Original Article
ISSN (Print) : 0971-6580
ISSN (Online) : 0976-5131

Toxicology International, *Vol 25(2), 124-129, April-June 2018, DOI: 10.18311/ti/2018/v25i2/21736*

Adulteration in the Drug of Abuse: An Autopsy Study on the Prevalence and its Role in Natural Death

A. H. Hasmi, P. S. Lai, K. Subramaniam and M. S. Mahmood

National Institute of Forensic Medicine, Hospital Kuala Lumpur, Jalan Pahang 50586, Kuala Lumpur, Malaysia; kuna0921@yahoo.com

Abstract

Introduction: The number of natural deaths among drug abuser is increasing in number at our centre. We aim to study the prevalence of adulterants and their role in natural deaths. **Methods:** This was a retrospective study of all autopsy cases with positive toxicology results from the year 2014-2016 at the Forensic Medicine Department of Hospital Kuala Lumpur. Cases that died at the ward, resuscitated, decomposed and were excluded. Data for this study were retrieved from the autopsy reports which include the toxicology report. The positive toxicology cases were then categorised into morphine group, amphetamine group and methadone group. The prevalence and relatedness using statistical analysis were computed. **Results and Discussion:** Morphine (18.36%) was the highest prevalent drug of abuse detected from the post-mortem cases. The commonest adulterant seen in our study was chloroquine followed by paracetamol and lidocaine. A significant difference obtained in cross tabulation between respective adulterant and drug of abuse, X^2 (1, N = 80) = 14.159, $p < 0.05$ (CI – 95%) which proves that chloroquine was preferred adulterant in all the drug groups especially in morphine group. The highest number of chloroquine was seen in cases with lung infection and perforated gastric ulcer. Lidocaine was present in the highest number in death related to the heart pathology. **Conclusion:** Adulterants in the drug of abuse is becoming common, with chloroquine leading the list followed by lidocaine at our centre. The effect of adulterants is not negligible. It has a role in the development of natural disease and even deaths.

Keywords: Adulterants, Drug of Abuse, Post-mortem

Key Messages: This study demonstrates the prevalence and types of adulterants in the drug of abuse in our centre. We also studied on the relevance of adulteration and natural death.

1. Introduction

The number of post-mortem cases with positive toxicology is increasing in number at our centre[1]. Not all of them died due to intoxication. Some of them also died from natural diseases. Perforated gastric ulcers, ischaemic heart disease and lung infection were among the leading natural causes of deaths involving the drug abusers[2,3]. Because of this, we start to wonder whether these adulterants of the drugs could have played role in the natural deaths.

Based on our literature search, most common adulterants that were reported include chloroquine, paracetamol, lidocaine, dextromethorphan, phenobarbital, diphenhydramine and caffeine. These adulterants can act as diluents, debulking agents or even cause a synergistic effect. Unfortunately, there weren't much-recorded information about adulterants from the post-mortem cases in Malaysia.

In view of limited information about the adulterants in Malaysia, we studied the adulterants in the drug of abuse from our post-mortem cases. The purpose of this study is to determine the prevalence of adulterants in our centre. We have also analysed the possible interaction between adulterants and the cause of death.

**Author for correspondence*

2. Methods

This was a retrospective study of all autopsy cases with positive toxicology results from the year 2014 to 2016 at the Forensic Medicine Department of Hospital Kuala Lumpur. The inclusion criteria are cases that brought in dead to the mortuary for which their blood and/or urine were sent for toxicology analysis at Chemistry Department, Malaysia. The toxicology tests are done using Enzyme Linked Immunosorbent Assay (ELISA) and Gas Chromatographs with mass selective detectors (GCMS)[4]. The results are quantitative for drugs of abuse and qualitative for adulterants. Cases that died at the ward or resuscitated were excluded. Decomposed and skeletal remains were also excluded. The toxicology samples were collected in a bottle that contained Sodium Fluoride which acts as the preservative. The specimen was sealed and sent to an accredited laboratory at the Chemistry Department, Malaysia. Data for this study was retrieved from the autopsy reports which include the toxicology reports. The positive toxicology cases were categorised either in the morphine group, amphetamine group, or methadone group. Morphine type drugs include heroin, 6-monoacetyl-morphine, morphine, codeine. Amphetamine type drugs include amphetamine, methamphetamine, MDA, MDMA. The results were analysed using descriptive statistics and the relatedness using statistical analysis i.e. chi-square test.

