ISSN 2307-8960 (online)

World Journal of *Clinical Cases*

World J Clin Cases 2017 October 16; 5(10): 373-389

Published by Baishideng Publishing Group Inc

WJCC

World Journal of Clinical Cases

A peer-reviewed, online, open-access journal of Clinical Cases

Editorial Board

2017-2020

The *World Journal of Clinical Cases* Editorial Board consists of 509 members, representing a team of worldwide experts in clinical medical research. They are from 57 countries, including Afghanistan (2), Albania (1), Australia (7), Austria (1), Bangladesh (3), Belgium (3), Brazil (9), Bulgaria (1), Canada (12), China (46), Colombia (2), Croatia (3), Egypt (5), France (3), Germany (12), Greece (15), Hungary (2), India (54), Indonesia (1), Iran (13), Iraq (1), Ireland (1), Israel (5), Italy (57), Japan (34), Jordan (1), Kazakhstan (1), Kuwait (1), Lebanon (2), Malaysia (1), Mexico (1), Morocco (2), Nepal (1), Netherlands (2), New Zealand (2), Nigeria (1), Oman (1), Pakistan (1), Peru (1), Poland (4), Portugal (3), Qatar (1), Romania (3), Saudi Arabia (4), Serbia (4), Singapore (3), Slovakia (2), Slovenia (1), South Korea (27), Spain (9), Sudan (1), Thailand (2), Trinidad and Tobago (1), Tunisia (1), Turkey (29), United Kingdom (22), United States (82).

China

Shiu-yin Cho, *Hong Kong*
Lian Duan, *Beijing*
David Harold Garfield, *Shanghai*
Yong-Song Guan, *Chengdu*
Guo-Rong Han, *Nanjing*
Bin Jiang, *Beijing*
Alice Pik Shan Kong, *Hong Kong*
Fung Yee Janet Lee, *Hong Kong*
Jian-Jun Li, *Beijing*
Dezhi Mu, *Chengdu*
Simon SM Ng, *Hong Kong*
Huai-Yin Shi, *Beijing*
Su-Sheng Shi, *Beijing*
Xue-Ying Sun, *Harbin*
Xue-Rui Tan, *Shantou*
Feng Wang, *Shanghai*
Gang Wang, *Chengdu*
Niansong Wang, *Shanghai*
Ge Xiong, *Beijing*
Zheng-Feng Yin, *Shanghai*
Shao-Ping Yu, *Dongguan*
Qing Zhang, *Jingzhou*
Ming-Hua Zheng, *Wenzhou*
Jun Zhong, *Shanghai*
Yan-Ming Zhou, *Xiamen*

Colombia

Carlos A Calderon-Ospina, *Bogota*
Ivan Dario Velez Bernal, *Medellin*

Croatia

Srdana Culic, *Split*
Tomislav Kulis, *Zagreb*
Zvonimir Lovric, *Zagreb*

Egypt

RA Ali, *Mansoura*
Farid S El-Askary, *Cairo*
Sherifa A Hamed, *Assiut*
Ahmad Abd-Elgawad Nofal, *Zagazig*
Mohamed I Seleem, *Cairo*

France

Isabelle Andrée Chemin, *Lyon*
Jean-Francois Emile, *Boulogne*
Christophe Martinaud, *Clamart*

Germany

Sebastian Decker, *Hannover*
Michael Froehner, *Dresden*
Arndt Hartmann, *Erlangen*
Dirk M Hermann, *Essen*
Karl-Anton Kreuzer, *Berlin*
Wolf C Mueller, *Leipzig*
Andres HM Neuhaus, *Berlin*
Ingo S Nolte, *Mannheim*
Martin P Schencking, *Witten*
Hans-Joachim Schmoll, *Halle*
Andreas G Schreyer, *Regensburg*
Mathias Z Strowski, *Berlin*

Greece

Andrew P Andonopoulos, *Patras*
Dimitrios Daoussis, *Patras*
Ioanna Dimopoulou, *Athens*
Moses S Elisaf, *Ioannina*
Costas Fourtounas, *Rio-Patras*
Olga-Elpis Kolokitha, *Thessaloniki*
Marilita M Moschos, *Athens*
Nikolaos Papanas, *Alexandroupolis*
Athanasios G Papatsoris, *Athens*
Panagiotis Peitsidis, *Athens*
Zervoudis Stephane, *Athens*
Konstantinos Tepetes, *Larissa*
Apostolos Tsapas, *Thessaloniki*
Michail N Varras, *Athens*
Dimitrios Vavilis, *Thessaloniki*

Hungary

Andreas M Fette, *Budapest*
Tibor Hortobagyi, *Debrecen*

India

Subrat K Achaya, *New Delhi*
Amit A Agrawal, *Nasik*
Hena A Ansari, *Aligarh*
M S Ansari, *Meerut*
Ashu S Bhalla, *New Delhi*
Laxminarayan Bhandari, *Calicut*
Sachin A Borkar, *New Delhi*
Bhuvan Chanana, *New Delhi*
Kanishka Das, *Bangalore*
Reena Das, *Chandigarh*
Deep Dutta, *Delhi*
Mimi Gangopadhyay, *Siliguri*
Rakesh Garg, *New Delhi*
Sandeep Grover, *Chandigarh*
Meena Gupta, *New Delhi*
Mahendra S Hada, *Kota*
Produl Hazarika, *Manipal*
Sachin B Ingle, *Latur*
S Jayaprakash, *Kerala*
Parwez S Khan, *Srinagar*
Vivek Balkrishna Kute, *Ahmedabad*
Amol Lunkad, *Pune*
Nikhil Marwah, *Jaipur*
Amit K Mishra, *Indore*
Soma Mukherjee, *Bombay*
Deb S Nag, *Jamshedpur*
Kushal Naha, *Manipal*
Janardhanan C Narayanaswamy, *Bangalore*
Soubhagya R Nayak, *Mangalore*
Narendra Pamidi, *Karnataka*
Samir K Praharaj, *Karnataka*
Peralam Y Prakash, *Manipal*
C S Pramesh, *Mumbai*
Kishore Puthezhath, *Kerala*
Harbans S Randhawa, *Delhi*
Muthukumaran Rangarajan, *Coimbatore*
Sayantan Ray, *Kolkata*
Bharat Rekhi, *Bombay*
Dhananjaya Sabat, *New Delhi*
B Saha, *Calcutta*
Sachin C Sarode, *Pune*
J Sharma, *Udaipur*
Hakim Irfan Showkat, *Delhi*
Rikki Singal, *Mullana*
Deepak K Singh, *Jaipur*
Shyam Sundar, *Varanasi*
Naveen S Tahasildar, *Chandigarh*
Devinder M Thappa, *Pondicherry*
Pradeep Vaideeswar, *Bombay*
Murali P Vettath, *Kozhikode*
Mukul Vij, *Chennai*
Rajesh Vijayvergiya, *Chandigarh*
Sanjay Vikrant, *Shimla*
B Viswanatha, *Bangalore*

