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Beyond the Urinary System: A Review of Non-Urological Clinical Applications of the Foley Catheter

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Abstract

Objective: Since Frederic Foley introduced the self-retaining balloon catheter in the late 1930s, the Foley catheter has become one of the most widely used indwelling devices in modern medicine, with approximately 100 million units used worldwide each year. Although it was originally designed for continuous bladder drainage and post-prostatectomy management, its self-retaining balloon, multilumen design, low cost, and near-universal availability have led clinicians to apply it to a wide range of non-urological indications. This review synthesizes the evidence for these off-label applications. **Methods:** MEDLINE, Cochrane CENTRAL, and Embase were searched using Boolean combinations of device concepts and non-urological application concepts. Two reviewers independently screened the records against predefined inclusion criteria. Deduplication yielded approximately 376 records, and 52 articles published between 1937 and 2026 were ultimately retained, with priority given to randomized controlled trials, systematic reviews, and large case series, while classic historical and technical reports were preserved. **Results:** The non-urological value of the Foley catheter rests on four recurring mechanisms: balloon tamponade for haemostasis, self-retaining drainage of fluid collections, mechanical dilatation or temporary luminal support, and bridging to definitive therapy. Level 1 - 2 evidence supports cervical ripening and induction of labour. Level 3 evidence supports uterine balloon tamponade for postpartum haemorrhage, and level 2 - 3 evidence supports chest drainage (a 441-case prospective cohort). Level 3 - 4 evidence supports posterior nasal packing and paediatric intussusception reduction; the evidence for junctional trauma haemorrhage control is weak to moderate, resting on a 44-case uncontrolled case series and a recent systematic review and meta-analysis. Most remaining applications are based on case reports and technical notes. **Conclusions:** The Foley catheter is a versatile, inexpensive, and rapidly deployable multidisciplinary adjunct, but its

off-label use carries a defined spectrum of complications, including catheter-associated urinary tract infection, encrustation, pressure necrosis, balloon failure, and catastrophic intracranial misplacement in skull-base trauma. Appropriate selection of indications, meticulous technique, and heightened vigilance are essential.

Keywords

Foley Catheter, Non-Urological Applications, Expanded Clinical Use, Medical Device Review

1. Introduction

The word "catheter" derives from the Greek verb kathienai, meaning "to insert" or "to let down into". The earliest known catheter systems appear in the Sushruta Samhita, a Sanskrit treatise by the sixth-century BC Indian surgeon Sushruta describing rigid hollow tubes for bladder and urethral drainage. By the second century BC, Greek and Chinese medical texts described catheters as metal tubes made of gold, silver, iron, or wood [1] [2]. Over the following millennia catheter design advanced slowly, introducing curved and double-curved designs to bypass an enlarged prostate. After Charles Goodyear discovered the vulcanization of rubber in 1839, the French surgeon Auguste Nelaton produced the first rubber catheter—softer and better tolerated than its metallic predecessors—a transformative advance [1] [2]. The modern self-retaining balloon catheter was invented by the American urologist Frederic E. B. Foley. Foley first described his "haemostatic bag catheter" in 1929; C. R. Bard began marketing it as the "Foley catheter" in 1935, and the definitive description was published in the Journal of Urology in 1937 [3] [4]. His key innovation was integrating an inflatable balloon into the catheter shaft, eliminating the cumbersome external fixation of earlier designs [1] [3].

In its standard form, the Foley catheter is a double-lumen tube: one lumen drains fluid, while the smaller lumen communicates with the balloon through a proximal port for inflation and deflation. The distal tip is smooth and rounded, with side eyes proximal to the balloon. Sizes are expressed on the French (Fr) scale [2] [5]. Different materials and structural designs also influence indwelling time, comfort, and the risk of associated complications [6] [7]. The balloon volume commonly used in adults is 10 mL, whereas 5 mL is typical in children, and three-way irrigation catheters for managing gross haematuria may carry larger balloons. Balloons are usually filled with sterile water or normal saline; air is not recommended, to avoid balloon volume changes, valve blockage, or catheter dysfunction. An underfilled balloon assumes an asymmetric shape and may injure the mucosa on withdrawal [2] [5].

More than 100 million Foley catheters are used worldwide each year [5]. Its self-retaining balloon, reliable drainage performance, simple construction, and low cost make it attractive whenever clinicians need controlled pressure, secure fixa-

tion, fluid drainage, or luminal dilatation beyond the bladder [5]. The non-urological literature is markedly heterogeneous: at one extreme, multicentre randomized trials and Cochrane reviews have established the role of cervical ripening; at the other, a large body of case reports describes ingenious but unproven adaptations. This review systematically summarizes the expanded clinical applications of the Foley catheter beyond its principal urological indications, organizing the evidence by clinical field and analysing the mechanisms, operational features, and safety considerations. Several mechanical principles recur across these scenarios: balloon tamponade, self-retaining drainage, mechanical dilatation or support, and temporary bridging before definitive treatment. By synthesizing these shared mechanical principles, this review aims to build a systematic appreciation of the device's multidisciplinary value and to distinguish applications with stronger evidence from exploratory uses that rest mainly on case reports.

