For this, QbD approach can be used effectively for studying various formulation and process parameters for controlled-release formulations [76]. The patented technologies grip the market, and their development is also necessary [66]. The technology translation from the laboratory to the clinic is challenging for a newer technology.

11. CONCLUSION

The oral route is still the most preferred route of administration. Many attempts were made to improvise the oral drug delivery systems. The controlled release drug delivery systems have many advantages when compared with the conventional dosage forms. In this chapter, advanced oral controlled release drug delivery systems were discussed. However, advanced controlled drug delivery systems are not limited to the delivery systems discussed in this chapter. There are many more such systems. These advanced controlled-release systems have helped us to reduce the patient's burden in the case of chronic conditions. However, these formulations pose certain challenges on the formulation front. The major challenges in controlled release formulation development include prevalence of low solubility and high-dose compounds for oral delivery, patient-to-patient variability, and need for pediatric controlled release dosage forms. Dose dumping in the case of controlled release formulations is another serious problem. Dose dumping can be life-threatening if the drug is potent. All these factors must be kept in mind while developing these dosage forms. Personalization of these delivery systems is necessary to cater to the individual patient needs. Nevertheless, these advanced controlled release systems are a boon to the healthcare industry and the patients.

REFERENCES

[1] K.K. Jain, Drug delivery routes, in: K.K. Jain (Ed.), Drug Delivery Systems (Methods in Molecular Biology), Humana Press, Hatfield, Hertfordshire, UK, 2008, pp. 3–8.

[2] G. Singhvi, R. Ukawala, H. Dhoot, S. Jain, Design and characterization of controlled release tablet of metoprolol, J. Pharm. Bioall. Sci. 4 (5) (2012) 90.

[3] H.O. Tbompsont, C.O. Lee, History, literature, and theory of enteric coatings, J. Am. Pharm. Assoc. 34 (5) (1945) 135–138.

[4] V. Girdhar, S. Patil, S. Banerjee, G. Singhvi, Nanocarriers for drug delivery: mini review, Curr. Nanomed. 8 (2) (2018) 88–99.

[5] P. Lee, J.-X. Li, Evaluation of oral controlled release dosage forms. in: H. Wen, K. Park (Eds.), Oral Controlled Release Formulation Design and Drug Delivery, John Wiley & Sons, Inc., Hoboken, NJ, USA, 2010, pp. 22–31, https://doi.org/10.1002/9780470640487

[6] G. Singhvi, S. Banerjee, A. Khosa, Lyotropic liquid crystal nanoparticles: a novel improved lipidic drug delivery system, in: Organic Materials as Smart Nanocarriers for Drug Delivery, William Andrew Publishing, 2018, pp. 471–517.

[7] G. Singhvi, S. Patil, V. Girdhar, D.K. Chellappan, G. Gupta, K. Dua, 3D-Printing: an emerging and a revolutionary technology in pharmaceuticals, Panminerva Med. 60 (2018).

[8] Grand View Research, Controlled Release Drug Delivery Market Size Worth $69.8 Billion by 2027, Grand View Research, Inc. | Markets Insider, 2020. Available at: https://markets.businessinsider.com/news/stocks/controlled-release-drug-delivery-market-size-worth-69-8-billion-by-2027-grand-view-research-inc-1029011435. Accessed 2 April 2020.

[9] C.M. Lopes, C. Bettencourt, A. Rossi, F. Buttini, P. Barata, Overview on gastroretentive drug delivery systems for improving drug bioavailability, Int. J. Pharm. 510 (1) (2016) 144–158.

[10] S. Amidon, J.E. Brown, V.S. Dave, Colon-targeted oral drug delivery systems: design trends and approaches, AAPS PharmSciTech 16 (4) (2015) 731–741.

[11] Y. Boer, New developments in drug delivery research, Pharmaceutisch Weekblad 128 (43) (1993) 1256.

[12] W. Dulin, Oral targeted drug delivery systems: enteric coating, in: Oral Controlled Release Formulation Design and Drug Delivery: Theory to Practice, 2010.

[13] B.P. Gupta, N. Thakur, N.P. Jain, J. Banweer, S. Jain, Osmotically controlled drug delivery system with associated drugs, J. Pharm. Pharm. Sci. 13 (4) (2010) 571–588.

[14] G.P. Andrews, T.P. Laverty, D.S. Jones, Mucoadhesive polymeric platforms for controlled drug delivery, Eur. J. Pharm. Biopharm. 71 (3) (2009) 505–518.

[15] P. Saha, P.S. Das, Advances in controlled release technology in pharmaceuticals: a review. World J. Pharm. Pharm. Sci. 6 (9) (2017) 2070–2084, https://doi.org/10.20959/wjpps20179-10194.

[16] G. Singhvi, A. Shah, S.R. Nalla, R. N Saha, Comparative pharmacokinetic evaluation of controlled release matrix tablet of milnacipran hydrochloride in rabbit, Drug Deliv. Lett. 4 (1) (2014) 21–25.

[17] G. Singhvi, A. Shah, N. Yadav, R.N. Saha, Study the effect of formulation variables on drug release from hydrophilic matrix tablets of milnacipran and prediction of in-vivo plasma profile, Pharm. Dev. Technol. 19 (6) (2014) 708–716.

[18] D.H. Altreuter, A.R. Kirtane, T. Grant, C. Kruger, G. Traverso, A.M. Bellinger, Changing the pill: developments toward the promise of an ultra-long-acting gastroretentive dosage form, Expert Opin. Drug Deliv. 15 (2018) 1189–1198.

[19] A.M. Bellinger, M. Jafari, T.M. Grant, S. Zhang, H.C. Slater, E.A. Wenger, S. Mo, Y.A.L. Lee, H. Mazdiyasni, L. Kogan, R. Barman, C. Cleveland, L. Booth, T. Bensel, D. Minahan, H.M. Hurowitz, T. Tai, J. Daily, B. Nikolic, L. Wood, P.A. Eckhoff, R. Langer, G. Traverso, Oral, ultra-long-lasting drug delivery: application toward malaria elimination goals, Sci. Transl. Med. 8 (2016).