persons: … The performance by any person of or over the age of eighteen of … the castration of a male animal … whether by chemical means or otherwise."<br><br>"Part 2: Exclusions from the provisions of part 1: … Nothing in … this act shall authorise the castration of a male animal being … a ram which has reached the age of three months." | • Anyone over the age of 18 (and who is 'reasonably competent and humane', as of 2006) may carry out any kind of castration on farm animals.<br>• This only applies up to the age of three months, after which castration may only be performed by a veterinary surgeon. |
| **Defra Code of Recommendations for the Welfare of Livestock** | "Farmers and shepherds should consider carefully whether castration is necessary within any particular flock. Castration is unlikely to be necessary where lambs will be finished and sent to slaughter before reaching sexual maturity. The procedure should only be carried out when lambs are likely to be retained after puberty and where it is necessary to avoid welfare problems associated with the management of entire males.<br><br>Account should be taken not only of the pain and distress caused by castration but also the stress imposed by gathering and handling, and the potential risk of infection. For very young lambs gathered in large groups, there is a real risk of mismothering, which may lead ultimately to starvation and death. | • Following Defra recommendations fulfils the criteria for necessary suffering laid out in the Animal Welfare Act 2006 ("…conduct which caused the suffering [must be done] in compliance with … any relevant provisions of a licence or code of practice…").<br>• Farmers should not castrate if it can reasonably be avoided.<br>• Welfare considerations should be made regarding how lambs are handled/gathered during the castration process.<br>• Castration should not be performed on lambs until the ewe/lamb bond has become established.<br>• The current legal boundaries for castration are to be adhered to. |

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| | Castration should not be performed on lambs until the ewe/lamb bond has become established.<br><br>Castration may only be carried out in strict accordance with the law … The procedure should be performed by a competent, trained operator. Once a lamb is over three months of age, castration may only be performed by a veterinary surgeon using a suitable anaesthetic. Shepherds should only carry out surgical castration after having first considered and ruled out alternative methods, in discussion with their veterinary surgeon.” | |