

Bölüm 10

İLAÇ VE TOKSİNLERE BAĞLI SARILIK

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GİRİŞ

Reçeteli ya da reçetesiz birçok ilaç, bitkisel ürünler ve çevresel toksinler çeşitli mekanizmalarla hepatotoksisiteye neden olur. Tanı koyabilmek için yüksek şüphe indeksi gerekmektedir.

İlaç kaynaklı karaciğer hasarı semptom olarak akut ve/veya kronik karaciğer hasarını taklit edebilir. Etiyolojide 1000 in üzerinde ilaç ve bitkisel ürün tanımlanmıştır (1). Yeni başlangıçlı sarılık ile başvuran hastaların %50 si ilaç, bitkisel ürün ve toksin kaynaklıdır (2).

İlaç Metabolizmasında Karaciğerin Rolü

Karaciğer, vücuda giren birçok ilaç ve toksinin alımı, konsantrasyonu, metabolizması ve salımından sorumludur. Bazı ilaçlar direkt hepatotoksite oluşturken, genellikle ilaç metabolitleri karaciğer hasarından sorumludur. Bu metabolitler, özellikle hepatosit endoplazmik retikulumuyla ilişkili membrana bağlı veya sitoplazmada çözülebilir serbest enzimlerce işlenir. Her ilaçın, bu enzim sistemlerinden birini veya daha fazlasını içeren, kendine özgü yolakları vardır (3).

Gastrointestinal sistemden emilen ilaçların çoğu, lipofilitiktir ve suda çözünmez. Bunlar hepatik metabolizmayla suda çözünür hale getirilir ve böylece safra-ya da daha kolay salınır veya böbreklerden süzülür. İlaçlar karaciğerde Faz 1 ve Faz 2 reaksiyonları ile metabolize olur. Daha sonra Faz 3 reaksiyonuyla kanaliküler veya sinüzodal membranlar üzerindeki taşıyıcılar yoluyla atılır (4).

Faz 1 Reaksiyonları – Faz 1 reaksiyonları; lipofilik moleküller oksidasyon, reduksiyon veya hidroliz yoluyla daha polar, hidrofilik moleküllere dönüştürür. Bu reaksiyonlar membrana bağlı mikst fonksiyonlu oksidaz ailesinden sitokrom-P450

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Koruma – ilaca bağlı toksisitenin önlenmesi, hepatotoksik ilaç alan hastaların uygun doz ve diğer ilaçlarla, alkolle alınması durumunda gelişebilecek etkileşimler konusunda eğitilmelidir. Gelişebilecek semptom ve bulgular hakkında bilgi verilmelidir. İzoniazid ve metotreksat gibi şiddetli karaciğer hasarı yapan ilaçları hastalarda ALT düzeyleri izlenmelidir.

Sonuç olarak; ilaç almından sonra ortaya çıkan nonspesifik semptomlar (bulantı, istahsızlık, yorgunluk, sağ üst kadran ağrısı veya kaşıntı) ilaç toksisitesini gösterir ve ilaca bağlı toksisite için değerlendirme ve ileri tetkik gerektirebilir. Tanı koymak zor olabilir ve karaciğer hasarı yapabilecek diğer nedenlerin ekartasyonuna bağlıdır. Primer tedavi ilacın veya toksinin uzaklaştırılması, kesilmesi ve karaciğer fonksiyon testlerinin normal sınırlara gelmesini sağlamaya yönelik izlemidir. Çoğu vakada ilaç kesildikten sonra iyileşme gerçekleşir.