Indonesia

Coen Pramono, *Surabaya*

Iran

Masoud Amiri, *Shahrekord*
Seyyed A Ayatollahi Mousavi, *Kerman*
Mostafa Ghanei, *Tehran*
Setareh Mamishi, *Tehran*
Afshin Mohammadi, *Urmia*
Taher Mohammadian, *Tehran*
Mohammad T Rajabi, *South Kargar*
Amin Saburi, *Tehran*
Maryam Sahebari, *Mashhad*
Iman Salahshourifar, *Tehran*
Payman Vahedi, *Tehran*
Amir R Vosoughi, *Shiraz*

Iraq

Bassim I Mohammad, *Al-Qadisiya*

Ireland

Robbie SR Woods, *Dublin*

Israel

Nimer Assy, *Safed*
Gil Bar-Sela, *Haifa*
Itzhak Braverman, *Hadera*
Gary M Ginsberg, *Jerusalem*
Eyal Itshayek, *Jerusalem*

Italy

Giovanni Addolorato, *Rome*
Piero L Almasio, *Palermo*
Francesco Angelico, *Rome*
Marialuisa Appetecchia, *Rome*
Valeria Barresi, *Messina*
Gabrio Bassotti, *San Sisto*
Paolo Boffano, *Aosta*
Maria Luisa Brandi, *Florence*
Michelangelo Buonocore, *Pavia*
Giovanni Cammarota, *Rome*
Andrea Ciorba, *Ferrara*
Lucio Cocco, *Bologna*
Carlo Colosimo, *Rome*
Alfredo Conti, *Messina*
Giovanni Conzo, *Napoli*
Gennaro Cormio, *Bari*
Fabrizio D'Ascenzo, *Turin*
Luigi De Gennaro, *Rome*
Elia De Maria, *Modena*
Isidoro Di Carlo, *Catania*
Alessandro Federico, *Naples*
Gabriella M Ferrandina, *Campobasso*
Davide Firinu, *Cagliari*
Francesco Formica, *Monza*
Caterina Foti, *Bari*
Gennaro Galizia, *Naples*
Silvio Garattini, *Milan*
Giampietro Gasparini, *Roma*
Giorgio Ghilardi, *Milan*
Domenico Girelli, *Verona*
Carlo Lajolo, *Rome*
Alessandro Landi, *Rome*
Salvatore Leonardi, *Catania*
Carmela Loguercio, *Naples*
Marianna Luongo, *Potenza*
Roberto Manfredini, *Ferrara*
Annunziato Mangiola, *Rome*
Marco Mazzocchi, *Rome*
Roberto L Meniconi, *Rome*
Marco Milone, *Naples*
Paolo Nozza, *Genoa*
Pier P Panciani, *Brescia*
Desire' Pantalone, *Firenze*
Ilaria Peluso, *Rome*
Raffaele Pezzilli, *Bologna*
Giorgina B Piccoli, *Torino*
Roberto Pola, *Rome*
Marco Romano, *Naples*
Gianantonio Saviola, *Mantua*
Stefania Scala, *Naples*
Leonardo A Sechi, *Udine*
Leonello Tacconi, *Trieste*
Matteo Tebaldi, *Ferrara*
Riccardina Tesse, *Bari*
Tiziano Testori, *Milano*
Maddalena Zippi, *Rome*
Gianvincenzo Zuccotti, *Milan*

Japan

Ukei Anazawa, *Chiba*
Junichi Asaumi, *Okayama*
Takashi Asazuma, *Saitama-ken*
Norihiro Furusyo, *Fukuoka*
Kunihiko Hiraiwa, *Shizuoka*
Masaru Ishida, *Tokyo*
Tatsuaki Ishiguro, *Tokyo*
Hajime Isomoto, *Nagasaki*
Keita Kai, *Saga*
Terumi Kamisawa, *Tokyo*
Tatsuo Kanda, *Niigata*
Yuichi Kasai, *Tsu city*
Shigeyuki Kawa, *Matsumoto*
Kazushi Kishi, *Wakayama*
Satoru Kyo, *Ishikawa*
Nozomi Majima, *Takatsuki*
Kenji Miki, *Tokyo*
K Mizumoto, *Fukuoka*
Ryuichi Morishita, *Suita*
Atsushi Nakajima, *Yokohama*
Yuzuru Niibe, *Kanagawa*
Rui Niimi, *Mie Prefecture*
Masaharu Nomura, *Tokyo*
Yosuke Sato, *Niigata*
Boban Stanojevic, *Nagasaki*
Mitsushige Sugimoto, *Shiga*
Haruhiko Sugimura, *Hamamatsu*
Keisuke Uehara, *Aichi*
Manabu Watanabe, *Tokyo*
Takayuki Yamamoto, *Mie*
Junkichi Yokoyama, *Tokyo*
Yoshihito Yokoyama, *Aomori*
Kiyoshi Yoshino, *Osaka*