2. Methods

2.1. Search Strategy

A structured Boolean search was conducted in MEDLINE, Cochrane CENTRAL, and Embase, covering the period from database inception to 1 September 2026. Search strings combined device concepts with non-urological application concepts using Boolean operators. Deduplication yielded approximately 376 records. Titles and abstracts were screened independently by two reviewers against the inclusion criteria, and full texts were assessed for all potentially eligible records; disagreements were resolved by discussion or by consultation with a third reviewer. After screening, 52 articles published between 1937 and 2026 were ultimately retained.

2.2. Inclusion Criteria and Evidence Grading

Inclusion criteria required articles to describe clinical uses of the Foley catheter beyond its principal urological indications or to provide the mechanistic, technical, or historical background necessary to understand these uses. Exclusion criteria were: purely urological articles without cross-disciplinary relevance; editorials, letters, and commentaries lacking original data or technical content; and non-English articles without adequate English abstracts. Titles and abstracts were screened against these criteria; randomized controlled trials (RCTs), systematic reviews, and large case series were prioritized, while classic historical articles and representative case reports were retained to reflect the breadth of adaptation. Evidence quality was graded using the Oxford CEBM 2009 framework (level 1: systematic review or meta-analysis of RCTs; level 2: at least one RCT or prospective controlled cohort; level 3: uncontrolled retrospective cohort or case series; level 4: case reports, technical notes, or expert opinion), and recommendation strength was assigned on a GRADE-based scale (strong/weak (conditional)/conditional use). In applying GRADE, strong recommendations were reserved for applications supported by consistent level 1 - 2 evidence; weak (conditional) recommendations were assigned when the evidence consisted mainly of observational stud-

ies, uncontrolled case series, or case reports; and the designation "conditional use" indicated that an application is reasonable in experienced hands but is not yet validated as a standard of care. Where a body of evidence contained studies of more than one design, the level assigned reflected the highest reliable design present, downgraded when observational studies predominated. No prospective systematic review protocol was registered, consistent with the methodology of a narrative review.

3. Results

3.1. Obstetric and Gynaecological Applications

The most mature non-urological applications come from obstetrics, where the catheter serves two distinct purposes: intrauterine balloon tamponade for postpartum haemorrhage (PPH) and mechanical cervical ripening for induction of labour.

For PPH refractory to uterotonics, intrauterine balloon tamponade is an established second-line measure intended to avert emergency hysterectomy. A systematic review and meta-analysis pooling 91 studies including 4729 women (6 randomized trials, 1 cluster-randomized trial, 15 nonrandomized studies, and 69 case series) reported an overall haemostatic success rate of 85.9% (95% CI 83.9 - 87.9), highest in uterine atony (87.1%), and characterized the technique as a key bridging measure preventing hysterectomy after failure of medical therapy [8] [9]. Much of the supporting evidence comes from resource-limited settings. In an Egyptian prospective series, 50 women were treated with a condom catheter (a standard Foley catheter with a condom tied to its distal end): haemostasis was achieved in 96% (48/50), with a 100% success rate (28/28) in uterine atony; the technique cost a fraction of a commercial Bakri balloon while achieving comparable intrauterine tamponade pressure [8] [10]. In a North American series of 23 insertion attempts, 20 were correctly positioned (3 technical failures); among the 20 correctly positioned catheters, bleeding was controlled in 18 (90%), with 100% success (11/11) in atony, whereas 2 women with failed tamponade required hysterectomy despite a catheter in place [11]. For lower uterine segment bleeding in placenta praevia and abnormal placentation, a series demonstrated that Foley balloon tamponade achieved successful conservative control after other measures had failed [12].

Cervical ripening has the strongest evidence base in this review. A transcervically placed Foley balloon exerts sustained mechanical pressure on the internal cervical os, stimulating local prostaglandin release and cervical collagen remodelling while avoiding the systemic side effects of pharmacological agents. A 2019 Cochrane systematic review pooling 28 RCTs (6619 women) found that balloon catheter induction was comparable to vaginal prostaglandin E2 but with better neonatal safety, including less uterine hyperstimulation with fetal heart rate abnormalities [13]. A 2026 Cochrane network meta-analysis comparing 13 induction methods across more than 100 RCTs confirmed broadly comparable efficacy with differing safety profiles and favoured balloon catheters for their low cost,

availability, and safety [14]. The landmark PROBAAT multicentre RCT randomized 824 women (412 per group) across 12 Dutch hospitals and found no difference in caesarean delivery rates between the Foley catheter and vaginal PGE2 gel, but significantly less uterine hyperstimulation with fetal heart rate abnormalities, fewer assisted vaginal deliveries, and a better cost-effectiveness profile [15]. These findings have established the Foley catheter as a first-line mechanical method for cervical ripening in many national guidelines. The PROBAAT-M trial and its meta-analysis found comparable caesarean rates with significantly less hyperstimulation than misoprostol [16], a finding confirmed by another meta-analysis [17]. The multicentre PROBAAT-II non-inferiority RCT enrolled 1859 women across 29 Dutch hospitals (932 assigned to oral misoprostol and 927 to the Foley catheter); the composite adverse outcome (asphyxia or PPH) was comparable between groups (12.2% vs 11.5%; adjusted relative risk 1.06, 90% CI 0.86 - 1.31), confirming similar safety and efficacy of oral misoprostol and the Foley catheter [18]. Operational refinements include a Chinese RCT optimizing balloon volume (30 mL vs 80 mL) and indwelling time (12 h vs 24 h) [19]; a prospective cohort of 320 women confirming improved Bishop scores after 18 - 24 hours [20]; and a meta-analysis finding double-balloon and single-balloon catheters comparable in efficacy, with the single-balloon Foley preferred for simplicity and low cost [21]. Overall, cervical ripening is supported by level 1 - 2 evidence with a strong recommendation [13]-[21], whereas uterine balloon tamponade rests on level 3 evidence, systematic reviews and meta-analyses dominated by observational case series and uncontrolled cohorts, as a moderate-strength, conditional second-line measure [8]-[12] (see **Table 1** and **Table 2**).

