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REVIEW ARTICLE

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RANITIDINE HYDROCHLORIDE WITH THEIR *IN-VITRO* AND *IN-VIVO* PARAMETERS OF GRDDS

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ABSTRACT: New histamine H2-receptor antagonist ranitidine lacks the imidazole group observed in cimetidine. Ranitidine suppresses excessive stomach acid secretion in persons 4-10 times more efficiently per weight than cimetidine. In recent years, GRDDSs have soared in popularity as a technique of giving medications orally. Many difficulties, such as poor bioavailability, are addressed by this strategy, which entails retaining the dosage form in the stomach for a long period and releasing the drug slowly. The production of GRDDS makes use of a variety of cutting-edge procedures, such as magnetic field assisted gastro-retention, plug type swelling system, muco-adhesion technique, floating system with or without effervescence. To achieve enhanced gastro-retention and longer drug release, a well-designed *in vivo* study is important for successful GRDDS development in addition to in vitro characterization. *In vivo* stomach residency time is commonly measured using gamma scintigraphy and magnetic resonance imaging. Despite the various advantages, the number of GRDDS on the market is constrained by the large subject variability in gastrointestinal physiological condition, effect of meals, and variable rate of stomach emptying time. This article highlights current *in-vivo* GRDDS research, concentrating on its accomplishments, shortcomings, and the barriers that need to be overcome.

Keywords: GRDDS, H2-receptor antagonist, Ranitidine, Pharmacodynamic.

INTRODUCTION

Unlike ranitidine, the new histamine H2-receptor antagonist ranitidine does not have an imidazole group. When compared to cimetidine, ranitidine reduces stomach acid production by 4-10 times greater weight per weight [1]. Clinical studies comparing ranitidine with cimetidine for the treatment of duodenal and gastric ulcers over a period of 4 to 6 weeks have indicated that ranitidine 150mg twice a day is an effective alternative to cimetidine 1000mg daily in 4 split doses. Ranitidine prevents the return of ulcers when taken as a single 150mg dose just before bedtime. Preliminary research in the Zollinger-Ellison syndrome and in individuals intolerant to, or resistant to, cimetidine indicates that ranitidine effectively lowers stomach hyperacidity and heals most ulcers [2]. Unlike cimetidine, ranitidine does not reduce testosterone levels and does not prevent the liver from processing other medications [3]. The safety profile of ranitidine is excellent. Evidence suggests that ranitidine may be effective for cimetidine-intolerant patients, since early findings indicate that it reduces cimetidine-induced adverse effects. Only further, more comprehensive clinical experience with ranitidine will reveal whether or not these trials have therapeutic importance [4].

Oral formulations have gained a respectable standing. When weighing the pros and disadvantages, it's important to examine the pros. Poor bioavailability is a common problem with traditional oral administration methods owing to a number of reasons, including fast stomach emptying time [5]. The pharmaceutical industry, however, has benefited greatly from technological developments in the last several decades, with many new drugs coming to market, including controlled-release versions of existing medications. Patient adherence has been dramatically increased by advances in medication delivery systems including gastro-retentive drug delivery systems, which have stomach retention length and delayed drug release (GRDDS). The recognised limitations of conventional oral medication delivery systems have generated interest in this alternate administration mechanism [6]. The quick gastric emptying associated with typical oral drugs causes problems with absorption in the distal section of the intestine for several drug molecules (including pranlukast hydrate, metformin HCl, baclofen, *etc*.). Medications that are less soluble in the acidic environment of the intestine may become more soluble after being retained in the stomach for an extended period of time. The colon is a very sensitive site for the breakdown of numerous drugs, including captopril, metronidazole, ranitidine HCl, and many more. Short-half-life drugs need to be dosed more often to maintain therapeutic levels in the blood, since they are eliminated from circulation more quickly [7].

The limitations mentioned above are being worked over by developing a sustained-release oral formulation that will slowly release the medicine in the stomach while yet maintaining an effective drug concentration in the systemic circulation for a considerable amount of time. In addition to its systemic effects, GRDDS has been proven to be successful in killing Helicobacter pylori in the submucosal tissue of the stomach, making it a viable option for the local therapy of

gastric and duodenal ulcers, as well as esophagitis. Almost 30 years have passed since the introduction of GRDDS formulations. Similarly well-established are the fundamental methods of production and their in vitro characterizations. In addition, several GRDDS reviews have been published lately. The key concerns of these evaluations are the formulation particulars or *in vitro* characterization experiments performed by diverse researchers and summarised therein [8].