KAYNAKLAR

1. Suzuki A, Andrade RJ, Bjornsson E, Lucena MI, Lee WM, Yuen NA, Hunt CM, Freston JW. Drugs associated with hepatotoxicity and their reporting frequency of liver adverse events in VigiBase: unified list based on international collaborative work. *Drug Saf.* 2010 Jun 1;33(6):503-22. doi:10.2165/11535340-00000000-00000. PubMed PMID: 20486732.
2. Vuppalanchi R, Liangpunsakul S, Chalasani N. Etiology of new-onset jaundice: how often is it caused by idiosyncratic drug-induced liver injury in the United States? *Am J Gastroenterol.* 2007 Mar;102(3):558-62; quiz 693. PubMed PMID:17156142.
3. Nicoletti P, Aithal GP, Bjornsson ES, Andrade RJ, Sawle A, Arrese M, Barnhart HX, Bondon-Guitton E, Hayashi PH, Bessone F, Carvajal A, Cascorbi I, Cirulli ET, Chalasani N, Conforti A, Coulthard SA, Daly MJ, Day CP, Dillon JF, Fontana RJ, Grove JI, Hallberg P, Hernández N, Ibáñez L, Kullak-Ublick GA, Laitinen T, Larrey D, Lucena MI, Maitland-van der Zee AH, Martin JH, Molokhia M, Pirmohamed M, Powell EE, Qin S, Serrano J, Stephens C, Stolz A, Wadelius M, Watkins PB, Floratos A, Shen Y, Nelson MR, Urban TJ, Daly AK; International Drug-Induced Liver Injury Consortium, Drug-Induced Liver Injury Network Investigators, and International Serious Adverse Events Consortium. Association of Liver Injury From Specific Drugs, or Groups of Drugs, With Polymorphisms in HLA and Other Genes in a Genome-Wide Association Study. *Gastroenterology.* 2017 Apr;152(5):1078-1089. doi: 10.1053/j.gastro.2016.12.016. Epub 2016 Dec 30. PubMed PMID: 28043905; PubMed Central PMCID: PMC5367948.
4. Gunawan BK, Kaplowitz N. Mechanisms of drug-induced liver disease. *Clin Liver Dis.* 2007 Aug;11(3):459-75, v. Review. PubMed PMID: 17723915.
5. Danielson PB. The cytochrome P450 superfamily: biochemistry, evolution and drug metabolism in humans. *Curr Drug Metab.* 2002 Dec;3(6):561-97. Review. PubMed PMID: 12369887
6. Park BK, Pirmohamed M, Kitteringham NR. The role of cytochrome P450 enzymes in hepatic and extrahepatic human drug toxicity. *Pharmacol Ther.* 1995;68(3):385-424. Review. PubMed PMID: 8788564.
7. Zhou SF. Structure, function and regulation of P-glycoprotein and its clinical relevance in drug disposition. *Xenobiotica.* 2008 Jul;38(7-8):802-32. doi:10.1080/00498250701867889 . Review. PubMed PMID: 18668431
8. Pauli-Magnus C, Meier PJ. Hepatobiliary transporters and drug-induced cholestasis. *Hepatology.* 2006 Oct;44(4):778-87. Review. PubMed PMID: 17006912.
9. Smith G, Stubbins MJ, Harries LW, Wolf CR. Molecular genetics of the human cytochrome