3.2. Gastrointestinal and Hepatic Applications

In gastroenterology, the catheter is used for variceal tamponade, rectal sealing during enema reduction, caecostomy decompression, and luminal foreign-body retrieval or dilatation.

For acute oesophageal variceal bleeding, balloon tamponade is a temporizing measure while endoscopic or medical therapy is arranged. The Sengstaken-Blakemore tube or Foley-based modifications in resource-limited settings, applies direct radial pressure to the bleeding varices through gastric and oesophageal balloons, but placement must be confirmed radiographically or endoscopically and monitored continuously, because malposition and overinflation can cause catastrophic oesophageal rupture. A classic 63-case series reported gastric balloon haemostasis in 60% (37/63), with a further 27% (17/63) controlled after adding the oesophageal balloon, for overall initial control in 54 of 63 cases (86%); the 24-hour rebleeding rate was 26%, indicating that balloon tamponade achieves initial haemostasis but does not provide durable control before definitive endoscopic or pharmacological therapy [22]. Reviews confirm that tamponade controls more than 80% of initial variceal haemorrhage, but the effect is usually short-lived, the complication burden is substantial, and efficacy is comparable to vasoactive drugs

[23]. A retrospective study of 83 patients combined 12-hour modified Sengstaken-Blakemore compression with intensive endoscopic detachable mini-loop ligation without serious complications [24]. This strategy of brief balloon tamponade followed immediately by endoscopic ligation reflects the modern paradigm: using the balloon strictly as a bridge to definitive therapy rather than as standalone treatment [22] [24]. The principle is general: balloon tamponade buys time; it is not the end-point treatment. At the same time, oesophageal rupture and mediastinitis after prolonged Sengstaken-Blakemore tamponade carry life-threatening consequences, mandating limited inflation time, careful positioning, and early endoscopic intervention [22] [23].

In paediatric ileocolic intussusception, a Foley catheter seals the anus to prevent leakage of air or saline during pressurized enema reduction. A controlled retrospective study found that a Foley-type balloon catheter increased successful air enema reduction to 90% (36/40) and shortened procedure time from 28.2 to 7.6 minutes ($P < 0.009$) [25]. A nationwide cross-sectional survey in New Zealand found that 96% of clinicians preferred fluoroscopy-guided air enema reduction via a Foley catheter (initial pressure 0 - 120 mmHg; peak 100 - 130 mmHg) [26].

For colonic pseudo-obstruction (Ogilvie syndrome) and distal obstruction, after failed colonoscopy, percutaneous or laparoscopic-guided caecostomy via a Foley catheter provides minimally invasive decompression [27]. The described technique uses laparoscopic visualization to identify the caecum, secures it to the anterior abdominal wall with T-fasteners, and places a Foley catheter through a small enterostomy for continuous decompression until bowel motility returns [27]. A 24-Fr Foley catheter can be passed beyond a rectal foreign body and withdrawn under traction after inflation; paediatric series document extensive experience with Foley and magnet-tube retrieval of gastrointestinal foreign bodies [28]. Impacted oesophageal coins can likewise be removed by passing the catheter beyond the coin, inflating the balloon, and withdrawing slowly [29]. Across these gastrointestinal applications, the supporting evidence ranges from level 3 to level 4: variceal tamponade rests on large case series, retrospective studies, and expert reviews [22]-[24], intussusception reduction on a controlled retrospective study and a national survey [25] [26], and caecostomy and foreign-body retrieval on case series [27]-[29] (see **Table 1** and **Table 2**).

3.3. Otolaryngological Applications

Posterior epistaxis is the most iconic non-urological use of the Foley catheter. When anterior packing and endoscopic cautery fail or are unavailable, a 14 - 16 Fr catheter is advanced along the nasal floor into the nasopharynx, the balloon is filled with sterile water, and gentle forward traction seals the posterior choana, compressing the bleeding point in the distribution of Woodruff's plexus or the sphenopalatine artery. A cadaveric study of 20 nasal cavities quantified the mechanism: a 14-Fr Foley balloon sealed the posterior choana when inflated to 8 - 15 mL, with 65% achieving complete seal at 12 - 15 mL, and 8 - 12 mL significantly

better than 4 - 7 mL ($P < 0.002$); the mechanism of action is threefold—platform support, posterior choanal sealing, and compression behind the middle and inferior turbinates [30]. A classic large series of 235 cases from Pamplona confirmed that the technique is simple, inexpensive, and effective [31]. Despite the availability of dedicated nasal balloons, a telephone survey of 90 otolaryngology departments in England and Wales found that 92% used a Foley catheter for epistaxis, only 49% stocked commercial nasal balloons, and only 22% of residents were aware that the Foley catheter is not licensed for nasal use; most packing complications reported in the survey were attributed to off-label Foley use, raising medicolegal and informed-consent considerations for what is effectively a de facto standard of care [32]. This widespread use despite limited formal training argues for standardized placement protocols and awareness of complications [32] [33].