Jordan

Khaled M Sarraf, *Amman*

Kazakhstan

Sandro Vento, *Astana*

Kuwait

Naorem G Singh, *Jahra*

Lebanon

Kassem A Barada, *Beirut*
Raja Sawaya, *Beirut*

Malaysia

Mohamad N Shafiee, *Kuala Lumpur*

Mexico

Ernesto Roldan-Valadez, *Mexico*

Morocco

Alae El Koraichi, *Rabat*
Faycal Lakhdar, *Rabat*

Nepal

Laxmi V Ghimire, *Kathmandu*

Netherlands

Jan Jacques Michiels, *Rotterdam*
Paul E Sijens, *Groningen*

New Zealand

Rita R Krishnamurthi, *Auckland*
K Yun, *Dunedin*

Nigeria

Shamsideen A Ogun, *Ikorodu*

Oman

Itrat Mehdi, *Muscat*

Pakistan

Sabiha Anis, *Karachi*

Peru

Eduardo Gotuzzo, *Lima*

Poland

Lukasz S Matuszewski, *Lublin*
Tadeusz Robak, *Lodz*
Adam Wysokinski, *Lodz*
Witold A Zatonski, *Warsaw*

Portugal

Jorge Alves, *Braga*
Gustavo M Rocha, *Oporto*
Zacharoula Sidiropoulou, *Lisbon*

Qatar

Fahmi Y Khan, *Doha*

Romania

Simona Gurzu, *Targu Mures*
Doina Piciu, *Cluj*
Mugurel C Rusu, *Bucharest*

Saudi Arabia

Ahmed Alkhani, *Riyadh*

Iqbal A Bukhari, *Al Khobar*
Mohamed F Ibrahim, *Riyadh*
Yashpal Singh, *Al Qassim*

Serbia

Ivona M Djordjevic, *Nish*
Jelena L Lazic, *Belgrade*
Momcilo Pavlovic, *Subotica*
Mihailo I Stjepanovic, *Belgrade*

Singapore

Wei-Sheng Chong, *Singapore*
Khek-Yu Ho, *Singapore*
Yong Kuei Lim, *Singapore*

Slovakia

Michal Mego, *Bratislava*
Pavel Skok, *Maribor*
Ivan Varga, *Bratislava*

South Korea

Young-Seok Cho, *Seoul*
Tae Hyun Choi, *Seoul*
Yeun-Jun Chung, *Seoul*
Ki-Baik Hahm, *Seongnam*
Seung-Jae Hyun, *Gyeonggi Do*
Soo Bin Im, *Kyungki Do*
Soung Won Jeong, *Seoul*
Choun-Ki Joo, *Seoul*
Chang Moo Kang, *Seoul*
Byung-Wook Kim, *Incheon*
Gwi Eon Kim, *Seoul*
Gyeong-Moon Kim, *Seoul*
Hahn Young Kim, *Seoul*
Myoung Soo Kim, *Seoul*
Seung Taik Kim, *Cheongju*
Won Seog Kim, *Seoul*
Yoon Jun Kim, *Seoul*
Yun-Hee Kim, *Seoul*
Sun-Young Lee, *Seoul*
Sang-Chul Lim, *Kwangju*
Seung Sam Paik, *Seoul*
Jae Yong Park, *Taegu*
Jong-Ho Park, *Goyang*
Jun-Beom Park, *Seoul*
Chan Sup Shim, *Seoul*
Hae Ryong Song, *Seoul*
Hwa-Seung Yoo, *Daejeon*

Spain

Manuel Benito, *Madrid*
Vicente Carreno, *Madrid*
Rosa Corcoy, *Barcelona*
Exuperio Díez-Tejedor, *Madrid*
Carlos Alberto Dussan Luberth, *Torrevieja*
Sergio Fernandez-Pello Montes, *Gijon*
Luis I Gonzalez-Granado, *Madrid*
Juan D Molina Martin, *Madrid*
Tomas Sobrino, *Compostela*

Sudan

Samir MH Shaheen, *Khartoum*

Thailand

Sarunyou Chusri, *Songkhal*
Weekitt Kittisupamongkol, *Bangkok*

Trinidad and Tobago

Dale A Maharaj, *Trincity*

Tunisia

Makram Koubaa, *Sfax*

Turkey

Sami Akbulut, *Malatya*
Tamer Akca, *Mersin*
Cengiz Akkaya, *Bursa*
Ahmet Baydin, *Kurupelit*
Hasan Belli, *Istanbul*
Serbülent G Beyaz, *Sakarya*
Güldeniz K Cakmak, *Kozlu Zonguldak*
Turgay Celik, *Ankara*
Yasemin B Cihan, *Kayseri*
Omür Dereci, *Ankara*
Mehmet Doganay, *Kayseri*
Aylin T Ermertcan, *Manisa*
Kadir Ertem, *Malatya*
Aydin Gulses, *Ankara*
Mustafa K Gumus, *Kayseri*
F. Neslihan Inal-Emiroglu, *Izmir*
Ramazan Kahveci, *Kirikkale*
Saadettin Kilickap, *Ankara*
Fatih Kucukdurmaz, *Istanbul*
Aslihan Kucuker, *Ankara*
Nuray B Muluk, *Cankaya*
Orhan V Ozkan, *Sakarya*
Zeynep Ozkurt, *Istanbul*
Mustafa Sahin, *Ankara*
Ibrahim Sakcak, *Ankara*
Feyzi B Sarica, *Adana*
Ilke Sipahi, *Istanbul*
Selim Sozen, *Kayseri*
Murat Ugurlucan, *Istanbul*