- P450 monooxygenase superfamily. *Xenobiotica*. 1998 Dec;28(12):1129-65. Review. PubMed PMID: 9890157
10. Tanaka E. Update: genetic polymorphism of drug metabolizing enzymes in humans. *J Clin Pharm Ther*. 1999 Oct;24(5):323-9. Review. PubMed PMID: 10583694
 11. Berson A, Fréneaux E, Larrey D, Lepage V, Douay C, Mallet C, Fromenty B, Benhamou JP, Pessayre D. Possible role of HLA in hepatotoxicity. An exploratory study in 71 patients with drug-induced idiosyncratic hepatitis. *J Hepatol*. 1994 Mar;20(3):336-42. PubMed PMID: 8014443.
 12. Prescott LF. Paracetamol, alcohol and the liver. *Br J Clin Pharmacol*. 2000 Apr;49(4):291-301. Review. PubMed PMID: 10759684; PubMed Central PMCID: PMC2014937.
 13. Schiødt FV, Lee WM, Bondesen S, Ott P, Christensen E. Influence of acute and chronic alcohol intake on the clinical course and outcome in acetaminophen overdose. *Aliment Pharmacol Ther*. 2002 Apr;16(4):707-15. PubMed PMID: 11929388.
 14. Pantuck EJ, Pantuck CB, Garland WA, Min BH, Wattenberg LW, Anderson KE, Kappas A, Connely AH. Stimulatory effect of brussels sprouts and cabbage on human drug metabolism. *Clin Pharmacol Ther*. 1979 Jan;25(1):88-95. PubMed PMID: 758247.
 15. Zhang W, Parentau H, Greenly RL, Metz CA, Aggarwal S, Wainer IW, Tracy TS. Effect of protein-calorie malnutrition on cytochromes P450 and glutathione S-transferase. *Eur J Drug Metab Pharmacokinet*. 1999 Apr-Jun;24(2):141-7. PubMed PMID: 10510741
 16. Stepan AF, Walker DP, Bauman J, Price DA, Baillie TA, Kalgutkar AS, Aleo MD. Structural alert/reactive metabolite concept as applied in medicinal chemistry to mitigate the risk of idiosyncratic drug toxicity: a perspective based on the critical examination of trends in the top 200 drugs marketed in the United States. *Chem Res Toxicol*. 2011 Sep 19;24(9):1345-410. doi: 10.1021/tx200168d. Epub 2011 Jul 11. Review. PubMed PMID: 21702456
 17. US Food & Drug Administration. Clinical drug interaction studies - Study design, data analysis and clinical implications; Guidance for industry (October 24, 2017) available at: <https://www.fda.gov/media/82734/download>.
 18. US Food & Drug Administration. Drug Development and Drug Interactions: Table of Substrates, Inhibitors and Inducers. Available at: FDA.gov website.
 19. Hilmer SN, Shenfield GM, Le Couteur DG. Clinical implications of changes in hepatic drug metabolism in older people. *Ther Clin Risk Manag*. 2005 Jun;1(2):151-6. PubMed PMID: 18360554; PubMed Central PMCID: PMC1661619
 20. Hunt CM, Yuen NA, Stirnadel-Farrant HA, Suzuki A. Age-related differences in reporting of drug-associated liver injury: data-mining of WHO Safety Report Database. *Regul Toxicol Pharmacol*. 2014 Nov;70(2):519-26. doi:10.1016/j.yrtph.2014.09.007. Epub 2014 Sep 16. PubMed PMID: 25236535.
 21. Hunt CM, Westerkam WR, Stave GM. Effect of age and gender on the activity of human hepatic CYP3A. *Biochem Pharmacol*. 1992 Jul 22;44(2):275-83. PubMed PMID:1642641.
 22. García-Cortés M, Ortega-Alonso A, Lucena MI, Andrade RJ; Spanish Group for the Study of Drug-Induced Liver Disease (Grupo de Estudio para las Hepatopatías Asociadas a Medicamentos GEHAM).l. Drug-induced liver injury: a safety review. *Expert Opin Drug Saf*. 2018 Aug;17(8):795-804. doi: 10.1080/14740338.2018.1505861. Review. PubMed PMID: 30059261.
 23. Chalasani N, Reddy KRK, Fontana RJ, Barnhart H, Gu J, Hayashi PH, Ahmad J, Stoltz A, Navarro V, Hoofnagle JH. Idiosyncratic Drug Induced Liver Injury in African-Americans Is Associated With Greater Morbidity and Mortality Compared to Caucasians. *Am J Gastroenterol*. 2017 Sep;112(9):1382-1388. doi:10.1038/ajg.2017.215. Epub 2017 Aug 1. PubMed PMID: 28762375; PubMed Central PMCID: PMC5667647.
 24. Verbeeck RK. Pharmacokinetics and dosage adjustment in patients with hepatic dysfunction. *Eur J Clin Pharmacol*. 2008 Dec;64(12):1147-61. doi:10.1007/s00228-008-0553-z. Epub 2008 Sep 2. Review. PubMed PMID: 18762933.
 25. Chen M, Suzuki A, Borlak J, Andrade RJ, Lucena MI. Drug-induced liver injury: Interactions between drug properties and host factors. *J Hepatol*. 2015 Aug;63(2):503-14. doi: 10.1016/j.jhep.2015.04.016. Epub 2015 Apr 22. Review. PubMed PMID: 25912521.