3. Results

From a total of 1832 autopsy cases done at our centre during our study period, there was a total of 290 cases were positive for adulterants or drug of abuse. Adulterants were present in a combination with the drug of abuse in 50 cases. The majority of cases was aged from 16 to 45 years old (62.1%), followed by more than 45 years old (33.5%) and less than 16 years old (4.4%). 255 cases (88.2%) with positive toxicology results were Malaysian and the rest were foreigners. The male dominates with 285 cases.

Morphine group (18.36%) was the highest prevalent drug of abuse followed by a combination of morphine

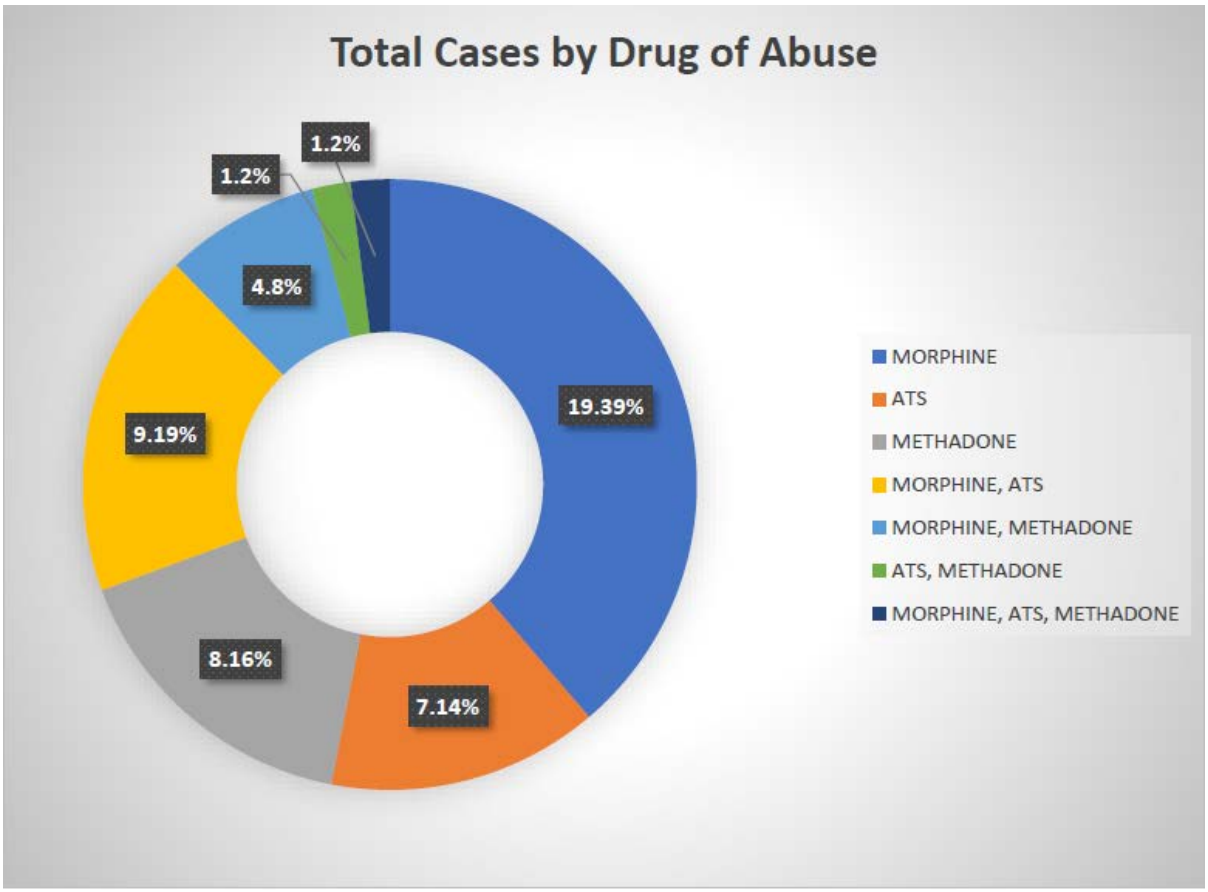


Figure 1. Total cases categorised by drug of abuse.

group and amphetamine-type group (11.22%). The combination of all the groups was the lowest with only 1.2% (Figure 1). The commonest adulterant seen in our study was chloroquine, which was present in 35 cases (Figure 2). The second commonest was paracetamol and followed by lidocaine. In our studied cases, chloroquine was frequently detected in a combination with other drugs such as theophylline, lidocaine or tramadol, paracetamol, diclofenac, metoclopramide and chlorpheniramine. There were also cases in which adulterants were present in blood and/or urine without drug of abuse. In this category, chloroquine was recorded in 10 cases whereas lidocaine was detected in 12 cases.

A significant difference obtained in cross tabulation between respective adulterant and drug of abuse, X^2 (1, N = 80) = 14.159, $p < 0.05$ on 3 degrees of freedom (CI-95%). There is a preference of chloroquine in the morphine group (Table 1). Lidocaine is seen almost equally in all the three categories. Overall, we deduce that chloroquine is preferred adulterant in all the drug groups especially morphine group.

The cause of death was solely related to the drug of abuse in 14 cases. Road traffic deaths recorded 8 cases while 17 cases of positive toxicology were natural deaths. 6 of the natural deaths were due to ischaemic heart diseases and another 6 died due to lungs infection. Homicide accounted for 8 cases, comprised of blunt trauma (5 cases), stab wound (3 cases) and 1 due to blast injuries. Two cases of suicidal hanging also had positive toxicology (Figure 3). The highest numbers of chloroquine were seen in cases with the lung infection and perforated gastric ulcer. Lidocaine was present in the highest number in death related to the heart pathology. Five ischaemic heart disease and two myocardial infarction cases were associated with the presence of lidocaine in the blood and/or urine (Figure 4).

