

Successful Surgical Management of Rumen Impaction Caused by Plastic Ingestion in a Crossbred Cow

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ABSTRACT

Plastic is now a familiar finding in the forestomachs of cattle that scavenge on roadsides and refuse heaps, and rumen impaction caused by plastic is a recognised cause of illness, lost production and death in livestock. Reports of its surgical treatment are common and are usually framed as successes. No individual case is presented in this article. It is a narrative review of the published literature on plastic ingestion and rumen impaction in cattle, covering how plastic reaches the animal, what it does to rumen function, how the condition is recognised, what medical and surgical management are intended to achieve, how outcomes are reported, and how the problem can be prevented. The review draws on veterinary, ruminant physiology, waste management and evidence-appraisal sources and reports no new data. A central difficulty is that the clinical record consists mostly of case reports and small case series, which are shaped by selection and survivorship, and that success is rarely defined or followed beyond hospital discharge. Surgery can relieve an obstructed forestomach, but it treats a consequence and not the cause, and an animal returned to the same environment remains exposed. The review concludes that waste management, containment and early recognition probably matter more than any operative technique, and it sets out what better reporting of outcomes would involve.

Keywords: Rumen impaction; Plastic ingestion; Cattle; Rumenotomy; Foreign body; Waste management; Narrative review

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1. Introduction

Veterinarians who work with cattle in places where household and market waste is poorly collected will recognise the picture. A cow that has been eating less for days, ruminating little and losing condition turns out, on examination of the forestomach, to be carrying a matted mass of plastic bags and film. Reports of this condition have accumulated for decades, and it is now

described as an increasing threat to ruminants in developing countries [1, 2]. Most of those reports end on a satisfying note: the contents were removed, the animal recovered and the owner was pleased.

The title of this article refers to the successful surgical management of rumen impaction in a crossbred cow. It needs to be said plainly that no individual animal is described here. No clinical

findings, operative details, laboratory values or outcomes from any patient are reported, and nothing in the text should be read as a case record. The title has been retained as it appears in the journal record, and the article itself is a narrative review of the published literature on plastic ingestion and rumen impaction in cattle. We have chosen that form because a convincing account of one successful operation says very little about how often such operations succeed, what success means, or whether the animal stays well afterwards.

There is also a larger point. The rumen can be cleared of plastic, but the plastic arrives from somewhere, and that somewhere is a problem of waste management, land use and animal husbandry well outside the operating theatre [3, 4]. A literature that celebrates the operation while saying little about the source risks teaching the wrong lesson. This review therefore sets out how plastic reaches the animal, what it does to rumen function, how the condition is recognised and managed, how outcomes are reported, and what prevention would involve. The aim is a fair account of what has been reported and what has simply been repeated.

The review is narrative. It draws on published work from veterinary medicine, ruminant physiology, waste and environmental science, and the appraisal of clinical evidence, and it reports no new data. Where the clinical literature is thin or cannot be cited with confidence, we say so and describe what better evidence would look like, instead of quoting numbers we have not been able to check against their sources.

2. Literature Review

2.1 Plastic Waste and the Animals That Meet It

Plastic is cheap, light and durable, and those same properties make it difficult to dispose of. An analysis of production and fate across the whole history of plastics found that a large part of everything made has already been discarded, that packaging is a major use, and that only a small share has been recycled [3]. Recycling itself faces technical and economic obstacles, and thin, soiled film is among the hardest material to recover [5]. Where collection services are patchy, waste that is not collected is dumped, burned or left to blow about, and estimates of mismanaged waste in coastal countries have been used to model how much reaches the sea [6].

Much of the public attention has gone to oceans, but the land is where most plastic is used and first

discarded. Plastic debris in terrestrial settings has received far less study [7], although work on soils shows that plastic fragments can alter the physical environment where they accumulate [8, 9]. Waste generation is expected to keep rising with urbanisation [4], and in many low-income settings an informal sector of collectors and recyclers carries much of the burden of recovery [10]. Cattle that range through those settings share the habitat with the waste.