2. Pharmacodynamic Studies

Animal studies have shown that ranitidine prevents histamine from binding to H2 receptors. It outperforms cimetidine in terms of molar activity in both *in vitro* and *in vivo* settings. In both healthy persons and patients with duodenal ulcers, ranitidine is 4-10 times more effective than cimetidine at suppressing stomach acid output. This is because ranitidine inhibits not just the stomach acid production triggered by pentagastrin, histamine, and regular meals, but also the acid secretion that occurs during rest. In healthy volunteers, a single oral dosage of ranitidine (50, 100, 150, or 200 mg) decreased pentagastrin-stimulated mean acid production by 42%, 75%, 85%, and 95%, respectively [9]. After just 5 and 10 hours, a single 150mg dosage of ranitidine significantly reduced baseline stomach acid output by 70% and 38%, respectively. The stomach acid levels of patients with duodenal ulcers who received 150 mg of ranitidine twice day decreased by 70% after 24 hours. The night-time acid production decreased by 90% [10].

Studies mimicking clinical practise found that ranitidine doses of 300 mg and 400 mg lowered 24-hour acidity by 69% and 71%, respectively. After consuming 1000mg of cimetidine once a day for a week, stomach acidity was reduced by 48% [11]. Neither healthy volunteers nor patients with duodenal ulcers showed a significant change in serum gastrin, pancreatic, or mucus production in response to ranitidine. Pepsin production slows down [11].

Although concentrations are elevated following intravenous injection of a 300mg dosage of ranitidine, this has not been found to raise acute or chronic serum prolactin production at normal therapeutic levels. There is no indication that ranitidine has antiandrogen effects in either animals or people, and current research shows that ranitidine does not influence the hepatic metabolism of medicines [12].

3. Pharmacokinetics

No matter how recently a patient has eaten after taking a dosage orally, maximal plasma concentrations are attained after 1–2 hours. After ingesting 150 mg, plasma levels peak at roughly 400 ng/ml, on average. The reported bioavailability after a single dose varies widely, from 40% to 88%, with a typical value close to 50%. Intense "first-pass" metabolism occurs in the liver, as measured by the bioavailability and hepatic clearance values after oral dosage. The amount of circulation ranges from 1.22 to 1.88 litres per kilogramme [13]. When compared to contemporaneous plasma samples from healthy persons, ranitidine concentrations in cerebrospinal fluid are 20-30% lower. Ranitidine is 85% free and 15% bound to proteins. When ranitidine is taken orally or injected, it is mostly excreted in the urine. About 30% of a drug is cleared by the liver after intravenous delivery, whereas as much as 73% of a drug is cleared by the liver following oral administration. After many oral doses, ranitidine has a half-life of 2.25 hours in the body. Recent studies have indicated that a ranitidine plasma concentration of roughly 160 ng/ml is required to reduce acid production by 50% over a 2-hour period when exposed to pentagastrin [14].

4. Therapeutic Trials

In open investigations, placebo-controlled trials, and comparative trials with cimetidine, healing rates for duodenal ulcers after 4 weeks of medication ranged from 60% to 100%. More effective than placebo and frequently showing little to no difference from cimetidine 1000 mg daily in 4 divided doses, ranitidine 150 mg twice day has been the subject of several scientific research. In randomised clinical studies, the success rate for healing ulcers treated with a placebo ranged from 27% to 46%. Similar to other treatments for peptic ulcers, patients had decreased pain as their ulcers healed, but there was no correlation between the severity of their symptoms and the endoscopic procedure's effectiveness [15].

The endoscopist has often been kept in the dark in investigations with cimetidine as to which medication the patient really got. There was no statistically significant difference between ranitidine 300 mg day and cimetidine 1000 mg daily, according to all but one large multicenter study. After 4 weeks of treatment, duodenal ulcers healed at the same pace regardless of whether medication was used, however this study found that ranitidine was the superior medication (74 and 68 percent). There was a 63-77% recovery rate at 4 weeks for patients given either ranitidine 300 mg daily or cimetidine 1000 mg daily, according to other research. After 8 weeks of treatment, the success rate for ranitidine ranged from 85 to 92 percent, while the success rate for cimetidine was between 88 and 95 percent [16].

Therapy with ranitidine 300 milligrammes once a day was effective for patients whose peptic ulcers persisted after taking 1 to 1.6 grammes of cimetidine twice a day for 2 to 36 months [17].