United Kingdom

Henry DE Atkinson, *London*
Ioannis G Baraboutis, *Peterborough*
I Beegun, *London*
Roy G Beran, *Liverpool*
Ricky H Bhogal, *Birmingham*
Kuntal Chakravarty, *Essex*
Deyaa Elsandabesee, *Great Yarmouth*
Radwan Faraj, *South Yorkshire*
Babatunde A Gbolade, *Leeds*
Sanju George, *Birmingham*
David JA Goldsmith, *London*
Nadey S Hakim, *London*
Koshy Jacob, *Manchester*
Andrew RL Medford, *Leicester*
Rahul T Rao, *London*
Francis P Rugman, *Preston*
Crispin Schneider, *Nottingham*
Yousef Shahin, *Hull*
Badri M Shrestha, *Sheffield*
Jagdeep S Virk, *Harrow*
James CL Wong, *Manchester*
Kimia Ziahosseini, *Liverpool*

United States

Doru T Alexandrescu, *New York*
Naim Alkhouri, *Cleveland*
Mohammad M Alsolaiman, *Lehi*
Bhupinder S Anand, *Houston*
Suresh J Antony, *El Paso*
Normadeane Armstrong, *New York*
Wilbert S Aronow, *Valhalla*
Hossam M Ashour, *Detroit*
Rajendra Badgaiyan, *Buffalo*
Joseph R Berger, *Lexington*
Dennis A Bloomfield, *New York*
Neil F Box, *Aurora*
Jeffrey A Breall, *Indianapolis*
Susana M Campos, *Boston*
Robert Carter III, *San Antonio*
Kaisorn L Chaichana, *Baltimore*
Antonio J Chamoun, *Thorndale*
Vince P Clark, *Albuquerque*
C. Donald Combs, *Norfolk*
Suzanne M Crumley, *Houston*
Alain Cruz Portelles, *Plantation*
Parakkal Deepak, *Evanston*
Dale Ding, *Charlottesville*
Yuchuan Ding, *Detroit*
Konstantin H Dragnev, *Lebanon*
Cecilia L Dragomir, *New York*
Konstantinos P Economopoulos, *Boston*
James M Ford, *Stanford*
Yun Gong, *Houston*
Zeba H Hafeez, *Las Vegas*
Ardeshir Hakam, *Tampa*
T. Patrick Hill, *New Brunswick*
Hitoshi Hirose, *Philadelphia*
Elias Jabbour, *Houston*
Robert T Jensen, *Bethesda*
Huanguang Jia, *Gainesville*
Zhong Jiang, *Worcester*
Theodoros Kelesidis, *Los Angeles*
Kusum K Kharbanda, *Omaha*
Praveen Kumar, *Chicago*
Julius GS Latorre, *Syracuse*
Guojun Li, *Houston*
Sophia Lionaki, *Chapel Hill*

World Journal of Clinical Cases

Contents

Monthly Volume 5 Number 10 October 16, 2017

MINIREVIEWS

CASE REPORT

World Journal of Clinical Cases
Volume 5 Number 10 October 16, 2017

Contents

NAME OF JOURNAL
World Journal of Clinical Cases

ISSN
ISSN 2307-8960 (online)

LAUNCH DATE
April 16, 2013

FREQUENCY
Monthly

EDITORIAL OFFICE
Xiu-Xia Song, Director
World Journal of Clinical Cases
Baishideng Publishing Group Inc
7901 Stoneridge Drive, Suite 501, Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: editorialoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com

PUBLISHER
Baishideng Publishing Group Inc
7901 Stoneridge Drive,
Suite 501, Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com

PUBLICATION DATE
October 16, 2017

INSTRUCTIONS TO AUTHORS
http://www.wjgnet.com/bpg/gerinfo/204

ONLINE SUBMISSION
http://www.f6publishing.com

World Journal of Clinical Cases

Submit a Manuscript: http://www.f6publishing.com

World J Clin Cases 2017 October 16; 5(10): 373-377

DOI: 10.12998/wjcc.v5.i10.373

ISSN 2307-8960 (online)

MINIREVIEWS

Adrenal ganglioneuroma: What you need to know

Konstantinos S Mylonas, Dimitrios Schizas, Konstantinos P Economopoulos

Konstantinos S Mylonas, Division of Pediatric Surgery, Massachusetts General Hospital, Harvard Medical School, Boston, MA 02114, United States

Konstantinos S Mylonas, Dimitrios Schizas, Konstantinos P Economopoulos, Surgery Working Group, Society of Junior Doctors, 11852 Athens, Greece

Dimitrios Schizas, First Department of Surgery, Laiko General Hospital, National and Kapodistrian University of Athens, 11527 Athens, Greece

Konstantinos P Economopoulos, Department of Surgery, Duke University Medical Center, Durham, NC 27710, United States

Author contributions: Mylonas KS, Schizas D and Economopoulos KP designed the study; Mylonas KS collected the data; Mylonas KS drafted the manuscript; Mylonas KS, Schizas D and Economopoulos KP critically revised the manuscript; Economopoulos KP supervised this study.

Conflict-of-interest statement: The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Manuscript source: Invited manuscript

Correspondence to: Konstantinos P Economopoulos, MD, PhD, General Surgery Resident, Department of Surgery, Duke University Medical Center, 2301 Erwin Rd., Durham, NC 27710, United States. economopoulos@sni.gr
Telephone: +1-617-5104641

Received: April 26, 2017
Peer-review started: April 26, 2017
First decision: May 23, 2017
Revised: June 14, 2017
Accepted: July 7, 2017
Article in press: July 7, 2017
Published online: October 16, 2017

Abstract

Adrenal ganglioneuromas (GNs) constitute rare, differentiated tumors which originate from neural crest cells. GNs are usually hormonally silent and tend to be discovered incidentally on imaging tests. Adrenalectomy is the gold standard for the treatment of primary adrenal GNs. Nevertheless, preoperative differential diagnosis of GNs remains extremely challenging, and thus histopathological examination is required in order to confirm the diagnosis of GN. Overall, prognosis after surgical resection seems to be excellent, without any recurrences or need for adjuvant therapy.