26. Chang CY, Schiano TD. Review article: drug hepatotoxicity. *Aliment Pharmacol Ther.* 2007 May 15;25(10):1135-51. Review. PubMed PMID: 17451560.
27. Zhang X, Ouyang J, Thung SN. Histopathologic manifestations of drug-induced hepatotoxicity. *Clin Liver Dis.* 2013 Nov;17(4):547-64, vii-viii. doi:10.1016/j.cld.2013.07.004. Epub 2013 Sep 4. Review. PubMed PMID: 24099017.
28. Andrade RJ, Lucena MI, Kaplowitz N, García-Muñoz B, Borraz Y, Pachkoria K, García-Cortés M, Fernández MC, Pelaez G, Rodrigo L, Durán JA, Costa J, Planas R, Barriocanal A, Guarner C, Romero-Gómez M, Muñoz-Yagüe T, Salmerón J, Hidalgo R. Outcome of acute idiosyncratic drug-induced liver injury: Long-term follow-up in a hepatotoxicity registry. *Hepatology.* 2006 Dec;44(6):1581-8. PubMed PMID: 17133470.
29. Stieger B, Fattinger K, Madon J, Kullak-Ublick GA, Meier PJ. Drug- and estrogen-induced cholestasis through inhibition of the hepatocellular bile salt export pump (Bsep) of rat liver. *Gastroenterology.* 2000 Feb;118(2):422-30. PubMed PMID: 10648470.
30. Studniarz M, Czubkowski P, Cielecka-Kuszyk J, Jankowska I, Teisseire M, Kamińska D, Mankiewicz M, Broniszczak D, Pawłowska J. Amoxicillin/clavulanic acid-induced cholestatic liver injury after pediatric liver transplantation. *Ann Transplant.* 2012 Jan-Mar;17(1):128-31. PubMed PMID: 22466919.
31. Degott C, Feldmann G, Larrey D, Durand-Schneider AM, Grange D, Machayekhi JP, Moreau A, Potet F, Benhamou JP. Drug-induced prolonged cholestasis in adults: a histological semiquantitative study demonstrating progressive ductopenia. *Hepatology.* 1992 Feb;15(2):244-51. PubMed PMID: 1735527.
32. Ramachandran R, Kakar S. Histological patterns in drug-induced liver disease. *J Clin Pathol.* 2009 Jun;62(6):481-92. doi: 10.1136/jcp.2008.058248. Review. Erratum in: *J Clin Pathol.* 2010 Dec;63(12):1126. PubMed PMID: 19474352.
33. Cullen JM. Mechanistic classification of liver injury. *Toxicol Pathol.* 2005;33(1):6-8. Review. PubMed PMID: 15805050.
34. Kumar S, DeLeve LD, Kamath PS, Tefferi A. Hepatic veno-occlusive disease (sinusoidal obstruction syndrome) after hematopoietic stem cell transplantation. *Mayo Clin Proc.* 2003 May;78(5):589-98. Review. PubMed PMID: 12744547.
35. Björnsson E. Drug-induced liver injury: Hy's rule revisited. *Clin Pharmacol Ther.* 2006 Jun;79(6):521-8. Review. PubMed PMID: 16765139
36. O'Grady JG, Alexander GJ, Hayllar KM, Williams R. Early indicators of prognosis in fulminant hepatic failure. *Gastroenterology.* 1989 Aug;97(2):439-45. PubMed PMID: 2490426.
37. Björnsson E, Davidsdottir L. The long-term follow-up after idiosyncratic drug-induced liver injury with jaundice. *J Hepatol.* 2009 Mar;50(3):511-7. doi: 10.1016/j.jhep.2008.10.021. Epub 2008 Dec 25. PubMed PMID: 19155082.
38. Mindikoglu AL, Magder LS, Regev A. Outcome of liver transplantation for drug-induced acute liver failure in the United States: analysis of the United Network for Organ Sharing database. *Liver Transpl.* 2009 Jul;15(7):719-29. doi: 10.1002/lt.21692. Erratum in: *Liver Transpl.* 2010 Dec;16(12):1446. PubMed PMID: 19562705.
39. Chalasani N, Bonkovsky HL, Fontana R, Lee W, Stoltz A, Talwalkar J, Reddy KR, Watkins PB, Navarro V, Barnhart H, Gu J, Serrano J; United States Drug Induced Liver Injury Network. Features and Outcomes of 899 Patients With Drug-Induced Liver Injury: The DILIN Prospective Study. *Gastroenterology.* 2015 Jun;148(7):1340-52.e7. doi: 10.1053/j.gastro.2015.03.006. Epub 2015 Mar 6. PubMed PMID: 25754159; PubMed Central PMCID: PMC4446235.
40. Degott C, Feldmann G, Larrey D, Durand-Schneider AM, Grange D, Machayekhi JP, Moreau A, Potet F, Benhamou JP. Drug-induced prolonged cholestasis in adults: a histological semiquantitative study demonstrating progressive ductopenia. *Hepatology.* 1992 Feb;15(2):244-51. PubMed PMID: 1735527.
41. Andrade RJ, Lucena MI, Kaplowitz N, García-Muñoz B, Borraz Y, Pachkoria K, García-Cortés M, Fernández MC, Pelaez G, Rodrigo L, Durán JA, Costa J, Planas R, Barriocanal A, Guarner C, Romero-Gómez M, Muñoz-Yagüe T, Salmerón J, Hidalgo R. Outcome of acute idiosyncratic