Taking 150 milligrammes of ranitidine twice a day has been demonstrated to hasten the recovery of stomach ulcers in placebo-controlled studies. The success rate with ranitidine after 3 or 4 weeks of treatment varies between 59% and 76%, whereas the success rate with placebo varies between 23% and 44%. Ranitidine does not substantially enhance healing durations or reduce intolerability in comparison to cimetidine [18].

Studies compare ranitidine to cimetidine and others that used a placebo found that taking 150 mg of ranitidine before night helped minimise the frequency with which duodenal ulcers

returned. After 12 months of maintenance medication, the incidence of ulcer recurrence was 25% with ranitidine 150mg and 24% with cimetidine 400mg [19].

In investigations encompassing people with endoscopically and bioptically confirmed cases of reflux oesophagitis, ranitidine 150 mg twice day was shown to improve the endoscopic look of oesophagitis compared to placebo [20].

Initial studies found that people with Zollinger-Ellison syndrome who were intolerant of cimetidine were able to have their symptoms controlled for longer periods of time and have their ulcers healed by taking up to 900 mg of ranitidine daily [21].

While preliminary studies of ranitidine in the treatment and prevention of acute upper gastrointestinal bleeding in critically ill patients have shown promising results in patients with duodenal ulcer, these studies have been too small to permit any clear conclusions regarding the possible beneficial effects of the drug [22].

5. Side Effects

Doses of ranitidine between 100 and 150 milligrammes twice day for the treatment of peptic ulcers have been proven to be well tolerated, with just 3 percent of patients experiencing side effects such skin rash, headache, and dizziness in controlled and open studies. Patients who are intolerant of cimetidine may transition to ranitidine without risk of relapsing gynecomastia or erectile dysfunction, according to case studies [23].

6. Dosage

Ranitidine 150 mg twice day is the standard dose for treating duodenal or benign gastric ulcer in adults. If an endoscopic re-evaluation is not possible within 4-8 weeks, therapy must be continued until the ulcer has healed. The occasional treatment of Zollinger-Ellison syndrome with ranitidine 600-900 mg daily in divided doses has showed promise. Maintenance treatment with ranitidine 150 mg before night is advised for ulcer prevention [24].

7. GRDDS

7.1. Stomach physiology

To be effective, GRDDS requires an understanding of stomach physiology and the gastric emptying process. The fundus, the body, and the antrum are the three anatomically separate parts of the human stomach that are seen in Fig. 1. (pylorus). The empty stomach can hold around 250–500 ml of liquid, whereas a full stomach can hold about 1.5 l. The antrum is where most of the mixing takes place, while the fundus and body serve as a storage space for undigested food. The antrum is the stomach's lowest portion and plays a significant role in the emptying process by pushing the food out. Time spent in the stomach is greatly influenced by the pylorus, which connects the stomach to the duodenum. However, fasting and fed states have different patterns of stomach motility. Stomach motility occurs in a cyclical fashion, with active and inactive phases. Each round lasts anywhere from 90 to 120 minutes and consists of four phases. The motility pattern of the stomach is sometimes referred to as the "migrating motor complex" (MMC) [25].

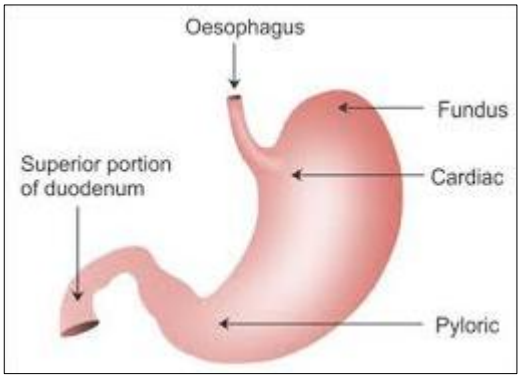

FIG. 1: DIAGRAM OF HUMAN STOMACH

7.2. Approaches to fabricate gastro-retentive systems

Researchers have attempted several different approaches, all with the same overarching goal: to lengthen the time a drug remains in the stomach before being absorbed. The concept of high density formulation is one such method (Fig. 2). To avoid disintegration from the peristaltic action of the GIT *in vivo*, the formulated dosage form was made thick (density: 2.5 to 3.0 g/ml). We thus expected a total GI transit time increase of 5.8.-25. Tablet density was increased with the use of barium sulphate, iron powder, titanium oxide, and zinc oxide in the formulation [26]. The increased dose required for such a high density was a major drawback of this method. A magnetic field was also presented as a potential method for keeping the dosage form where it belongs: in the stomach. The magnetically active components in the pill. The patient had to lie on their stomach while wearing an external magnet to keep the medication in place. While innovative in theory, in vivo design challenges stemmed from poor patient compliance [27].