Key words: Ganglioneuroma; Neurogenic tumors; Neural crest; Adrenalectomy

Core tip: Adrenal ganglioneuromas (GNs) are uncommon, differentiated tumors which originate from neural crest cells. These lesions are usually discovered incidentally because they tend to be hormonally silent. Even though, surgery is the gold standard for the treatment of adrenal GNs, the process of preoperative differential diagnosis remains extremely challenging. Therefore, histologic examination is necessary in order to confirm this rare diagnosis. In general, there is no need for adjuvant treatment and the overall prognosis of these patients is excellent.

Mylonas KS, Schizas D, Economopoulos KP. Adrenal ganglioneuroma: What you need to know. *World J Clin Cases* 2017; 5(10): 373-377 Available from: URL: http://www.wjgnet.com/2307-8960/full/v5/i10/373.htm DOI: http://dx.doi.org/10.12998/wjcc.v5.i10.373

INTRODUCTION

Ganglioneuromas (GNs) constitute rare, differentiated tumors which originate from neural crest cells[1]. As such, they are usually located in the retroperitoneal space (32%-52%) or in the posterior mediastinum (39%-43%). Less commonly, GNs can be seen in the cervical region (8%-9%) as well[2,3]. Interestingly enough, thoracic tumors have been found to be larger than non-thoracic ones at the time of diagnosis[4]. Adrenal GNs occur most frequently in the fourth and fifth decades of life, whereas GNs of the retroperitoneum and posterior mediastinum are usually encountered in children and younger adults. GNs seem to develop in females and males with equal rates; yet most of our data derive from case reports or small case series[5-7]. Nonetheless, a familial predisposition as well as an association with Turner syndrome and multiple endocrine neoplasia Ⅱ have also been suggested[5].

Commonly, adrenal GNs are hormonally silent and as a result can be asymptomatic; even when the lesion is of substantial size[5,8]. On the other hand, it has been reported that up to 30% of patients with GNs may have elevated plasma and urinary catecholamine levels, but without exhibiting any symptoms of catecholamine excess[4]. Additionally, it has been noted that ganglion cells can secrete vasoactive intestinal peptide (VIP), whilst pluripotent precursor cells sometimes produce steroid hormones, such as cortisol and testosterone[9,10].

IMAGING

Adrenal GNs are usually discovered incidentally due to the widespread use of computed tomography (Figure 1) and MRI (Figure 2) imaging techniques[2,11]. Particularly, GNs account for approximately 0.3%-2% of all adrenal incidentalomas[12-14]. In most cases, ultrasonography reveals a well-circumscribed, homogenous, hypo-echogenic lesion[15]. Furthermore, CT findings are usually compatible with a well-defined, lobular-shaped, solid, encapsulated mass. These tumors can been seen ranging from iso-attenuating to hypo-attenuating lesions compared to muscle signals[15]. Usually, the mass surrounds major blood vessels without imposing compression or occlusion[16]. Fine, punctate calcifications are found at a frequency ranging from 20% to 69% and are considered highly indicative of GNs[5,11]. On magnetic resonance imaging, T1-weighted images tend to have homogeneously low or intermediate signal, whereas T2-weighted images have heterogeneously intermediate or high signal[17]. Arguably, the latter is caused by the presence of the myxoid matrix along with a relatively low number of ganglion cells[18]. Furthermore, gadolinium administration can result in delayed and progressive enhancement of the lesion[8,15].

In reality, the aforementioned radiology findings are not pathognomonic of adrenal GNs[15]. Particularly the preoperative misdiagnosis rate of adrenal GNs based on CT and MRI findings has been attested to be 64.7%[5]. Also, MIBG (131-metaiodobenzylguanidine) scintigraphy produces similar results in GNs, ganglioneuroblastomas and neuroblastomas[2,15]. Recently, PET scans have been proclaimed to facilitate the diagnostic process. Particularly, Standardized Uptake Value (SUV) of 3.0 or higher has been suggested to distinguish malignant from benign adrenal lesions with 100% sensitivity and 98% specificity[19]. However, Adas *et al*[20] did report an adrenal GN with a SUV of 4.1 that was determined to be histologically benign. Taking everything into consideration, preoperative differential diagnosis of GNs remains extremely challenging and includes a variety of lesions, such as ganglioneuroblastoma, neuroblastoma, composite pheochromocytoma, adrenal cortical adenoma and adrenocortical carcinoma[2,21].

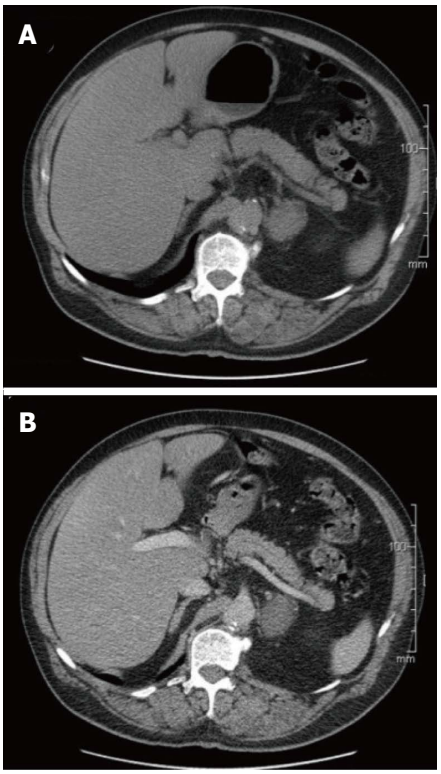

Figure 1 Axial computed tomography of left adrenal ganglioneuroma: Well-defined, solid, encapsulated mass (in *intravenous* contrast). A: Non-enhanced image; B: Enhanced image (venous phase).