Plastic does not stay as it was made. It fragments, it persists, and it accumulates where nothing removes it [11, 12]. That persistence matters for a grazing animal in a simple way: an item that does not rot or dissolve in the rumen has no natural route out except the one that its size allows.

2.2 How Cattle Come to Eat Plastic

Cattle are bulk-and-roughage feeders. Comparative work on ruminant digestion places them among the animals that take in large amounts of coarse feed, with a big forestomach and a relatively unselective way of feeding compared with the small, picky browsers [13, 14]. They graze by wrapping the tongue around vegetation and tearing it off, which is efficient on pasture and indiscriminate on a verge where grass grows through litter.

The reasons they swallow plastic are probably several. Free-ranging or stray animals that scavenge on refuse heaps and roadsides meet plastic in large quantities, often wrapped around food scraps [1]. Hunger, poor-quality fodder and mineral imbalance have all been suggested as drivers of depraved appetite, and in sheep studied in a semi-arid region, indigestible foreign bodies in the rumen were linked to a feed-scarce environment [2]. It is reasonable to suppose that these factors interact, but the strength of each has not been cleanly separated, and most of what is written is observation and inference.

This matters for the way a case is read. The same cow that eats plastic in a dry season when fodder is short may not do so when feed is plentiful. An operation that clears the rumen does nothing to change the feed supply, the grazing range or the nearest dump.

2.3 Rumen Function and What Plastic Does to It

The rumen is a fermentation chamber. Feed is broken down by a dense community of microbes, and the volatile fatty acids they produce supply most of the energy a ruminant uses [15]. The relationship is a mutualism, and it depends on a steady flow of fermentable feed, good mixing and a

stable environment [16, 17]. Chewing the cud reduces particle size so that material can leave the rumen, and large particles are retained until they have been broken down [18].

Plastic breaks that logic. It is not fermentable, it does not shrink as fermentation proceeds, and a sheet of film that has been swallowed is unlikely to be reduced to particles small enough to pass on. Light material of this kind can tangle with fibrous digesta and with other plastic, so that over days and weeks a mass builds up [1]. Unlike fibre, which at least ferments slowly and can be assessed by standard methods [19], this material occupies space and contributes nothing.

Space matters because intake in cattle is limited in part by physical fill. Models and reviews of intake regulation describe how bulky, slowly digested material fills the gut and signals satiety [20, 21]. A rumen partly occupied by inert plastic therefore has less room for feed, and an animal can feel full while receiving little energy. Reduced eating lowers the supply of fermentable substrate, which in turn alters the microbial community, because diet is a main determinant of its composition [22, 23]. Figure 1 sketches the loop. It is a conceptual schematic and not a measured relationship, and the arrows indicate plausible directions of influence. Small as each of these disturbances is, they add up over days of reduced eating.

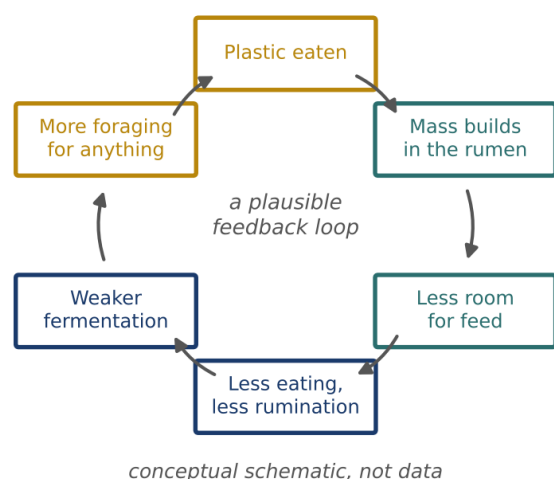


Figure 1. A loop by which plastic in the rumen could reduce intake and prolong exposure (conceptual schematic, not data).