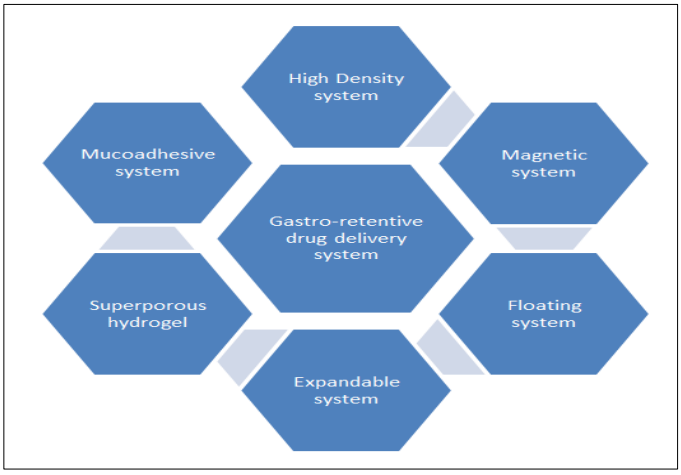

FIG. 2: GASTRO-RETENTIVE DRUG DELIVERY SYSTEM BASED ON HIGH DENSITY

GRDDS used a swelling and expanding mechanism, which was successful in vitro and in vivo, to retain the dosage form in the stomach. Bolton and Desai reported one such system, which they manipulated to expand beyond the pyloric sphincter's diameter and became clogged there. The device was frequently referred to as a "plug type system" because of its capacity to block the pyloric sphincter. After absorbing water from the stomach acid, the polymer expanded [28]. By selecting a polymer (or combination of polymers) with the appropriate molecular weight/viscosity grade and swelling properties for the dosage form, a sustained-release effect was obtained. The rapid expansion to equilibrium size in under a minute made possible by new, super-porous polymers has enabled this kind of dosage form to go even farther. Polymers having an average pore size greater than 100 m swell rapidly (swelling ratio of 1:100 or more) when exposed to GI fluid because capillary wetting occurs through multiple linked open pores [29].

A novel kind of GRDDS has been developed because of the capacity of any dosage form to float (buoyancy) in GI fluid. Eventually, the bulk density of the dose form will fall below that of stomach fluid (1.004 to 1.010 g/ml). Variables such as polymer type, viscosity grade, the presence of a wicking agent or swelling boosters, etc. all affect how quickly the polymer in the formulation swells. These formulation considerations impact not only the floating time but also the *in vitro* drug release rate. The effectiveness of floating behaviour in patients is affected by factors such as whether they have just eaten, if they are fasting, the amount of stomach fluid present, and so on. Once the effects of the medicine have worn off, the discarded dosage form is expelled from the stomach. As can be observed in Fig. 3, the addition of a characteristic like effervescence improved the floating behaviour (floating lag time and floating duration) of this swelling-based floating delivery system. Several fizzing substances (including sodium bicarbonate, tartaric acid, and citric acid) were incorporated inside the dosage form. Carbon dioxide (CO_2) is caught by the gellified hydrocolloid system when these chemicals undergo a chemical interaction with stomach contents and produce CO2 [30]. Because its effective density is less than that of stomach fluid, the combination of effervescence and swelling creates a dose form that floats for a prolonged period of time. In addition to studying single-unit systems, researchers have looked at bi-layer and tri-layer designs of this combination approach for including two drugs with different release properties. One medicine is included in the immediate-release layer, while the other is mixed with the gas-generating unit and excipients to produce a sustained-release layer.

Bio-adhesive or muco-adhesive drug delivery systems were another approach to the development of gastro-retentive systems. The dosage form was created to stay put inside the stomach's lumen and to withstand gastrointestinal motility for a considerable amount of time. One of the benefits of this method was the targeted administration of medicine to the irritated stomach area. Muco-adhesive excipients such polycarbophil, lectins, carbopol, chitosan, carboxy-methylcellulose (CMC), pectin, and gliadin have been documented in formulation formulations for this kind of design. Combining macho-adhesion with a floating or swelling process is another cutting-edge approach to improving gastro-retention qualities [31].