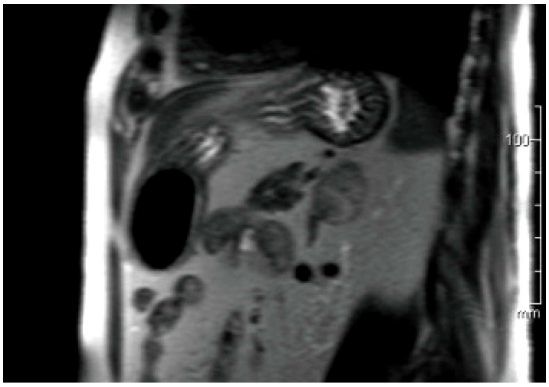

Figure 2 Coronal magnetic resonance imaging of left adrenal ganglioneuroma: A coronal T1-weighted out-of-phase image shows intracellular lipid and no signal loss within the lesion.

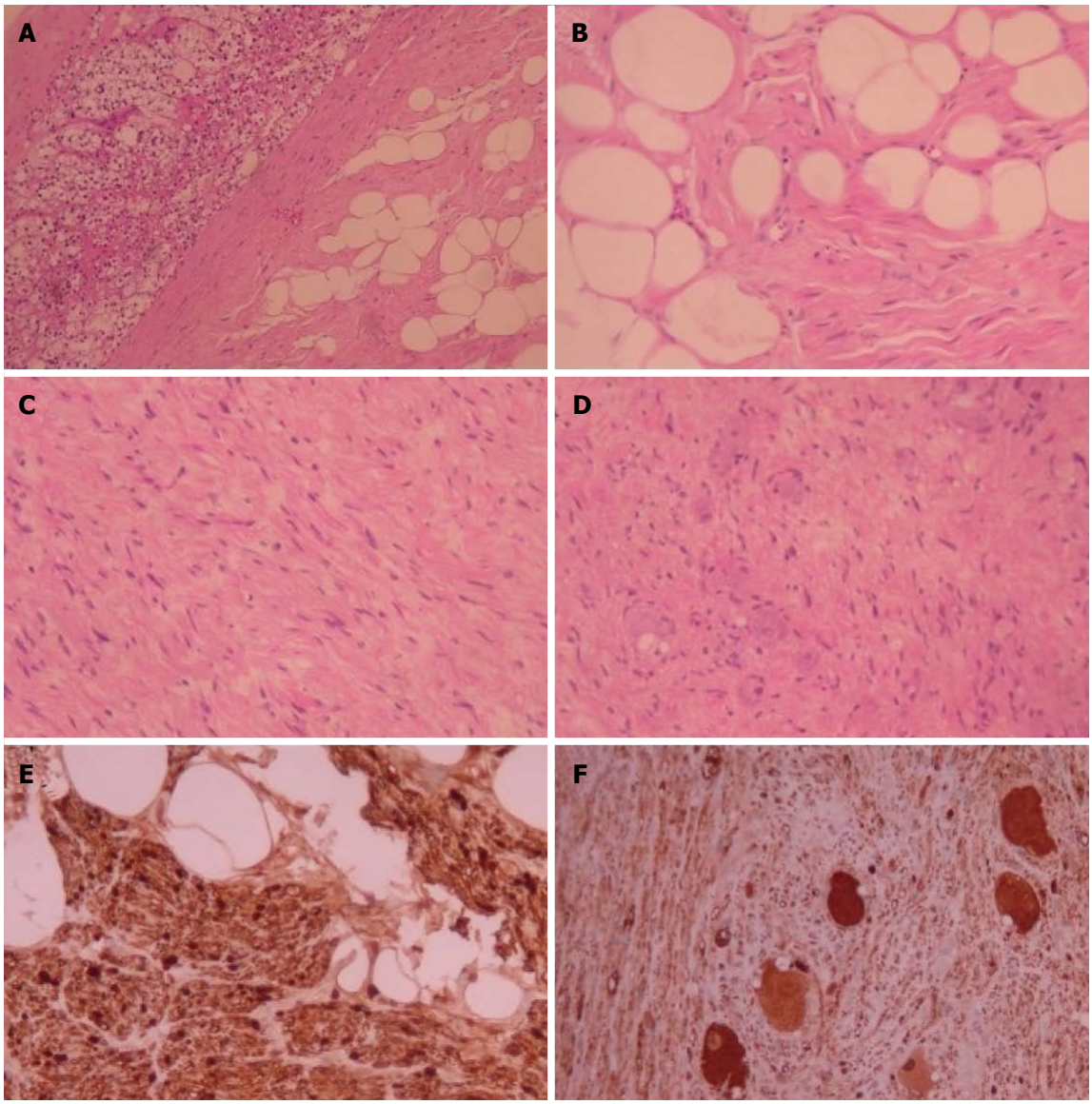

Figure 3 Histopathologic features of adrenal ganglioneuromas. A: Margin between adrenocortical parenchyma and adrenal ganglioneuroma with Schwann cells in adipose stroma (H and E × 100); B: Schwann cells in adipose stroma (H and E × 400); C: Schwann and ganglion cells in non-adipose stroma (H and E × 200); D: Schwann cells and multiple ganglion cells (H and E × 200); E: Protein S100 (+) Schwann cells (immunostaining × 400); F: Neuron-specific enolase (+) ganglion cells (immunostaining × 200). H and E: Hematoxylin and eosin.

HISTOPATHOLOGIC FEATURES

Ultimately, histopathological examination is required in order to confirm the diagnosis of GN (Figure 3). In the vast majority of cases, GNs are histologically benign lesions GNs which can be classified into two main categories[4]. Firstly, "mature type" GNs comprise of mature Schwann cells, ganglion cells and perineural cells within a fibrous stroma whilst completely lacking neuroblasts and mitotic figures[8]. Secondly, "maturing type" GNs consist of similar cellular populations with miscellaneous maturation degrees, ranging from fully mature cells to neuroblasts. Nevertheless, detection of neuroblasts is typically indicative of neuroblastomas or ganglioneuroblastomas. These types of neurogenic tumors have the potential to evolve into GNs[15]. Characteristically, GNs exhibit immunohistochemical reactivity for specific markers such as S-100, vimentin, synaptophysin and neuron-specific enolase[17].