The loop has a practical corollary. An animal that eats less because the rumen is partly filled may also be driven by hunger to forage more widely, or to take whatever it finds. We do not know how often this happens, and we have not seen the question tested, but it is a reason not to treat the first appearance of signs as the first appearance of the problem.

2.4 Clinical Presentation and Diagnosis

The signs of rumen impaction are non-specific. Affected animals eat less, produce less milk, ruminate less and lose weight; faeces become scant and dry; and bloat may recur [1, 2]. Each of these also occurs in many other conditions. Changes in feeding and rumination behaviour are widely used as indicators of ill health in cattle [24, 25], but they say that something is wrong without saying what. Other disorders of the forestomach, acidosis among them, also depress intake and disturb motility [26], so reduced appetite alone cannot distinguish impaction from its mimics. Table 1 lists the features most often described and the limit of each.

Diagnosis therefore rests on a combination of history, examination of the abdomen and rumen, and sometimes imaging or fluid analysis, interpreted against what else could explain the picture. Plastic film is poorly visible on some imaging methods, which is one reason a history of access to waste carries weight. A history is not always available, particularly for stray or purchased animals, and a clinician who does not ask about waste is unlikely to be told about it.

Table 1. Features that raise suspicion of forestomach impaction and the limits of each.

Feature	What it suggests	Limit
Reduced appetite and milk yield	Falling intake and fill problems [21, 25]	Common to many illnesses
Reduced rumination	Disturbed forestomach activity [18, 25]	Needs a baseline for the animal
Poor rumen motility on examination	Mechanical or functional obstruction [1]	Subjective; varies with examiner
Dry, scant faeces and weight loss	Prolonged low intake [1, 2]	Appears late
Recurrent or persistent bloat	Disturbed gas escape [1]	Has other causes
Palpable doughy or firm rumen contents	Packed, poorly mixed contents [1]	Does not identify the material
History of access to waste	Raises the likelihood [1, 2]	History is often unavailable

Note: Qualitative summary. None of these features is specific to plastic, and several overlap with other causes of reduced intake.

2.5 Management Options

Management of rumen impaction has two broad strands, and the choice between them depends on the animal, the facilities and the owner. Supportive and medical care aims to correct

dehydration and energy deficit and to encourage the forestomach to move again; surgical removal of the contents aims to relieve the obstruction directly [1]. In practice they are combined. Table 2 summarises the purpose and main limits of each approach in general terms. We deliberately omit technique and drug doses: this is not a clinical manual, and doses and methods belong in sources that can be checked against the original studies.

Table 2. Management approaches for plastic-related rumen impaction: purpose and main limits.

Approach	Intended purpose	Main limits
Supportive and medical care	Correct fluid, electrolyte and energy deficits; restore motility [1, 15]	Seldom removes a matted plastic mass
Surgical removal of contents	Relieve obstruction and restore fill capacity [1]	Needs facilities, skill and asepsis; carries risk
Analgesia and aftercare	Reduce pain and support return to feed [27, 28]	Choice constrained by drug residues in milk and meat
Rumen microbial support	Help fermentation recover after prolonged poor intake [22, 23]	Evidence in this condition is thin
Culling or salvage decisions	Avoid prolonged suffering and cost	Depends on economics and welfare judgement

Note: Qualitative comparison from the cited literature and general veterinary principles. No protocol, dose or technique is implied.

Pain and aftercare deserve more space than they usually receive. Procedures on cattle are painful, and pain is easy to under-recognise in a species that tends not to show it [24, 27]. The range of analgesics used in food animals is limited, in part by concern for residues in milk and meat [28]. A report that calls an operation successful without mentioning analgesia has left out a part of the animal's experience.

2.6 Plastic Ingestion in Other Animals and the Wider Concern

Ruminants are not the only animals that swallow plastic. A large literature on marine animals documents ingestion and entanglement across many groups [29, 30], and the physical effects of ingested particles, including blockage and reduced feeding, have been reviewed [31]. Plastic particles that are small enough to remain in the environment for a long time are widely reported [32].