- drug-induced liver injury: Long-term follow-up in a hepatotoxicity registry. *Hepatology*. 2006 Dec;44(6):1581-8. PubMed PMID:17133470.
- 42. Bjornsson ES, Jonasson JG. Drug-induced cholestasis. *Clin Liver Dis*. 2013 May;17(2):191-209. doi: 10.1016/j.cld.2012.11.002. Epub 2012 Dec 20. Review PubMed PMID: 23540497.
 - 43. Kleiner DE. Liver histology in the diagnosis and prognosis of drug-induced liver injury. *Clin Liver Dis (Hoboken)*. 2014 Jul 25;4(1):12-16. doi:10.1002/cld.371. eCollection 2014 Jul. Review. PubMed PMID: 30992912; PubMed Central PMCID: PMC6448725.
 - 44. Prescott LF, Park J, Ballantyne A, Adriaenssens P, Proudfoot AT. Treatment of paracetamol (acetaminophen) poisoning with N-acetylcysteine. *Lancet*. 1977 Aug27;2(8035):432-4. PubMed PMID: 70646.
 - 45. Rumack BH, Hess AJ, editors: *Poisindex*, Denver, 1995, Micromedix. Adapted from Rumack BH, Matthew H: Acetaminophen poisoning and toxicity, *Pediatrics* 55:871-876, 1975.)
 - 46. Giannattasio A, D'Ambrosi M, Volpicelli M, Iorio R. Steroid therapy for a case of severe drug-induced cholestasis. *Ann Pharmacother*. 2006 Jun;40(6):1196-9. Epub 2006 May 23. PubMed PMID: 16720710.