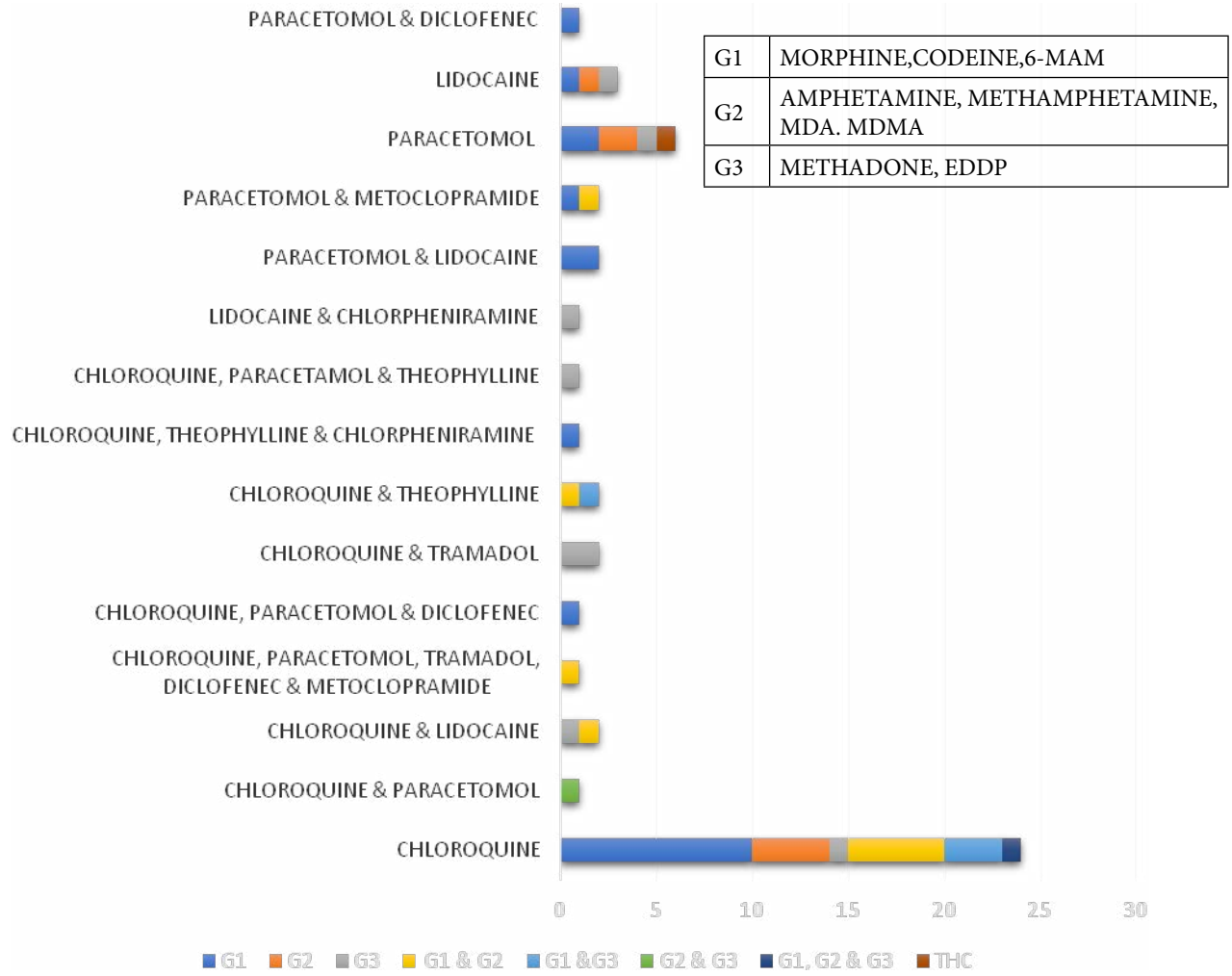


Figure 2: Types of adulterants in the post-mortem cases from the year 2014–2016.