There is a chemical dimension too. Plastics contain additives and can adsorb pollutants, and the transport and release of those chemicals to wildlife has been described [33, 34]. Wider reviews of

plastics and human health note both the concern and the uncertainty about exposure routes [35, 36]. Whether chemicals leaching from plastic retained in a cow's rumen reach milk or meat in meaningful amounts is not something we can answer from the sources we are confident of, and it is better flagged as an open question than guessed at.

3. Materials and Methods

3.1 Scope and Question

The review asks one question in several parts: what does the published literature say about how plastic reaches cattle, what it does to the rumen, how the resulting impaction is recognised and managed, how treatment outcomes are reported, and what prevention involves? We also asked a narrower question that follows from the title, namely what 'successful' surgical management can reasonably be taken to mean given what is reported. None of these questions is difficult, but each is easy to leave unasked.

3.2 Literature Assembly

The review draws on peer-reviewed work in four areas: the veterinary literature on plastic and other foreign bodies in ruminants; ruminant digestive physiology and intake regulation; plastic waste, its environmental fate and its effects on animals; and the methodology of clinical reporting and evidence appraisal. Sources were chosen for relevance, standing in their field and clarity. Evidence from other species is used for what it teaches about mechanisms and limits, and not as proof of effects in cattle.

We did not run a formal systematic search and we do not claim one. This is a narrative synthesis, and the choice of sources reflects the authors' judgement, a form of review that has its defenders and its limits [37]. One consequence needs to be stated frankly. Much of the clinical record is made up of individual case reports and small series, many in regional journals and textbooks, and we cite only sources we could identify precisely. The clinical literature is therefore described in general terms, with a small number of specific sources, and no numerical outcome from any individual report is quoted.

3.3 Appraisal Framework

To judge how far a report of successful treatment can be trusted, we asked four questions. How were the animals selected, and would failures have been included [38, 39]? What was counted as success, and when was it assessed [40]? Was follow-up long enough to see recurrence or relapse? And did the

report address the source of the plastic as well as its removal? These questions borrow from guidance on reporting clinical cases [41] and from the methodology of evidence synthesis in veterinary medicine [42], adapted to a narrative review.

4. Results

4.1 What the Reports Describe

The reports share a recognisable shape. An animal, usually adult and often a milking cow or a small ruminant, is presented after a period of reduced eating; a diagnosis of impaction is reached; plastic and other indigestible material is found in the forestomach; and the animal is treated, with a recovery described [1, 2]. The ingested material is frequently a mixed mass, in which plastic bags are joined by rope, cloth and other debris, which suggests that the animals are eating what the local waste stream offers and not plastic alone.

What is usually absent is a denominator. A report of one cow tells us that recovery is possible. It does not tell us how many comparable animals were treated elsewhere, how many died before reaching a surgeon, how many were sold, slaughtered or abandoned, or what became of the recovered animal a year later. Figure 2 shows, as a schematic, where a published report usually enters the course of the condition. Read this way, the silence of the literature about failures is itself informative.

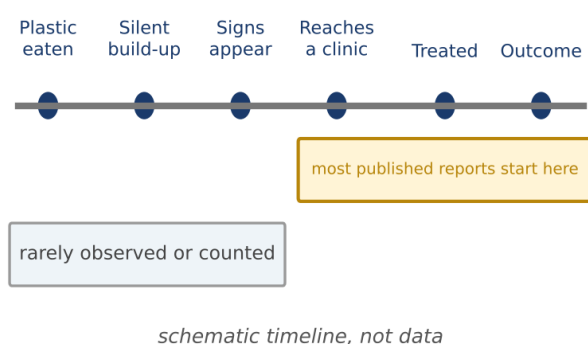


Figure 2. Where published reports usually enter the course of the condition (schematic timeline, not data).

4.2 Diagnosis and Its Uncertainty

Clinical reasoning in these reports moves from a general picture of poor intake to a specific suspicion of obstruction. The first step is easy and the second is not. Behaviour, rumination and appetite are informative, but none is specific [24, 25], and acid-related disorders and other forestomach problems can mimic the early picture

[26].