Technical refinements target pitfalls in the procedure. Standardized protocols emphasize pre-marking the catheter, adjusting balloon position, and avoiding pressure necrosis of the alar cartilage from external traction [33]. Experimental studies of inflation media show that air is unsuitable (complete collapse to 0 mL within 48 hours), whereas water and saline retain approximately 8.7 mL and 8.5 mL, respectively; water is recommended [34]. A recognized recurring pitfall is failure of balloon deflation when the pack is removed, for which specific strategies have been described [35]. A catastrophic complication is intracranial migration of the balloon into the frontal lobe in a patient with severe craniofacial trauma and a skull-base fracture; this cautions against blind transnasal Foley packing when anterior skull-base integrity is compromised [36].

Beyond epistaxis, the catheter has been used for emergency bridging in aortoesophageal and arterio-oesophageal fistulas: inflating a Foley balloon endoscopically at the bleeding point achieves emergency haemostasis, bridging to definitive endovascular treatment [37]. Supporting evidence is predominantly observational (level 3 - 4): posterior packing rests on large case series, cadaveric mechanistic studies, and national surveys [30]-[32], whereas fistula bridging rests only on isolated case reports [37] (see **Table 1** and **Table 2**).

3.4. Orbital and Maxillofacial Applications

In orbital blowout fractures, the Foley catheter provides transnasal support, reducing herniated orbital contents back into the maxillary sinus and maintaining reduction during bone healing, thereby avoiding external facial incisions and orbital implants. A retrospective cohort of 24 patients treated transnasally and endoscopically with a Foley catheter and an Endoloop achieved complete symptom resolution in 22 of 24 cases with at least three months of follow-up and no significant complications [38]. The transnasal endoscopic approach avoids external facial incisions and orbital implants and is particularly suited to simple orbital floor fractures without marked comminution or enophthalmos [38] [39]. Technical refinements include customized contrast-filled balloons shaped with a micro saw to provide more uniform, broader support, fill the maxillary sinus dead space, and

reduce discomfort [39]. The contrast medium also permits intraoperative fluoroscopic confirmation of balloon position and extent, an advantage over saline-filled balloons, whose position cannot be verified radiographically. These reports constitute level 3 - 4 evidence—a 24-case retrospective cohort and several technical series [38] [39], and no randomized comparison with open or implant-based repair has been published (see **Table 1** and **Table 2**).

3.5. Neurosurgical and Skull-Base Applications

Endoscopic endonasal skull-base surgery has created two roles for the Foley catheter: emergency haemostasis in catastrophic internal carotid artery (ICA) injury and routine packing to secure vascularized nasoseptal flap (NSF) reconstruction.

When the ICA is injured unexpectedly, immediate haemorrhage control is critical. In a 26-year-old patient who developed a postoperative cerebrospinal fluid (CSF) leak after transsphenoidal pituitary surgery and sustained an accidental ICA injury during repair, emergency nasal packing with four Foley catheters controlled the haemorrhage without neurological deficit; the authors emphasized the easy availability and immediate deployability of the Foley catheter for haemorrhage control [40]. The use of multiple catheters in this case reflects the need for circumferential packing when a single balloon cannot achieve sufficient compression of the injured vessel within the narrow nasal corridor.

In skull-base reconstruction, the vascularized nasoseptal flap is the principal means of dural repair, and nasal packing has traditionally been used to hold the flap in place. A "multiple-balloon catheter" technique pairs a Foley catheter with another nasal catheter for mutual support, securing the NSF in 8 complex cases (6 olfactory neuroblastomas, 1 recurrent craniofacial meningioma, 1 recurrent chordoma) with no postoperative CSF leak and no flap necrosis, addressing the instability that follows resection of the nasal support structures [41]. The technique was developed because, in the extensively resected sinonasal cavity, normal anatomical support has been removed and a single Foley balloon tends to dislodge or lose contact with the reconstruction site.

The core neurosurgical warning mirrors that of otolaryngology: in traumatic skull-base disruption, blind transnasal Foley packing can be fatal. A case of severe craniofacial fracture involving the frontal and sphenoid sinuses was managed with emergency nasopharyngeal Foley packing, but CT showed intracranial migration of the balloon into the frontal lobe, requiring bifrontal craniotomy, dural repair, and ventriculoperitoneal shunting [42]. Together with the earlier report of intracranial migration [36], this experience cautions against blind transnasal packing when skull-base integrity is uncertain. Both skull-base applications remain at level 3 - 4: ICA-injury tamponade rests on case reports [40] and nasoseptal flap fixation on a small series [41] (see **Table 1** and **Table 2**).

3.6. General Surgery, Trauma, and Interventional Applications

Beyond the abdomen and chest, the catheter serves as a self-retaining drain, a

chest drain, and a device for junctional haemorrhage control.