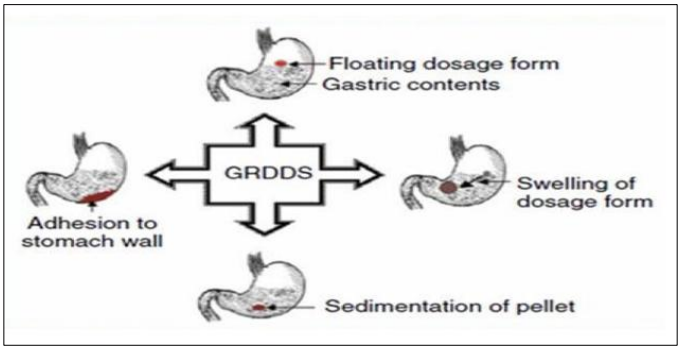

FIG. 3: GASTRO-RETENTIVE DRUG DELIVERY SYSTEM BASED ON COMBINATION OF POLYMER SWELLING AND EFFERVESCENCE

In-situ gelling (or raft formation) in combination with carbon dioxide bubble trapping is another reported patient compliance strategy for gastro-retention. In this route of administration, sodium alginate serves as the in-situ gel forming polymer, while carbonates or bicarbonates provide the fizz. Because of their expansion and the formation of a viscous cohesive gel in which carbon dioxide bubbles are imprisoned, the drug delivery devices float in the stomach. Raft generating systems are often used to treat gastroesophageal reflux disease (GERD) because of their capacity to produce a layer on top of the stomach fluid [32].

9. *In vitro* assessment of GRDDS

In vitro assessments are necessary to ensure the in vivo performance of GRDDS with regards to floating lag time and floating duration, as well as to define the optimal formulation composition. The usual battery of evaluation techniques for tablets includes tests for hardness, friability, appearance, drug content, uniformity of content, weight variation, and in vitro drug release. Deionized water and stomach fluid models were used to assess the floating behaviour of any GRDDS, including floating lag time and floating duration [33]. The possible differences in buoyant abilities between the dose forms are investigated in each of these environments. Polymeric dosage forms are tested for at least 8 hours for swelling property and rate of swelling when placed in a dissolving media to ensure drug release and a floating mechanism (0.1N HCl). This may be done by collecting samples of the larger pill size or the amount of weight gain at the end of the trial. The stomach fluid model is used as the in vitro drug release testing medium. At certain intervals, the drug concentration is checked by diluting a sample taken from the dissolution basket. Microscope examination, preferably with scanning electron microscopy (SEM), is used at different magnifications to observe the surface shape of the dosage form. In order to find the optimal formulation composition and processing parameters for gastro-retentive beads and microspheres, researchers conduct supplementary

investigations on topics such as drug loading, particle size measurement, and drug entrapment efficiency. Spectrophotometers, optical microscopes, and particle size analyzers are common pieces of equipment used in in vitro evaluation investigations [34].

10. *In vivo* gastric retention as a surrogate of pharmacokinetic study

In-depth studies on a suitable animal model or on healthy human volunteers are required to prove the efficacy of any GRDDS *in vivo*. Small animals such as mice, rats, guinea pigs, or rabbits might be difficult to work with when validating stomach retention and bioavailability investigations, as detailed by Turner *et al.* Most of the published research on GRDDS formulation showed *in vitro* characterisation tests, such as dissolving study, determination of floating lag time, and floating duration, as well as in vivo stomach retention in much bigger animals, such as dog or human subjects [35]. Because of its increased time spent in the stomach after administration, the GRDDS was supposed to be more therapeutically effective than the regular dosage. Numerous cutting-edge visualisation techniques might be useful in this respect. Gamma scintigraphy is a popular and cutting-edge technique for determining the gastro-retentivity of humans. A radioisotope with a short half-life is present in very minute quantities in the dosage form. The neutrons from the adjacent source strike the formulation, creating the distinctive gamma rays that may be digitally captured and analysed later [36].

Badve *et al.* produced diclofenac sodium-filled hollow calcium pectinate beads for chronopharmacological action. The floating beads were structurally hollow spheres with densities below 1 g/ml and porosities of 34% [37]. Using gamma scintigraphy, researchers were able to observe rabbits in real time and learn that the animals could keep beads in their stomachs for up to five hours. Ascarizole, calcium-disodium edentate, and repaglinide are just a few of the flexible medicinal compounds that have been demonstrated to be retained in the stomach when encapsulated in a floating tablet or microsphere [38]. The *in vivo* gastro-retention of a GRDDS may be shown using MRI, in addition to endoscopy. This non-invasive technique makes use of magnetic fields and radio waves to disclose the body's structural makeup and identify the precise place where an orally administered medicine was taken [39]. Super paramagnetic materials (like ferrous oxide) are added for this purpose [40].