Because plastic is often missed by imaging and may be identified only at operation or post-mortem, published series are likely to over-represent animals in which the diagnosis was eventually confirmed. Animals whose illness resolved on supportive care, or who died with the cause unrecognised, are less likely to appear. This is not a criticism of the authors of any report; it is a property of how clinical series are assembled [39].

4.3 Medical and Surgical Management

Surgical removal of forestomach contents is a long-established response to impaction, and the reports describe recovery in many treated animals [1]. The case for operating is strongest where a mass is too large or too tangled to clear, and where the animal is otherwise fit enough to be anaesthetised or restrained and to withstand the stress of surgery. Supportive care alone may be enough for lighter impactions, but plastic film is among the less forgiving materials.

Two comparisons would make the choice evidence-based, and neither exists in a form we can cite. The first is between operating and not operating, in animals of similar severity. The second is between different aftercare regimes. Without them, the decision rests on experience and on circumstances: the facilities available, the value of the animal, the owner's means and the clinician's judgement. These are legitimate grounds for a decision, but they are not evidence of benefit, and a literature made of successful single cases cannot supply it. Nothing in this reading argues against operating; it argues for asking what happens next.

Recovery after prolonged poor intake is not instantaneous. Fermentation depends on a microbial community that responds to diet [22, 23], and an animal that has eaten little for days must rebuild intake and fermentation gradually. Pain control, feeding and monitoring in the days after the operation are as much a part of the outcome as the operation, even if reports treat them as a footnote [28].

4.4 What 'Success' Means

The word 'successful' carries more than it can bear. It can mean that the animal survived the operation, that it left the clinic alive, that it ate and ruminated again, that milk returned, that nothing went wrong in the following months, or simply that the owner was satisfied. Each is a different outcome, assessed at a different time, and each is open to its own bias (Table 3). Which one a report

uses is often left unstated.

Table 3. Candidate meanings of “successful” treatment and the bias each is open to.

Possible outcome	What is missed	Source of bias
Animal survived the operation	Late deaths and relapse [39, 40]	Survivorship
Animal left the clinic alive	Course at the farm	Loss to follow-up
Eating and ruminating again	Subtle intake deficits [24, 25]	Subjective assessment
Milk yield recovered	Comparison with what yield would have been [38]	No control, varying lactation stage
No recurrence	Re-exposure to plastic	Short or absent follow-up
Owner satisfied	Cost, welfare and herd effects	Reporting and selection [41]

Note: Authors’ synthesis of the appraisal literature cited; it is not drawn from a single study.

Survivorship is the most obvious problem. A case series of operated animals contains only animals that were operated on, and the animals that died at the farm, were slaughtered or never reached the clinic are not in it [38, 40]. An uncontrolled series can describe what happened to the animals it contains; it cannot show that the operation caused the outcome, and it should not be read as a cohort [39]. The more successful the outcomes in a series, the more likely it is that failures have been filtered out, whether deliberately or by the ordinary workings of who reports what.

There is a further difficulty with the word itself. A cow that returns to her herd and to the same refuse heap, and has plastic in her rumen again within a year, was treated successfully by one definition and unsuccessfully by another. Reports rarely follow animals for long enough to distinguish them.

4.5 Prevention

Prevention works at several levels, and the more upstream the measure, the more animals it protects (Figure 3). The widest is waste reduction and better collection, which determines how much plastic is available to animals at all [3, 4]. Next comes containment, in the sense of keeping waste away from grazing areas and discouraging open dumping and burning, which depends on municipal systems and on the informal sector that often runs them [5, 10]. Then comes management of the animals themselves: controlling access to refuse, providing adequate fodder and minerals, and attending to the conditions that make scavenging attractive [1, 2].