As a wound and abscess drain, the inflated balloon anchors the catheter and creates a channel for pus or fluid egress. Unlike conventional Penrose or corrugated drains, the self-retaining balloon prevents accidental dislodgement in mobile patients and permits gentle traction to maintain gravity drainage, being especially useful for deep neck spaces and pelvic collections where external fixation is difficult. In a prospective comparative study of 80 patients undergoing surgery for impacted mandibular third molars, the drained group had comparatively less postoperative swelling, lower visual analogue scale pain scores, and a greater maximal interincisal distance; the authors concluded that drainage significantly reduced postoperative oedema, pain, and trismus [43]. The same principle is used to drain deep neck space infections of the floor of the mouth and the parapharyngeal space, with balloon inflation securing the catheter and maintaining an effective channel [44]. For postoperative bowel perforation, a Foley catheter placed at the leak site, secured with a purse-string suture and a 3-mL saline balloon, controls enteric content immediately under gentle external traction and permits early enteral nutrition [45].

As a chest drain, the Foley catheter was evaluated in a single-centre prospective cohort of 441 consecutive patients after video-assisted thoracoscopic surgery (VATS) lobectomy (208 with a Foley catheter and 233 with a conventional 28-Fr chest tube): compared with the 28-Fr tube, the Foley group had significantly shorter chest drainage duration (2.6 ± 1.3 vs 3.5 ± 2.0 days; $P < 0.001$), shorter hospital stay (3.8 ± 2.5 vs 5.2 ± 4.1 days; $P < 0.001$), lower pain scores at 6 hours ($P = 0.025$) and 48 hours ($P < 0.001$) after lobectomy and at all timepoints after chest tube removal ($P < 0.001$), and fewer wound-healing problems at the drainage site (5.8% vs 11.6%; $P = 0.043$), although the pain differences were clinically modest [46]. The Foley catheter is placed through the same intercostal space as a conventional drain, and the balloon is inflated within the pleural cavity to anchor the catheter and prevent dislodgement; no additional incision is required, and the catheter connects to a standard underwater-seal drainage system. Placement of an 18 - 24 Fr catheter through the seventh intercostal space, with the balloon inflated with diluted contrast medium for fixation and connected to a standard drainage bag, provides a simple, low-complication method for pleural effusion [47].

As a haemorrhage-control device in trauma, the catheter addresses non-compressible junctional and visceral bleeding. A penetrating aortic root injury was controlled by Foley balloon tamponade after failed digital pressure, creating a nearly bloodless field for repair [48]. The largest series comprises 44 penetrating neck injuries in which Foley catheter balloon tamponade was applied to actively bleeding wounds; overall mortality was 11%, ICU admission 18%, and median hospital stay 1 day, supporting the technique as an effective adjunct that can achieve definitive haemostasis in selected patients [49]. The series included wounds of the neck, supraclavicular fossa, and axilla, where direct manual compression is not feasible, and the authors emphasized that Foley balloon tamponade should be

considered whenever the penetrating tract can accommodate the catheter and balloon, even in prehospital or emergency department settings. A 2025 systematic review and meta-analysis pooling 9 studies with 1658 subjects reported a pooled usage rate of 27.85% for Foley catheter balloon tamponade in penetrating neck injury, with pooled morbidity of 11.70% (95% CI 0.00 - 50.47) and pooled mortality of 6.30% (95% CI 0.00 - 19.97). These estimates describe current utilisation and outcomes rather than comparative effectiveness: the very wide confidence intervals and the absence of comparator arms mean they cannot by themselves confirm the efficacy of the technique, which should be regarded as a temporising adjunct supported mainly by uncontrolled case series [50]. Evidence quality across these applications is mixed (level 2 - 4): third-molar drainage rests on a prospective comparative study [43], chest drainage on a 441-case prospective cohort [46], junctional haemorrhage control on uncontrolled case series, case reports, and a recent systematic review and meta-analysis [48]-[50], and abscess and fistula drainage on case series [44] [45] [47] (see **Table 1** and **Table 2**).

3.7. Plastic Surgery and Other Novel Applications

Finally, the catheter supports intraoperative tissue expansion and continuous drainage of malignant ascites. In scalp defect reconstruction, a subperiosteal pocket is dissected and a Foley catheter is placed within it; periodic balloon inflation and deflation provides sufficient skin extensibility to achieve primary wound closure [51]. Repeated inflation and deflation of the Foley balloon achieves progressive intraoperative skin expansion more rapidly and economically than chronic tissue expanders and is suitable for primary closure of large complex defects [51]. The technique is best suited to scalp and forehead defects with limited skin laxity, in which traditional staged tissue expansion would delay reconstruction [51]. Greenbaum's original description emphasized that periodic inflation and deflation exploits the viscoelastic properties of skin—stress relaxation and mechanical creep—to gain additional tissue length in a single operation, avoiding the weeks required with chronic implantable expanders.

In advanced ovarian cancer with malignant ascites, a self-retaining Foley catheter placed intraperitoneally at surgery provides long-term continuous drainage, avoiding repeated paracentesis; the main complication risk is peritonitis [52]. Both applications remain at level 4, with tissue expansion supported only by technical notes [51] and ascites drainage only by isolated case reports [52] (see **Table 1** and **Table 2**).

