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Gastro Retentive Drug Delivery System: A review

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ABSTRACT:The purpose of this article is to compile the various Gastro Retentive approaches. In order to understand various physiological difficulties to achieve gastric retention, we have summarized need, advantages, disadvantages, physiology of stomach and types of Gastro Retentive drug delivery system. The present review addresses briefly about the current status of various leading Gastro Retentive drug delivery technologies, developed until now, i.e. high density (sinking), floating, bio-adhesive or mucoadhesive, expandable, unfoldable. In addition, important factors controlling gastro retention, and finally, future potential are discussed.

KEYWORDS:GRDDS, Floating System, Stomach Physiology, Factor Controlling Gastric Retention, Classification of GRDDS.

I. INTRODUCTION

[1] One of the commonly used type of route of administration is oral route. Now a days Oral controlled release drug delivery have recently been of increasing interest in pharmaceutical field as it helps to improve Therapeutic Effectiveness of Drug Along with patient compliance. many drugs are easily absorb in Gastro Retentive Drug Delivery System but due to short half-life they are eliminated rapidly , which leads frequent dosing of drug to achieve therapeutic effect. to overcome these condition sustain released dosage form is working as divine miracle which leads to release drug slowly in GI track, and reducing dosing frequency. GRDDS (Gastro Retentive Drug Delivery System) is one of the leading drug delivery system(E intro) which can provide therapeutically effective plasma drug concentration for a longer period, thereby reducing the dosing frequency and minimizing fluctuation in plasma drug concentration at steady state by delivering the drug in a controlled and reproducible manner.

II. NEED

[2] Gastro retentive drug delivery systems are a good example; they emerged to enhance the bioavailability and effectiveness of drugs with a narrow absorption window in the upper gastrointestinal tract following are the common need to develop GRDDS.

- ✓ Useful for the drugs that are absorbed from proximal part of gastrointestinal tract.
- ✓ Useful for drug get degraded in alkaline PH.
- ✓ To provide local drug delivery in stomach.
- ✓ Drugs that are absorbed due to variable gastric emptying time.

III. ADVANTAGES

[3]The GRDDS can be advantageous in various manner as follows

- ✓ To get prolonged /sustained released in stomach.
- ✓ Increased bioavailability.
- ✓ Increased stability.
- ✓ To improved therapeutic efficacy of the drug
- ✓ Reduction in frequent dosing.
- ✓ Patient compliance.

IV. DISADVANTAGES

- ✓ [4]The high level of fluid require in stomach for floating and working efficiently. Therefor more water intake is prescribed with such formulation.
- ✓ Not suitable for drugs that have solubility or stability problem in GIT.
- ✓ Drug which are irritant to gastric mucosa are also note suitable.
- ✓ High turnover rate of gastric mucus is major challenge for bio adhesive system.

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V. PHYSIOLOGY OF STOMACH

[5]Stomach is one of crucial section of digestive system lies between small intestine and the oesophagus. In case of no food i.e. empty stomach, mucosa transferred in folded state known as Rugae.

[6, 7]Anatomically the stomach is divided into three regionsFundus, Body and Antrum (pylorus) The proximal part made of fundus and body acts as a reservoir for undigestedmaterials, whereas the antrum is the main site for mixingmotions and acts as a pump for gastric emptying by propelling actions Gastric emptying occurs in both the fasting andfed states.

[8]During the fasting state an interdigestive series ofelectrical events take place which cycle both through stomachand intestine every 2-3 hrs, which is called as inter digestivemyoelectric cycle or migrating myoelectric cycle (MMC)which is further divided in to four phases. After the ingestionof a mixed meal, the pattern of contractions changes fromfasted to that of fed state which is also termed as digestivemotility pattern.