GENETIC FEATURES

The tyrosine kinase receptor ERBB3 is one of the most commonly up-regulated genes in GNs[22]. Additionally, recent case series have found high expression of GATA3 in all of their GN tumors (100%) meaning that this may be a very reliable marker for GNs[23,24]. Lastly, the coexistence of GN with neuroblastoma has been associated with a hemizygous deletion of 11q14.1-23.3. Indeed, the predisposition to the development of neurogenic tumors may be attributed to the deletion of the *NCAM1* and *CADM1* genes which lie in 11q[25]. In contrast to neuroblastomas though, GNs do not seem to exhibit MYCN gene amplifications[4].

MANAGEMENT

Last but not least, literature is consistent with the fact that when dealing with large (> 6 cm) adrenal incidentalomas there is a 25% probability of the lesion being an adrenocortical carcinoma. Geoerger *et al*[4] described local lymph node involvement in two GN patients and one case of distant metastasis to soft tissues in their 49-patient case series. Nonetheless, malignant GNs remain extremely rare occurrences[21]. Ultimately, surgery constitutes the gold standard for the treatment of primary adrenal GNs[4,26]. Even though, laparoscopic adrenalectomy is usually the procedure of choice, a number of variables (*e.g.*, hormonal activity, tumor location, and proximity to adjacent structures) also need to be taken into account when deciding on the best approach to operate on these rare tumors[24]. Of note, wide excisions are unnecessary since adrenal GNs rarely metastasize or recur. Postoperatively, there is no need for adjuvant therapy in patients with adrenal GNs and their prognosis is excellent[4,21].

CONCLUSION

Adrenal GNs are uncommon, differentiated tumors which originate from neural crest cells. These lesions are usually discovered incidentally and tend to be hormonally silent. Even though, adrenalectomy is the gold standard for the treatment of adrenal GNs, the process of preoperative differential diagnosis remains extremely challenging. Ultimately, histologic examination is necessary in order to confirm this rare diagnosis. Postoperatively, there is no need for adjuvant treatment and the overall prognosis of these patients is excellent.

REFERENCES

1 **Joshi VV**. Peripheral neuroblastic tumors: pathologic classification based on recommendations of international neuroblastoma pathology committee (Modification of shimada classification). *Pediatr Dev Pathol* 2000; **3**: 184-199 [PMID: 10679039 DOI: 10.1007/s100240050024]

2 **Rha SE**, Byun JY, Jung SE, Chun HJ, Lee HG, Lee JM. Neurogenic tumors in the abdomen: tumor types and imaging characteristics. *Radiographics* 2003; **23**: 29-43 [PMID: 12533638 DOI: 10.1148/rg.231025050]

3 **Zografos GN**, Kothonidis K, Ageli C, Kopanakis N, Dimitriou K, Papaliodi E, Kaltsas G, Pagoni M, Papastratis G. Laparoscopic resection of large adrenal ganglioneuroma. *JSLS* 2007; **11**: 487-492 [PMID: 18237516]

4 **Geoerger B**, Hero B, Harms D, Grebe J, Scheidhauer K, Berthold F. Metabolic activity and clinical features of primary ganglioneuromas. *Cancer* 2001; **91**: 1905-1913 [PMID: 11346873 DOI: 10.1002/1097-0142(20010515)91:103.0.CO;2-4]

5 **Qing Y**, Bin X, Jian W, Li G, Linhui W, Bing L, Huiqing W, Yinghao S. Adrenal ganglioneuromas: a 10-year experience in a Chinese population. *Surgery* 2010; **147**: 854-860 [PMID: 20060552 DOI: 10.1016/j.surg.2009.11.010]

6 **Linos D**, Tsirlis T, Kapralou A, Kiriakopoulos A, Tsakayannis D, Papaioannou D. Adrenal ganglioneuromas: incidentalomas with misleading clinical and imaging features. *Surgery* 2011; **149**: 99-105 [PMID: 20452635 DOI: 10.1016/j.surg.2010.03.016]

7 **Li L**, Shao J, Gu J, Wang X, Qu L. Adrenal ganglioneuromas: experience from a retrospective study in a Chinese population. *Urol J* 2014; **11**: 1485-1490 [PMID: 24807765]

8 **Allende DS**, Hansel DE, MacLennan GT. Ganglioneuroma of the adrenal gland. *J Urol* 2009; **182**: 714-715 [PMID: 19539319 DOI: 10.1016/j.juro.2009.05.036]

9 **Koch CA**, Brouwers FM, Rosenblatt K, Burman KD, Davis MM, Vortmeyer AO, Pacak K. Adrenal ganglioneuroma in a patient presenting with severe hypertension and diarrhea. *Endocr Relat Cancer* 2003; **10**: 99-107 [PMID: 12653673 DOI: 10.1677/erc.0.0100099]

10 **Gaisa NT**, Klöppel G, Brehmer B, Neulen J, Stephan P, Knüchel R, Donner A. [Virilizing adrenal ganglioneuroma: A rare differential diagnosis in testosterone secreting adrenal tumours]. *Pathologe* 2009; **30**: 407-410 [PMID: 19396442 DOI: 10.1007/s00292-009-1145-0]

11 **Majbar AM**, Elmouhadi S, Elaloui M, Raiss M, Sabbah F, Hrora A, Ahallat M. Imaging features of adrenal ganglioneuroma: a case report. *BMC Res Notes* 2014; **7**: 791 [PMID: 25380617 DOI: 10.1186/1756-0500-7-791]

12 **Kasperlik-Zaluska AA**, Roslonowska E, Slowinska-Srzednicka J, Otto M, Cichocki A, Cwikla J, Slapa R, Eisenhofer G. 1,111 patients with adrenal incidentalomas observed at a single endocrinological center: incidence of chromaffin tumors. *Ann N Y Acad Sci* 2006; **1073**: 38-46 [PMID: 17102070 DOI: 10.1196/annals.1353.004]

13 **Bjornsson B**, Birgisson G, Oddsdottir M. Laparoscopic adrenalectomies: A nationwide single-surgeon experience. *Surg Endosc* 2008; **22**: 622-626 [PMID: 18163169 DOI: 10.1007/s00464-007-9729-3]