3.8. Overview of Applications

Table 1 summarizes the principal non-urological applications by clinical field, mechanism of action, and level of evidence. **Table 2** summarises the key studies, total patient numbers, main outcomes, and reported complications for each application, allowing the reader to judge the weight of evidence behind each indication.

Table 1. Overview of the principal non-urological applications of the Foley catheter by clinical field, mechanism of action, and level of evidence.

Field	Clinical application	Mechanism of action	Level of evidence
Obstetrics & gynaecology	Uterine balloon tamponade for PPH	Balloon tamponade	Level 3 (moderate, conditional; second - line bridging; systematic reviews dominated by observational studies)
Obstetrics & gynaecology	Cervical ripening/induction of labour	Mechanical dilatation	Level 1 - 2 (strong; multiple RCTs, Cochrane reviews)
Obstetrics & gynaecology	Lower uterine segment bleeding	Balloon tamponade	Level 3 - 4 (conditional; case series)
Gastroenterology	Variceal haemorrhage tamponade	Balloon tamponade/bridging	Level 3 - 4 (conditional; large case series, retrospective studies, expert reviews)
Gastroenterology	Paediatric intussusception enema reduction	Self-retaining rectal seal	Level 3 - 4 (low to moderate; controlled studies, surveys)
Gastroenterology	Caecostomy/colonic decompression	Self-retaining drainage	Level 3 - 4 (conditional; case series)
Gastroenterology	Foreign body retrieval	Retrieval	Level 4 (weak; case reports, series)
Otolaryngology	Posterior epistaxis packing	Balloon tamponade	Level 3 - 4 (low to moderate; large series, cadaveric studies)
Otolaryngology	Aortooesophageal/arterio-oesophageal fistula	Balloon tamponade bridging	Level 4 (weak; case reports)
Orbital & maxillofacial	Blowout fracture reduction	Mechanical support	Level 3 - 4 (conditional, low to moderate; cohort, technical series)
Neurosurgery & skull base	ICA injury haemostasis	Balloon tamponade bridging	Level 4 (conditional; case reports)
Neurosurgery & skull base	Nasoseptal flap fixation	Mechanical support	Level 3 - 4 (low to moderate; small series)
General surgery & trauma	Wound/abscess drainage	Self-retaining drainage	Level 2 - 4 (moderate; comparative study, case series)
General surgery & trauma	Pleural/chest drainage	Self-retaining drainage	Level 2 - 3 (moderate; prospective cohort, n = 441)
General surgery & trauma	Junctional/visceral haemorrhage control	Balloon tamponade	Level 3 - 4 (weak to moderate, conditional; largest series n = 44 uncontrolled; systematic review & meta - analysis)
Plastic surgery & others	Intraoperative tissue expansion	Mechanical dilatation	Level 4 (weak; technical series, case reports)
Plastic surgery & others	Malignant ascites drainage	Self-retaining drainage	Level 4 (weak; case reports)

4. Discussion

This review shows that the non-urological applications of the Foley catheter are not a random collection of curiosities but expressions of a few recurring mechanical principles. Circumferential balloon tamponade achieves controlled, evenly distributed pressure exceeding venous and capillary pressure by inflating against

Table 2. Evidence summary for each non-urological application: key study designs, total patient numbers, main outcomes, reported complications, and level of evidence.

Application	Key studies (design)	Total patients	Main outcomes	Reported complications	Level
Uterine balloon tamponade for PPH	SR/MA: 91 studies (6 RCTs, 1 cluster RCT, 15 nonrandomised, 69 case series); Cochrane review: 9 RCTs (944 women); prospective series; retrospective series	4729 (SR/MA); 50; 23	Overall success 85.9% (95% CI 83.9 - 87.9); 96% (48/50) in Egyptian condom-catheter series; 90% (18/20) when correctly positioned	Complications attributed to tamponade ≤ 6.5% in SR/MA; technical balloon failures (3/23); hysterectomy after failed tamponade	Level 3
Cervical ripening/induction of labour	Cochrane SR (28 RCTs, 6619 women); 2026 Cochrane network meta-analysis; PROBAAT (824); PROBAAT-M; PROBAAT-II (1859); prospective cohort (320)	6619; 824; 1859; 320	Comparable efficacy to PGE2 and misoprostol with less uterine hyperstimulation; PROBAAT-II composite adverse outcome 12.2% vs 11.5% (aRR 1.06, 90% CI 0.86 - 1.31)	Less hyperstimulation with fetal heart rate abnormalities than pharmacological agents	Level 1 - 2
Variceal haemorrhage tamponade	Case series (63); retrospective study (83)	63; 83	Initial control in 54/63 (86%); 24-hour rebleeding 26%	Oesophageal rupture, mediastinitis with prolonged tamponade	Level 3 - 4
Paediatric intussusception reduction	Controlled retrospective study (40); national survey	40 (controlled study); NR (survey)	Successful air enema reduction 90% (36/40); procedure time reduced from 28.2 to 7.6 min ($P < 0.009$); 96% of surveyed clinicians preferred Foley-assisted reduction	NR	Level 3 - 4
Caecostomy/colonic decompression	Case series	NR	Minimally invasive decompression until bowel motility returns	NR	Level 3 - 4
Foreign body retrieval	Case series and case reports	NR	Successful retrieval of gastrointestinal foreign bodies	NR	Level 4
Posterior epistaxis packing	Cadaveric study (20 cavities); large series (235); national survey (90 departments)	20; 235; 90 departments	Complete posterior choanal seal with 8 - 15 mL inflation (65% at 12 - 15 mL)	Alar cartilage pressure necrosis; balloon deflation failure; intracranial migration in skull-base trauma	Level 3 - 4
Aorto-oesophageal/arterio-oesophageal fistula	Case reports	NR	Emergency haemostasis bridging to definitive endovascular treatment	NR	Level 4
Orbital blowout fracture reduction	Retrospective cohort (24)	24	Complete symptom resolution in 22/24 with ≥3 months follow-up	No significant complications reported	Level 3 - 4
ICA injury haemostasis	Case report	1	Haemorrhage controlled without neurological deficit	Intracranial balloon migration risk with skull-base disruption	Level 4