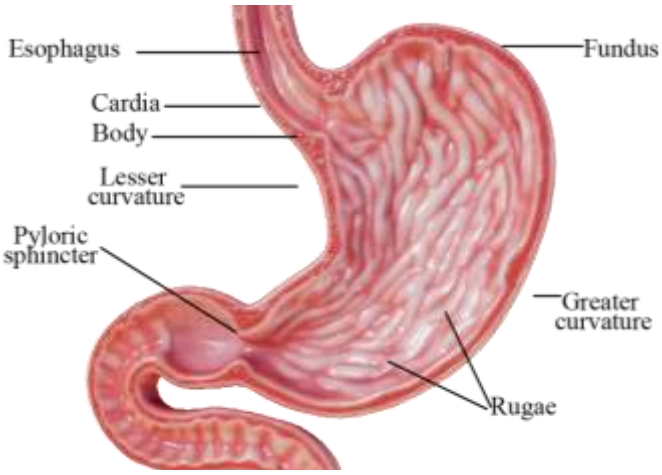

Fig.1 Physiology of HumanStomach

VI. CLASSIFICATION OF GRDDS

[9]The GRDDS is divides into two main types Floating and Non-floating System. Floating system is Further Divided into Effervescent and Non Effervescent systems. Other classes can further classified into various different Types.Various System of GRDDS are given in Fig 2

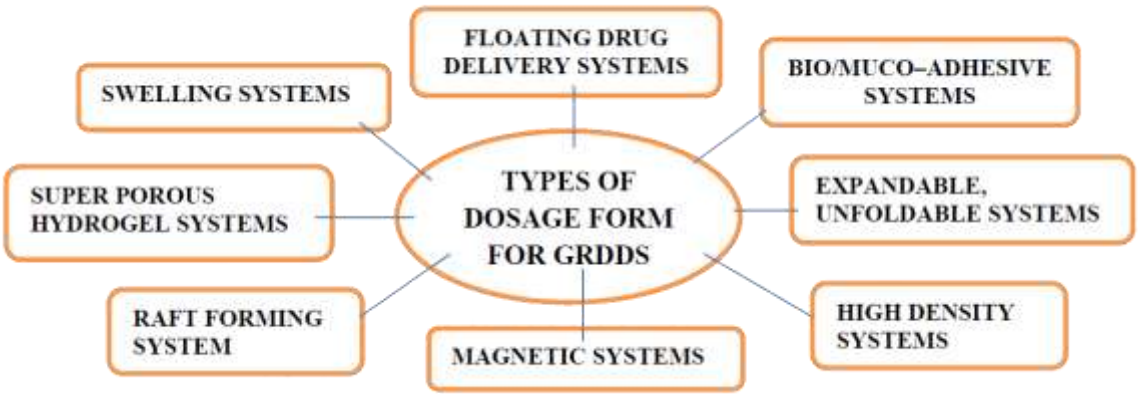

Fig.1 Types of GRDDS Dosage Form.

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A) Floating system

[10]This type of system have low density so that have sufficient floatability to float over gastric content along with remain in stomach for prolonged time. In this period drug is released slowly at desired rate resulting increased gastric retention time and reduced fluctuation in plasma drug concentration. Floating system is one of the widely used approach for gastric retention. This system is broadly researched because it does not adversely effect on motility of gastric tract. It is divided into two types effervescent and non-effervescent system

B) Bio adhesive / Mucoadhesive system

[11, 12, 13]This system contains polymers which adheres to gastric mucosal surface and extends retention time in gastro intestinal tract. Capacity to adhere mucus membrane varies from polymer to polymer. As per need of gastric retention required, we can choose particular polymer. These polymers can be natural such assodium alginate, gelatine, guar gum etc. Semisynthetic polymers such as HPMC, carbopol, sodiumcarboxymethyl cellulose.