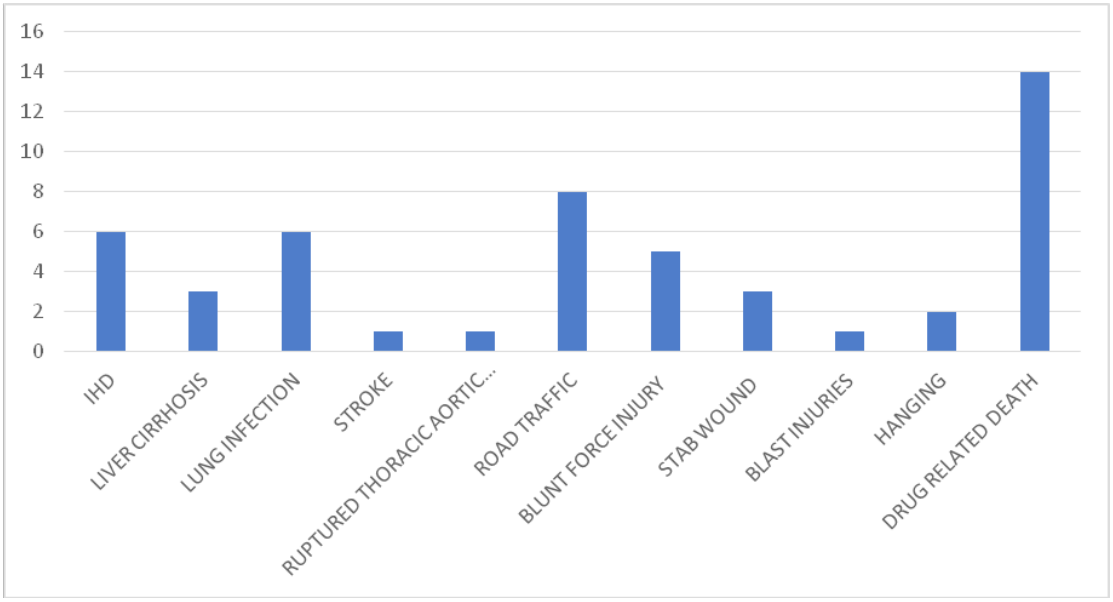


Figure 3. Cause of death with positive toxicology from the year 2014-2016.

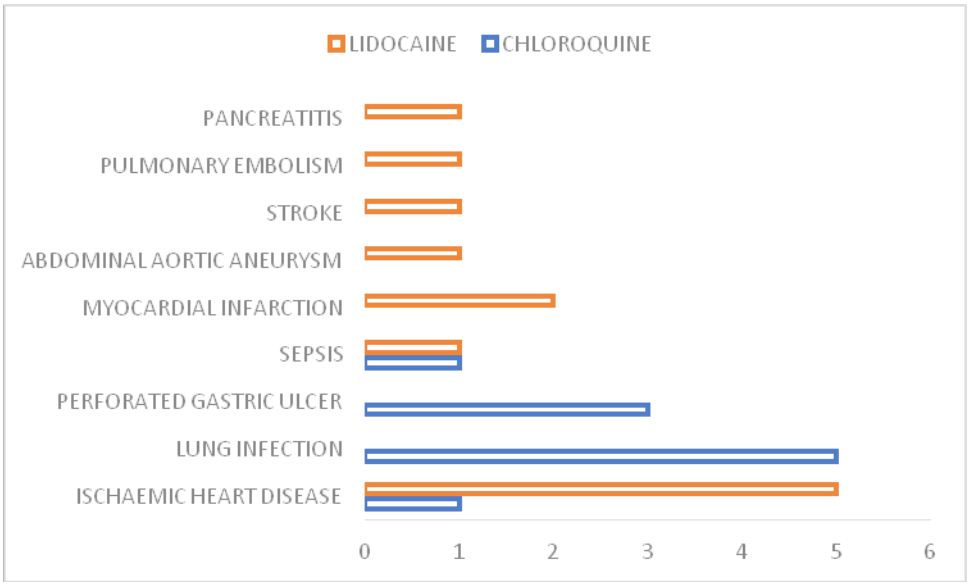


Figure 4. Causes of death and types of adulterants.

Table 1. Adulterant drug group cross-tabulation

			Drug_Group				Total
			No Drug of Abuse	Morphine Group	Amphetamine Group	Methadone Group	
Adulterant	Chloroquine	Count	10	25	14	11	60
		% of Total	12.5%	31.2%	17.5%	13.8%	75.0%
	Lidocaine	Count	12	4	2	2	20
		% of Total	15.0%	5.0%	2.5%	2.5%	25.0%
Total		Count	22	29	16	13	80
		% of Total	27.5%	36.2%	20.0%	16.2%	100.0%

4. Discussion

The rise in the drug of abuse over the years is clearly evident from our post-mortem cases. In the year of 2014, 68 cases of drug abuse detected and it was almost two-fold in 2016, despite no rise in the total autopsy cases. The commonest drugs of abuse were morphine group and amphetamine type stimulants. This is consistent with Malaysian drug agency report published in 2016 which recorded 85.29% of total drug abusers prefer morphine group or amphetamine type stimulants[1]. There was also no case of cocaine abuse was detected in the particular years[1].