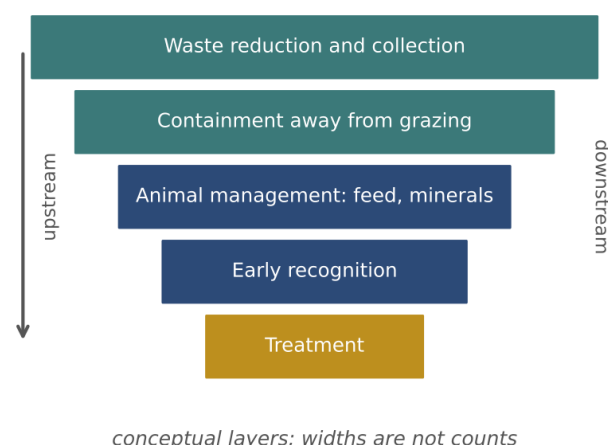


Figure 3. Layers of prevention, from upstream waste control to treatment (conceptual schematic; widths are not counts).

Nearer the animal come early recognition, which relies on attention to feeding and rumination behaviour [24, 25], and finally treatment. Treatment is the narrowest layer, because it reaches only animals that have already been harmed and that someone has chosen to take to a clinic. A health system that invests only in the last layer will keep producing patients. This is not an argument against surgery. It is an argument for placing surgery in proportion. These points apply with equal force to many conditions in large-animal practice, not only to this one.

Prevention also has a welfare and economic logic that reports of single cases rarely develop. An impacted animal suffers during the weeks of reduced eating before diagnosis, loses production, and may die despite treatment, and the cost of this to a smallholder is large relative to the cost of removing plastic from where animals graze. Calculations of that kind have not, to our knowledge, been done carefully for the settings in which the problem is common, and without them the argument for prevention rests on plausibility.

4.6 Reading a Report of Successful Treatment

A reader who meets a report of a successful operation can ask a short run of questions. How was the animal chosen, and would one that died on the table or at the farm have appeared in the same paper [38]? What exactly is meant by success, and on which day was it judged [40]? Was eating and rumination assessed with some care, since subtle deficits are easy to miss [24, 25]? Was the animal followed on the farm, or only until it left the clinic? And was anything said about where the plastic came from, and what would stop it returning? A report that answers all five is uncommon, and one that answers none is best read as an observation

about a single animal.

The questions are not meant to belittle clinical reporting. Case reports have real uses: they record unusual presentations, they show that something is possible, and they generate hypotheses that better designs can test [39, 41]. Problems arise only when the weight placed on them exceeds what they can carry, as when a handful of recoveries is read as a rate. The same caution applies to enthusiasm in any applied field, where striking positive findings circulate more readily than quiet negative ones [43].

It also helps to ask what the report is for. A paper written to teach technique to colleagues can be valuable even if it says little about outcomes across a population, whereas a paper offered as evidence that a procedure works needs a different standard. The distinction is easy to blur when a title announces success, which is one reason this review has taken care to separate the question of what has been reported from the question of what has been shown. It is a habit worth keeping even when the outcome looks obviously good.

5. Discussion

5.1 Interpretation

The main finding of this review is a negative one about evidence and a positive one about priorities. The literature on surgical management of plastic-related impaction is dominated by case reports and small series, it seldom defines success, and it rarely follows animals long enough to know. Recovery after surgery is plausible and often reported, but the size of the benefit, the animals who benefit most and the proportion that relapse cannot be taken from it [39, 40]. That is a modest claim, and it is the one the literature can currently bear.

The positive finding is about where effort should go. Plastic reaches the rumen because it is available and because the animals are in places and conditions that lead them to eat it [1, 3]. Removing it from one rumen does not reduce the supply. If the aim is fewer sick cattle, the arithmetic favours the upstream layers of Figure 3.

These two findings are linked. Because surgery produces visible, satisfying successes, it attracts reports; because prevention produces absences, it does not. A literature built from what is reported therefore tilts towards the operating theatre, even when the biggest gains lie elsewhere. This is a familiar pattern in applied science, in which positive and striking results are more likely to be published and believed [43].