Continued

Nasoseptal flap fixation	Small series (8)	8	No postoperative CSF leak or flap necrosis	NR	Level 3 - 4
Wound/abscess drainage	Prospective comparative study (80); case series	80	Less postoperative swelling, pain, and trismus in the drained group	NR	Level 2 - 4
Pleural/chest drainage	Prospective cohort (441)	441 (208 Foley vs 233 28-Fr)	Chest tube removal 2.6 ± 1.3 vs 3.5 ± 2.0 d ($P < 0.001$); hospital stay 3.8 ± 2.5 vs 5.2 ± 4.1 d ($P < 0.001$); lower pain scores ($P = 0.025$/$P < 0.001$); wound healing disorder 5.8% vs 11.6% ($P = 0.043$)	Disordered wound healing at the drainage site (5.8%)	Level 2 - 3
Junctional/visceral haemorrhage control	Uncontrolled case series (44); SR/MA (9 studies)	44; 1658	Series: mortality 11%, ICU admission 18%, median stay 1 day; MA: usage rate 27.85%, morbidity 11.70%, mortality 6.30%	Rebleeding; morbidity per meta-analysis	Level 3 - 4
Intraoperative tissue expansion	Technical notes	NR	Primary closure of large scalp defects achieved	NR	Level 4
Malignant ascites drainage	Case reports	NR	Continuous drainage avoiding repeated paracentesis	Peritonitis	Level 4

NR, not reported in the reviewed source; SR/MA, systematic review and meta-analysis; RCT, randomized controlled trial; NMA, network meta-analysis; PGE2, prostaglandin E2; aRR, adjusted relative risk; CSF, cerebrospinal fluid; ICU, intensive care unit; d, days.

the bleeding surface, bridging the patient to definitive therapy; it is seen in uterine atony, lower uterine segment bleeding, variceal bleeding, posterior epistaxis, junctional neck bleeding, and cardiovascular injury, as described in Sections 3.1, 3.2, 3.3 and 3.6. A balloon inflated within a closed cavity generates sustained transmural pressure sufficient to collapse venous and capillary bleeding while permitting distal perfusion, which explains why the technique is more effective for venous and capillary oozing than for high-pressure arterial transection. Self-retaining drainage works through balloon anchorage at an orifice or within a cavity, allowing continuous egress of blood, pus, air, bile, ascites, or enteric content without dislodgement; applications include caecostomy, abscess drainage, bowel leak management, chest drainage, and malignant ascites. Unlike conventional drains fixed by sutures or tape, the Foley balloon provides internal fixation that resists patient movement and traction on the drainage tubing—a property of particular value in deep neck spaces and pelvic collections, where external fixation is mechanically difficult. Mechanical dilatation and support are exemplified by cervical ripening, orbital fracture reduction, and nasoseptal flap fixation. In cervical ripening, the balloon exerts sustained radial pressure on the internal os, stimulating local prostaglandin release and collagen remodelling; in orbital surgery, the balloon acts as a temporary internal splint, maintaining fracture reduction during the initial heal-

ing period and then being deflated and removed without a second operation. Temporary bridging characterizes the device's role in aortooesophageal fistulas, intraoperative ICA injury, and oesophageal foreign bodies, in which it stabilizes the clinical situation while definitive endovascular, endoscopic, or surgical treatment is mobilized. This bridging function is therefore most critical in emergencies, where the catheter is universally available and can be deployed before specialist teams arrive.

Across all fields, the arguments of economy and availability are strong. A standard latex Foley catheter costs a fraction of a commercial Bakri balloon, dedicated nasal balloon, purpose-built chest drain, or customized tissue expander, and is stocked in virtually every hospital, ambulance bay, and operating room. In low- and middle-income countries, this cost differential translates directly into access to a potentially effective intervention. The strongest evidence comes not from wealthy tertiary centres but from resource-limited settings, where the device's very low unit cost and near-universal availability make it a practical substitute for expensive commercial devices; the Egyptian condom-catheter PPH series exemplifies this advantage [10]. Yet the very properties that make the device versatile also make it dangerous when used carelessly: it is not licensed for most of these indications, and its latex and silicone walls are not designed for intracranial or great-vessel exposure.