TABLE 2: DRUG FORMULATED AS GASTRO-RETENTIVE DRUG [40]

S. no.	*Drug*	*Gastro-retentive Dosage form*
1	Ranitidine	Tablet
2	Famotidine	Calcium pectinate gel beads
3	Ciprofloxacin HCl	HDB Tablet
4	Ofloxacin	Tablet
5	Propranolol HCl	Tablet
6	Norfloxacin	Tablet
7	Furosemide	Mini-Tablet
8	Pregapalin	Tablet
9	Aluminium hydroxide	Floating liquid alginate preparation
10	Fluconazole	Tablet

11. Challenges ahead with GRDDS

How long different dosage forms spend in the gastrointestinal tract (GIT) influences how well those drugs work. Generally speaking, GRDDS only causes gastrointestinal distress. The key challenge in developing a GRDDS is, therefore, maintaining the delivery system in the stomach or upper small intestine for a long time until all the drugs have been administered at a set speed. Stomach emptying times may vary considerably from person to person. Two of the most crucial factors are the method of dosing and whether or not the stomach is full. Fasting causes the stomach to empty more quickly than after a meal. The range of stomach emptying times is also affected by factors such as the type of meal consumed, the number of calories consumed, the person's gender, and their age. A high-fat meal's high caloric content causes gastric emptying to be greatly retarded. Indigestible polymers and fatty acid salts have been shown to slow gastric emptying by changing the pattern of motility in the empty stomach. Furthermore, Mojaverian *et al.* showed that GRT differs across people depending on demographic characteristics including age and gender. The pylorus limitation has a major impact on the gastric retention of any GRDDS. During digestion, the pylorus's diameter is around 2–3 mm, but during the interdigestive phase, it expands to about 12.8–7 mm. Food must be smaller than 5 mm in diameter to pass through the pylorus and into the duodenum. Also, keep in mind that the pylorus and the rate of its peristaltic movement are not identical in humans, dogs, or rabbits. As a result, it is crucial to approach *in vivo* effectiveness data with caution.

The effectiveness of the dose form depends on a variety of elements, such as the size and shape of the dosage form, the individual's illness status, and the body mass index, all of which influence the gastric residence duration. It has been claimed that the consistency and reliability of drug release from multiple-unit GRDDS is superior to that of single-unit GRDDS. A single-unit gastro-retentive dosage form (GRDF) may be expelled from the stomach before it has had time to exert its full therapeutic effect due to the gastric emptying process and the time lag between when the dose is administered and when it takes action. The primary challenges in developing an optimum GRDDS stem from the need to reduce the stomach's emptying rate and maintain a steady drug release rate for a period of time sufficient for the medication to be metabolised.

CONCLUSION

Literature reviews and in-depth analyses of commercial products both point to the same conclusion: no one gastro-retentive system is superior to others for all possible medicine candidates. However, these studies overwhelmingly demonstrate GRDDS's positive effects on patients. Each potential pharmaceutical or medication combination needs its own dose and manufacturing complexity assessment. Polymer selection remains a key factor in developing effective high-dose formulations. This option is critical for achieving the compressibility needed to make the most of the APIs' high

doses. However, the dosage form's polymer content must be taken into account; ideally, the least amount of polymer necessary to produce considerable stomach retention must be used. There has not been a lot of reporting on the performance of these many approaches *in vivo*, despite the fact that many have been presented over the years. These methods include floating, bio-adhesion, effervescence, sinking, magnetic, swelling, etc. Recently, there has been a shift in the direction of a more streamlined approach to the formulation of a polymer-based formulation for use in the production of a floating delivery system. The commercialization of this distribution system has been slow despite its numerous potential benefits due to various intrinsic difficulties. The advantages of GRDDS in terms of delivering drugs to the systemic circulation suggest that it will gain popularity in the near future. However, the efficacy of a particular treatment must be verified by carefully organised *in vivo* study owing to the intricacy of pharmacokinetic and pharmacodynamic aspects.

AI Disclosure Statement

During the preparation of this manuscript, the author(s) used ChatGPT by OpenAI and Grammarly for language editing and grammar improvement. After its use, the author(s) thoroughly reviewed, verified, and revised all ai-assisted content to ensure accuracy and originality. The author(s) take full responsibility for the integrity and final content of the published article.