5.2 Limitations

This is a narrative review and shares the limitations of that form. The selection of sources reflects the authors' judgement, there was no formal search or quality scoring, and a different group might have chosen differently. The review also leans on sources about plastics, ruminant physiology and the appraisal of clinical evidence because these could be cited precisely, while much of the clinical case literature on rumen impaction, which is dispersed and hard to verify, is summarised only in general terms. A reader who needs specific outcomes or techniques should consult the original reports and veterinary surgical texts directly.

Evidence from other species is an imperfect proxy for cattle. Studies of marine animals and of soils describe different animals and environments, and we have used them for mechanisms and context. Finally, no individual case is reported here, so this article cannot offer the thing the title might lead a reader to expect. Reviews of this kind are more useful when they say where the evidence stops than when they smooth it over.

5.3 Implications for Practice and Reporting

For clinicians, the practical implications are modest but real. A history of access to waste should be sought routinely. Outcomes should be recorded against a stated definition, with a follow-up long enough to see relapse, and failures and deaths should be reported alongside recoveries. Reporting guidance for clinical cases exists and can be adapted for veterinary use [41], and a few extra sentences on what happened to the animal afterwards would make an ordinary report far more useful.

For those who commission or advise on animal health programmes, the implication is that surgical capacity and prevention are complements and not substitutes. A district that trains and equips surgeons but does nothing about open dumping will have good operations and steady demand for them. For the wider public, the connection between waste handling and animal welfare is a concrete reason to care about collection and disposal.

5.4 Directions for Future Work

Three needs stand out. First, a formal systematic review of the clinical literature, with a transparent search and an honest account of the case-based nature of the evidence, would let others see how thin or thick it is [42]. Second, prospective follow-up of treated animals, with a defined outcome and a long enough horizon, would give

the first real estimates of relapse. Third, studies of prevention, including the economics of waste control and of animal management at village and district scale, would test the claim that upstream measures matter most, which at present is an argument from plausibility.

5.5 Welfare and Wider Considerations

The animal's experience runs through all of this. A cow with a plastic-filled rumen goes hungry while surrounded by feed, and the weeks before diagnosis are a welfare cost whether or not treatment follows. Behaviour-based monitoring of intake and rumination may offer the earliest signal [24, 25], and good analgesia is part of humane treatment [27, 28]. The question of chemical transfer from retained plastic to milk and meat remains open [33, 35], and should be treated as a research question, not an assurance in either direction.

Communication with owners is part of the same picture. An owner who is told only that the operation went well may reasonably conclude that the problem is solved. One who is also told that the plastic came from somewhere, that the animal may meet it again, and that feed, minerals and grazing range matter, has been given information that bears directly on the animal's next year [1, 2]. That conversation costs little and is rarely recorded.

6. Conclusion

Plastic ingestion is a real and apparently growing cause of rumen impaction in cattle, and surgical treatment can relieve it. What the published literature does not show is how often treatment succeeds, over what period, or how many animals do well after leaving the clinic. It consists mostly of case reports and small series that are shaped by selection and survivorship, and it uses the word 'successful' without defining it. No individual case has been presented here, and the title should be understood as a theme, not as a claim about any particular animal.

What the evidence does support is a shift of emphasis. Better waste management, containment of refuse, attention to feed and minerals, and early recognition probably prevent more suffering than any improvement in operative technique. Clinicians can contribute by reporting outcomes with defined measures and longer follow-up, and by including the failures. Until that is done, claims of successful management should be read as encouraging observations about individual animals and not as measures of how well the problem is being controlled.

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9. Conflict of Interest

The authors declare no conflict of interest.

10. Author Contributions

B.B. conceived the review and wrote the sections on clinical presentation and management. M.B. wrote the sections on rumen physiology and the appraisal of evidence. E.S. wrote the sections on waste, prevention and welfare. All authors revised the manuscript and approved the final version.

11. Ethics Statement

This is a review of published literature. No animals were used, no individual case is reported and no ethical approval was required.

12. Data Availability

No new data were generated. All sources are cited in the reference list.

13. References

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