The complication spectrum follows directly from the mechanisms of use and the catheter's indwelling biology. In its native urological context, catheter-associated urinary tract infection (CAUTI) is among the most common healthcare-associated infections, with a daily bacteriuria risk of approximately 3% - 7% during short-term use and near-universal colonization in patients with long-term indwelling catheters [2] [5]-[7]. Approximately half of patients with long-term indwelling catheters also develop encrustation, driven mainly by Proteus mirabilis biofilms, whose urease hydrolyses urea, raises urinary pH, and promotes struvite and carbonate apatite deposition. Balloon-related bladder spasm and pain are common and may require anticholinergics or β3 agonists; chronic pressure can cause urethral erosion and, in the most severe cases, traumatic hypospadias. Balloon-related failure, rupture, spontaneous deflation (a filled balloon emptying completely within 48 hours), and failure to deflate on removal are all well documented, mandating contingency planning before placement [2] [5] [34] [35]. In off-label use, these harms are compounded: posterior nasal packing carries a risk of alar cartilage pressure necrosis, preventable by improved fixation [33]; the most catastrophic complications are intracranial migration with blind transnasal packing in skull-base fractures [36] [42], oesophageal rupture and mediastinitis after prolonged variceal tamponade [22] [23], and balloon fixation failure on pack removal [35]. In the chest and abdomen, infection, peritonitis, and pressure necrosis of adjacent structures are characteristic risks. Although tolerated in most patients, the catheter's latex content can provoke type I hypersensitivity in sensitized individuals, and the non-compliant shape of an underfilled balloon can abrade mu-

cosa during placement or withdrawal. These device-specific hazards, combined with the lack of regulatory approval for most off-label indications, support informed consent, meticulous technique, and explicit exit strategies before every non-urological placement. These hazards support operational rules: never perform blind transnasal balloon packing when anterior skull-base integrity is unknown; use sterile water rather than air for balloons that must remain inflated; limit packing time and transition promptly to definitive therapy; ensure meticulous fixation to prevent external pressure injury; use the smallest Fr size and shortest indwelling time that achieve the clinical goal; and plan for balloon deflation failure before placement.

The evidence base is uneven and must be viewed honestly. A core challenge is that specialties report outcome definitions, balloon volumes, indwelling times, and follow-up periods inconsistently, so that even within a single mechanism (e.g., tamponade), results from obstetrics, gastroenterology, and otolaryngology cannot be directly pooled, as described in Sections 3.1 to 3.3. Cervical ripening is supported by two Cochrane reviews, multiple multicentre RCTs, and several meta-analyses (level 1 - 2, strong recommendation) [13]-[18] [21] and can be regarded as an evidence-based first-line treatment. Uterine balloon tamponade is supported by a Cochrane review and systematic reviews dominated by observational studies (level 3, moderate strength, conditional recommendation) [8] [9]; it is best regarded as a second-line bridging measure after failure of uterotonics rather than a first-line intervention. Posterior epistaxis and paediatric intussusception rest on large case series, cadaveric mechanistic data, and national practice surveys (level 3 - 4, low to moderate quality) [25] [26] [30]-[32] [35]. Orbital fracture reduction, nasoseptal flap fixation, ICA-injury tamponade, aortic root and cardiovascular balloon control, intraoperative tissue expansion, and ascites drainage rest mainly on level 3 - 4 evidence (uncontrolled case series and technical reports, conditional use in experienced hands). The reader should therefore regard each of the latter applications as a reasonable, published option in experienced hands rather than a universally validated standard of care.

This review has limitations. As a narrative review, it did not employ formal systematic review methodology. The evidence base is also markedly heterogeneous, with most applications resting on uncontrolled case series, technical notes, and case reports (Oxford CEBM levels 3 - 4), and there is a risk of publication bias favouring successful and novel adaptations. Publication bias is a particular concern for the novel applications reviewed here, because failed attempts and device-related complications are far less likely to be published than successful case reports; the true complication rates of several off-label uses are therefore likely to be underestimated. Finally, the vast majority of off-label applications lack regulatory approval, overall evidence quality is low, and most recommendations are rated weak or conditional.

5. Conclusion

Nearly nine decades after Frederic E. B. Foley introduced the self-retaining bal-

loon catheter, the device has become a genuinely versatile adjunct that has travelled from the bladder into nearly every surgical and medical specialty. Its value lies not in any single indication but in a handful of reusable mechanical principles: tamponade, self-retaining drainage, dilatation and support, and temporary bridging. Clinicians have creatively redeployed it against bleeding, obstruction, infection, and structural failure. The strongest evidence supports its role in cervical ripening, where randomized and systematic data have earned it first-line status; for postpartum haemorrhage, it is a well-supported second-line bridging measure. In other fields, it is an inexpensive, immediately available, and often effective adjunct whose benefits must be weighed against a defined and occasionally catastrophic spectrum of complications. Several of the more recently described applications remain supported only by case reports and technical notes; they should be regarded as promising but unproven, and high-quality prospective studies with standardised outcome reporting are required before they can be recommended for general use.

Author Contributions

Conceptualization, H.Y. and J.D.; methodology, J.D.; validation, H.Y., K.Z., and K.Q.; formal analysis, J.D.; investigation, J.D., K.Z., and K.Q.; resources, H.Y.; data curation, K.Z. and K.Q.; writing—original draft preparation, J.D.; writing—review and editing, H.Y., J.D., K.Z., and K.Q.; visualization, K.Z.; supervision, H.Y.; project administration, H.Y. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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