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CONFLICT OF INTEREST: Nil

REFERENCES:

1. Daly MJ, Humphray JM, Stables R. Inhibition of gastric acid secretion in the dog by the H2-receptor antagonists, ranitidine, cimetidine, and metiamide. Gut. 1980;21(5):408-12.
2. Lancaster-Smith MJ, Jaderberg ME, Jackson DA. Ranitidine in the treatment of non-steroidal anti-inflammatory drug associated gastric and duodenal ulcers. Gut. 1991;32(3):252-5.
3. Bhowmik D, Chiranjib TK, Pankaj KS. Recent trends of treatment and medication peptic ulcerative disorder. Int J Pharm Tech Research. 2010;2(1):970-80.
4. Tomita K, Izumi K, Okabe S. Roxatidine-and cimetidine-induced angiogenesis inhibition suppresses growth of colon cancer implants in syngeneic mice. Journal of pharmacological sciences. 2003;93(3):321-30.
5. Patisaul HB, Jefferson W. The pros and cons of phytoestrogens. Frontiers in neuroendocrinology. 2010;31(4):400-19.
6. Tiwari G, Tiwari R, Sriwastawa B, Bhati L, Pandey S, Pandey P, Bannerjee SK. Drug delivery systems: An updated review. International journal of pharmaceutical investigation. 2012;2(1):2.
7. Wu H, Huang J. Optimization of protein and peptide drugs based on the mechanisms of kidney clearance. Protein and peptide letters. 2018;25(6):514-21.
8. Bannigan P, Aldeghi M, Bao Z, Häse F, Aspuru-Guzik A, Allen C. Machine learning directed drug formulation development. Advanced Drug Delivery Reviews. 2021;175:113806.
9. Jafarzadeh A, Nemati M, Khorramdelazad H, Hassan ZM. Immunomodulatory properties of cimetidine: Its therapeutic potentials for treatment of immune-related diseases. International immunopharmacology. 2019;70:156-66.
10. McKeage K, Blick SK, Croxtall JD, Lyseng-Williamson KA, Keating GM. Esomeprazole: a review of its use in the management of gastric acid-related diseases in adults. Drugs. 2008;68:1571-607.
11. Goss SL. The role of gastric pH and bicarbonate secretion in intestinal absorption of calcium from supplements. University of Connecticut; 2008.
12. Although concentrations are elevated following intravenous injection of a 300mg dosage of ranitidine, this has not been found to raise acute or chronic serum prolactin production at normal therapeutic levels.
13. Torre DL, Falorni A. Pharmacological causes of hyperprolactinemia. Therapeutics and clinical risk management. 2007;3(5):929-51.
14. Maher HM, Alzoman NZ, Shehata SM, Abahussain AO. UPLC–ESI–MS/MS study of the effect of green tea extract on the oral bioavailability of erlotinib and lapatinib in rats: Potential risk of pharmacokinetic interaction. Journal of Chromatography B. 2017;1049:30-40.
15. Higuchi K, Watanabe T, Tanigawa T, Tominaga K, Fujiwara Y, Arakawa T. Sofalcone, a gastroprotective drug, promotes gastric ulcer healing following eradication therapy for Helicobacter pylori: A randomized controlled comparative trial with cimetidine, an H2-receptor antagonist. Journal of gastroenterology and hepatology. 2010;25:S155-60.
16. Hearnshaw SA, Logan RF, Lowe D, Travis SP, Murphy MF, Palmer KR. Acute upper gastrointestinal bleeding in the UK: patient characteristics, diagnoses and outcomes in the 2007 UK audit. Gut. 2011;60(10):1327-35.
17. Yuan Y, Padol IT, Hunt RH. Peptic ulcer disease today. Nature Clinical Practice Gastroenterology & Hepatology. 2006 Feb 1;3(2):80-9.
18. Gralnek IM, Dumonceau JM, Kuipers EJ, Lanas A, Sanders DS, Kurien M, Rotondano G, Hucl T, Dinis-Ribeiro M, Marmo R, Racz I. Diagnosis and management of nonvariceal upper gastrointestinal hemorrhage: European Society of Gastrointestinal Endoscopy (ESGE) Guideline. Endoscopy. 2015;47(10):a1-46.
19. Azoulay P. Do pharmaceutical sales respond to scientific evidence? Journal of Economics & Management Strategy. 2002;11(4):551-94.
20. Dellon ES, Gonsalves N, Hirano I, Furuta GT, Liacouras CA, Katzka DA. ACG clinical guideline: evidenced based approach to the diagnosis and management of esophageal eosinophilia and eosinophilic esophagitis (EoE). Official journal of the American College of Gastroenterology| ACG. 2013;108(5):679-92.
21. Reid JL, McKay GA, Walters MR. Clinical pharmacology and therapeutics. John Wiley & Sons; 2011 Nov 28.
22. Spirt MJ. Stress-related mucosal disease: risk factors and prophylactic therapy. Clinical therapeutics. 2004;26(2):197-213.
23. Xie Y, Zhu Y, Zhou H, Lu ZF, Yang Z, Shu X, Guo XB, Fan HZ, Tang JH, Zeng XP, Wen JB. Furazolidone-based triple and quadruple eradication therapy for Helicobacter pylori infection. World Journal of Gastroenterology: WJG. 2014;20(32):11415.
24. Tan KR, Magill AJ, Parise ME, Arguin PM. Doxycycline for malaria chemoprophylaxis and treatment: report from