The use of adulterants in the production of heroin is not new. A number of substances that are typically used as adulterants are ethanol, diethyl ether, concentrated hydrogen chloride, activated charcoal, sodium carbonate, ammonium chloride, acetic anhydride and chloroquine[5–11]. The use of chloroquine as adulterants in heroin is popular because of the similar bitter taste and the respiratory rush felt by injection heroin users[12]. For the therapeutic purpose, chloroquine mainly used to treat malaria infection. Despite its medicinal use, it has been known for several complications. Among them are the acute renal failure, cinchonism, gastric disturbances, thrombosis and hypotension with intravenous use, blindness and even death.

In our study, chloroquines are commonly seen in lung infection deaths. Although we could not directly link the use of choloroquine to lung infection, we believe that the source of lung infection could arise from the contamination during morphine preparation. We believe that the unhygienic preparation and contaminated tools contributed to the lung infection deaths among the drug abusers. In addition to lung infection, chloroquines are also detected in a number of deaths due to perforated gastric ulcers. Gastric ulcers have been reported among people who take quinine for therapeutic purpose[13]. The association of quinine and gastric ulcer have been proved in animal studies. Laboratory experiments using rats have demonstrated that quinine delays ulcer healing by prolonging the inflammatory phase of healing, increasing oxidative stress, reducing antioxidant activity and gastric mucus secretion[14]. This could be one of the reasons why 3 of our cases associated with chloroquine died due to perforated gastric ulcers.

Lidocaine is also commonly detected in our cases. The therapeutic functions of lidocaine are mainly as a local anaesthetic and antiarrhythmic. Few literatures have reported the use of lidocaine as an adulterant in heroin, cocaine and amphetamine[15–17]. From our study, we found that lidocaine was present in the morphine group and amphetamine group.

In cases with lidocaine, 8 cases died due to either ischaemic heart disease or myocardial infarction. The association of lidocaine and heart related deaths have been reported previously. A meta-analysis study suggested that prophylactic lidocaine administration might actually increase mortality due to pump failure or asystole, despite most of the studies reported that administration of lidocaine prevents ventricular fibrillation that occurs during and shortly after myocardial infarction[18]. Haigney et al., have also reported on the effects of supratherapeutic concentrations of lidocaine. Higher levels of lidocaine may increase sodium channel blockade and subsequently reduce ischaemic sodium accumulation and sodium-dependent calcium loading[19]. Therefore, a higher level of lidocaine could actually worsen the heart condition in which we presumed that could have happened in our cases.

There were some limitations to this study. The adulterants in the blood and/or urine were not quantified. Therefore, we were not able to study the direct toxicity of the adulterants. Also, the cases which came through the Emergency Department were excluded. Adulterants might be present in these cases, but we were not able to distinguish them.

5. Conclusion

Adulterants in the drug of abuse are becoming common, with chloroquine leading the list followed by lidocaine at Forensic Medicine Department, Hospital Kuala Lumpur. These adulterants have deleterious effect on health and have been associated with natural deaths. Future studies should investigate on the causation between adulterants and natural deaths including the direct toxicity of adulterants.

6. Conflict of Interest

None.

7. Source of Funding

Self funding.

8. Ethical Clearance

No ethical approval is required as the data were utilized without any clinical intervention.