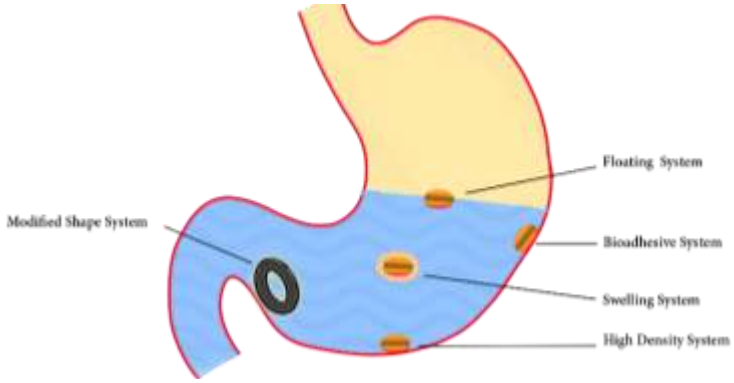

Fig.3.Representation of Various Systems

The adhesion of polymer with mucus membrane is mediated by hydration bonding or receptor mediated adhesion. In case of hydrogen mediated adhesion the polymer is hydrophilic which becomes sticky and stick to the mucus membrane on hydration. Bonding mediation involves mechanical or chemical bonding chemical bond involves ionic or covalent bond or van der walls forces. Whereas in case of receptor mediated adhesion it take place between certain receptor on gastric cells and polymers.

C) High density (sinking) system or non-floating drug delivery system

[14, 15, 16]This type of drug of dosage form which exceed density of normal stomach content(~1.004 gm/cm^3) which can achieved by coating drug on heavy core or mix with inert material such as iron powder barium sulphate and titanium dioxide density of 2.5 gm/cm^3 is necessary for significant prolongation of gastric residence time. But, effectiveness of this system in human beings was not observed and no system has been marketed

D) Swellable and expanding system:

[17, 18] If the size of doses form bigger than pyloric sphincter between it will with stand gastric transits but the dosage form must be of enough small to be swallowed and should not cause gastric blockage this leads to develop an expandable system / swelling system. The swelling is result from osmotic absorption of water after intake.

[18, 7]Expandable system have some drawback such as storage short life difficult to industrialize and not cost effective. Permanent retention of single unit expandable drug delivery dosage form cause gastric blockage and to gastropathy.

VII. FACTOR CONTROLLING GASTRIC RETENTION

[19, 20]Density, size, Shape, pH, Food Intake, Disease Condition are the factor which mainly affects the gastric retention explained below.

1) Density of dosage forms

A density of <1.0 gm/cm^3 is required to exhibit floating property. Shape and size of the dosage formDosage forms having a diameter of more than 7.5 mm show abetter gastric residence

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time compared with one having 9.9 mm.Ring-shaped and tetrahedron-shaped devices have a better gastricResidence time as compared with other shapes.

2) Size & Shape of dosage form:

Shape and size of the dosage forms are important in designing indigestible single unit solid dosageforms. The mean gastric residencetimes of non-floating dosage formsare highly variable and greatlydependent on their size, which maybe large, medium and small units. Inmost cases, the larger the dosageform the greater will be the gastricresidence time.

3) Gastrointestinal pH:

Gastricemptying is retarded at low stomachpH and promoted at higher pH. HCl > acetic acid > lactic acid > tartaric acid> citric acid

4) Nature of meal :

Feeding of indigestible polymers or fatty acid salts can change the motility patternof the stomach to a fed state, thus decreasing the gastric emptying rate and prolonging drug release.

5) Age:

Elderly people, especially those over 70, have a significantly longer GRT.

6) Diseasestate:

Gastric ulcer,diabetes, hypothyroidism increaseGRT. Hyperthyroidism, duodenalulcers decrease GRT.

CONCLUSION :

Gastro retentive drug delivery systems are the mostpreferable systems in order to deliver the drugs whichhave a narrow absorption window near the gastricregion. Now a days a number of drug delivery devicesare being developed which aim at releasing the drug atgastric region. Even though these drug delivery systemshave several advantages they also have disadvantageslike their invitro - invivo correlation is very less.

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