the CDC expert meeting on malaria chemoprophylaxis. The American journal of tropical medicine and hygiene. 2011;84(4):517.
25. Suradkar P, Mishra R, Nandgude T. Overview on trends in development of gastroretentive drug delivery system. Research Journal of Pharmacy and Technology. 2019;12(11):5633-40.
26. Tiwari G, Tiwari R, Sriwastawa B, Bhati L, Pandey S, Pandey P, Bannerjee SK. Drug delivery systems: An updated review. International journal of pharmaceutical investigation. 2012;2(1):2.
27. Vrettos NN, Roberts CJ, Zhu Z. Gastroretentive technologies in tandem with controlled-release strategies: A potent answer to oral drug bioavailability and patient compliance implications. Pharmaceutics. 2021;13(10):1591.
28. Mandal UK, Chatterjee B, Senjoti FG. Gastro-retentive drug delivery systems and their in vivo success: A recent update. asian journal of pharmaceutical sciences. 2016;11(5):575-84.
29. Nayak AK, Malakar J, Sen KK. Gastroretentive drug delivery technologies: Current approaches and future potential. Journal of Pharmaceutical Education and Research. 2010;1(2):1.
30. Nishanth I, Elango K, Deattu N, Stephen P. Formulation Development and Evaluation of Bilayer Tablets of Telmisartan for Immediate Release and Metformin Hydrochloride for Sustained Release. Research Journal of Pharmaceutical Dosage forms and Technology. 2013;5(3):139-44.
31. Mandal UK, Chatterjee B, Senjoti FG. Gastro-retentive drug delivery systems and their in vivo success: A. Expert Opin Drug Deliv. 2011;8:1189-203.
32. Bashaiwoldu AB, Podczeck F, Newton JM. A study on the effect of drying techniques on the mechanical properties of pellets and compacted pellets. European journal of pharmaceutical sciences. 2004;21(2-3):119-29.
33. Tripathi J, Thapa P, Maharjan R, Jeong SH. Current state and future perspectives on gastroretentive drug delivery systems. Pharmaceutics. 2019;11(4):193.
34. Shaha SH, Patel JK, Pundarikakshudu K, Patel NV. An overview of a gastro-retentive floating drug delivery system. Asian journal of pharmaceutical sciences. 2009;4(1):65-80.
35. Lehto P, Kortejärvi H, Liimatainen A, Ojala K, Kangas H, Hirvonen J, Tanninen VP, Peltonen L. Use of conventional surfactant media as surrogates for FaSSIF in simulating in vivo dissolution of BCS class II drugs. European journal of pharmaceutics and biopharmaceutics. 2011;78(3):531-8.
36. Ruff A, Holm R, Kostewicz ES. Evaluating the predictability of the *in vitro* transfer model and in vivo rat studies as a surrogate to investigate the supersaturation and precipitation behaviour of different Albendazole formulations for humans. European Journal of Pharmaceutical Sciences. 2017;105:108-18.
37. Gasthuys E, Vandecasteele T, De Bruyne P, Vande Walle J, De Backer P, Cornillie P, Devreese M, Croubels S. The potential use of piglets as human pediatric surrogate for preclinical pharmacokinetic and pharmacodynamic drug testing. Current pharmaceutical design. 2016;22(26):4069-85.
38. Kortejärvi H, Urtti A, Yliperttula M. Pharmacokinetic simulation of biowaiver criteria: the effects of gastric emptying, dissolution, absorption and elimination rates. European journal of pharmaceutical sciences. 2007;30(2):155-66.
39. Emami J. *In vitro-in vivo* correlation: from theory to applications. J Pharm Pharm Sci. 2006;9(2):169-89.
40. Patel N, Nagesh C, Chandrashekhar S, Jinal P, Devdatt J. Floating drug delivery system: an innovative acceptable approach in gastro retentive drug delivery. Asian Journal of Pharmaceutical Research. 2012;2(1):7-18.

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