9. References

1. National Drug Agency: Drug Information. Home Ministry Malaysia; 2016.
2. Kaye S, Darke S, Duflou J, McKetin R. Methamphetamine-related fatalities in Australia: Demographics, circumstances, toxicology and major organ pathology. Addiction. 2008; 103:1353–60. PMid: 18855825. https://doi.org/10.1111/j.1360-0443.2008.02231.x
3. Bartu A, Freeman NC, Gawthorne GS, Codde JP, Holman CD. Mortality in a cohort of opiate and amphetamine users in Perth, Western Australia. Addiction. 2004; 99:53–60. PMid: 14678062. https://doi.org/10.1111/j.1360-0443.2004.00602.x
4. Chemistry Department Malaysia. 2018. http://www.kimia.gov.my
5. Andreasen MF, Lindholst C, Kaa E. Adulterants and diluents in heroin, amphetamine, and cocaine found on the illicit drug market in Aarhus, Denmark. The Open Forensic Science Journal. 2009; 2:16–20. https://doi.org/10.2174/1874402800902010016
6. Akhgari M, Moradi F, Ziarati P. The texture of psychoactive illicit drugs in Iran: Adulteration with lead and other active pharmaceutical ingredients. Journal of Psychoactive Drugs. 2018; 50(5):451–9. PMid: 30130472. https://doi.org/10.1080/02791072.2018.1508791
7. Akhgari M, Etemadi-Aleagha A, Jokar F. Street level heroin, an overview on its components and adulterants. Neuropathology of Drug Addictions and Substance Misuse. 2016; 1:867–77. https://doi.org/10.1016/B978-0-12-800213-1.00081-X
8. Masoodi M, Zali MR, Ehsani-Ardakani MJ, Mohammad-Alizadeh AH, Aiassofi K, Aghazadeh R, Shavakhi A, Somi MH, Antikchi MH, Yazdani S. Abdominal pain due to lead-contaminated opium: A new source of inorganic lead poisoning in Iran. Archives of Iranian Medicine. 2006; 9:72–5.
9. Verheij J, van Nieuwkerk CMJ, Jarbandhan SVA, Mulder CJJ, Bloemena E. Hepatic morphopathologic findings of lead poisoning in a drug addict: A case report. Journal of Gastrointestinal & Liver Diseases. 2009; 18:225–7.
10. Dunbar NM, Harruff RC. Necrotizing fasciitis: Manifestations, microbiology and connection with black tar heroin. Journal of Forensic Sciences. 2007; 52:920–3. PMid: 17524065. https://doi.org/10.1111/j.1556-4029.2007.00452.x
11. Kalka-Moll WM, Aurbach U, Schaumann R, Schwarz R, Seifert H. Wound botulism in injection drug users. Emerging Infectious Diseases. 2007; 13:942–3. PMid: 17582887 PMCid: PMC2792833. https://doi.org/10.3201/eid1306.061336
12. Furst RT. The re-engineering of heroin: An emerging heroin "cutting" trend in New York City. Addiction Research & Theory. 2000; 8:357–79. https://doi.org/10.3109/16066350009009521
13. Will you have Gastric ulcer with Quinine - from FDA reports - eHealthMe. 2018 Jun. https://www.ehealthme.com/ds/quinine/gastric-ulcer/
14. Adeniyi OS, Makinde OV, Friday ET, Olaleye SB. Effects of quinine on gastric ulcer healing in Wistar rats. J Complement Integr Med. 2017; 29;14. PMid: 28665790. https://doi.org/10.1515/jcim-2016-0132
15. Chaudron-Thozet H, Girard J, David JJ. Analysis of heroin seized in France. Bulletin on Narcotics. 1992; 44:29–33.
16. Bernardo NP, Siqueria MEPB, de Paiva MJN, Maia PP. Caffeine and other adulterants in seizures of street cocaine in Brazil. International Journal of Drug Policy. 2003; 14:331–4. https://doi.org/10.1016/S0955-3959(03)00083-5
17. Decorte T. Quality control by cocaine users: Underdeveloped harm reduction strategies. European Addiction Research. 2001; 7:161–75. PMid: 11752847. https://doi.org/10.1159/000050737
18. Hine LK, Laird N, Hewitt P, Chalmers TC. Meta-analytic evidence against prophylactic use of lidocaine in acute myocardial infarction. Arch Intern Med. 1989; 149:2694–8. PMid: 2688587. https://doi.org/10.1001/archinte.149.12.2694
19. Haigney MC, Lakatta EG, Stern MD, Silverman HS. Sodium channel blockade reduces hypoxic sodium loading and sodium-dependent calcium loading. Circulation. 1994; 90:391–9. PMid: 8026023. https://doi.org/10.1161/01.CIR.90.1.391