14 **Lee JH**, Chai YJ, Kim TH, Choi JY, Lee KE, Kim HY, Yoon YS, Kim HH. Clinicopathological Features of Ganglioneuroma Originating From the Adrenal Glands. *World J Surg* 2016; **40**: 2970-2975 [PMID: 27431319 DOI: 10.1007/s00268-016-3630-y]

15 **Lonergan GJ**, Schwab CM, Suarez ES, Carlson CL. Neuroblastoma, ganglioneuroblastoma, and ganglioneuroma: radiologic-pathologic correlation. *Radiographics* 2002; **22**: 911-934 [PMID: 12110723 DOI: 10.1148/radiographics.22.4.g02jl15911]

16 **Zugor V**, Schott GE, Kühn R, Labanaris AP. Retroperitoneal ganglioneuroma in childhood--a presentation of two cases. *Pediatr Neonatol* 2009; **50**: 173-176 [PMID: 19750893 DOI: 10.1016/S1875-9572(09)60058-9]

17 **Sasaki S**, Yasuda T, Kaneto H, Otsuki M, Tabuchi Y, Fujita Y, Kubo F, Tsuji M, Fujisawa K, Kasami R, Kitamura T, Miyatsuka T, Katakami N, Kawamori D, Matsuoka TA, Imagawa A, Shimomura I. Large adrenal ganglioneuroma. *Intern Med* 2012; **51**: 2365-2370 [PMID: 22975550 DOI: 10.2169/internalmedicine.51.7726]

18 **Otal P**, Mezghani S, Hassissene S, Maleux G, Colombier D, Rousseau H, Joffre F. Imaging of retroperitoneal ganglioneuroma. *Eur Radiol* 2001; **11**: 940-945 [PMID: 11419166 DOI: 10.1007/s003300000698]

19 **Mackie GC**, Shulkin BL, Ribeiro RC, Worden FP, Gauger PG, Mody RJ, Connolly LP, Kunter G, Rodriguez-Galindo C, Wallis JW, Hurwitz CA, Schteingart DE. Use of [18F]fluorodeoxyglucose positron emission tomography in evaluating locally recurrent and metastatic adrenocortical carcinoma. *J Clin Endocrinol Metab* 2006; **91**: 2665-2671 [PMID: 16621901 DOI: 10.1210/jc.2005-2612]

20 **Adas M**, Koc B, Adas G, Ozulker F, Aydin T. Ganglioneuroma presenting as an adrenal incidentaloma: a case report. *J Med Case Rep* 2014; **8**: 131 [PMID: 24779851 DOI: 10.1186/1752-1947-8-131]

21 **Shawa H**, Elsayes KM, Javadi S, Morani A, Williams MD, Lee JE, Waguespack SG, Busaidy NL, Vassilopoulou-Sellin R, Jimenez C, Habra MA. Adrenal ganglioneuroma: features and outcomes of 27 cases at a referral cancer centre. *Clin Endocrinol* (Oxf) 2014; **80**: 342-347 [PMID: 24033606 DOI: 10.1111/cen.12320]

22 **Wilzén A**, Krona C, Sveinbjörnsson B, Kristiansson E, Dalevi D, Øra I, De Preter K, Stallings RL, Maris J, Versteeg R, Nilsson S, Kogner P, Abel F. ERBB3 is a marker of a ganglioneuroblastoma/ganglioneuroma-like expression profile in neuroblastic tumours. *Mol Cancer* 2013; **12**: 70 [PMID: 23835063 DOI: 10.1186/1476-4598-12-70]

23 **Nonaka D**, Wang BY, Edmondson D, Beckett E, Sun CC. A study of gata3 and phox2b expression in tumors of the autonomic nervous system. *Am J Surg Pathol* 2013; **37**: 1236-1241 [PMID: 23715162

DOI: 10.1097/PAS.0b013e318289c765]
24 **Ordóñez NG**. Value of GATA3 immunostaining in tumor diagnosis: a review. *Adv Anat Pathol* 2013; **20**: 352-360 [PMID: 23939152 DOI: 10.1097/PAP.0b013e3182a28a68]
25 **Shiohama T**, Fujii K, Hino M, Shimizu K, Ohashi H, Kambe M, Nakatani Y, Mitsunaga T, Yoshida H, Ochiai H, Shimojo N. Coexistence of neuroblastoma and ganglioneuroma in a girl with a hemizygous deletion of chromosome 11q14.1-23.3. *Am J Med Genet A* 2016; **170A**: 492-497 [PMID: 26463893 DOI: 10.1002/ajmg.a.37430]
26 **Economopoulos KP**, Mylonas KS, Stamou AA, Theocharidis V, Sergentanis TN, Psaltopoulou T, Richards ML. Laparoscopic versus robotic adrenalectomy: A comprehensive meta-analysis. *Int J Surg* 2017; **38**: 95-104 [PMID: 28043926 DOI: 10.1016/j.ijsu.2016.12.118]

P- Reviewer: Letizia C, Lim SJ, Yu SP **S- Editor**: Ji FF
L- Editor: A **E- Editor**: Lu YJ

World Journal of Clinical Cases

Submit a Manuscript: http://www.f6publishing.com

World J Clin Cases 2017 October 16; 5(10): 378-380

DOI: 10.12998/wjcc.v5.i10.378

ISSN 2307-8960 (online)

CASE REPORT

Hydrogen peroxide ingestion with injury to upper gastrointestinal tract

Jonathan V Martin, Choichi Sugawa

Jonathan V Martin, Choichi Sugawa, Michael and Marian Ilitch Department of Surgery, 6-C University Health Center, Detroit, MI 48201, United States

Author contributions: Martin JV and Sugawa C contributed to the initial drafting and editing of manuscript; Sugawa C obtained clinical data.

Institutional review board statement: This case report was exempt from the Institutional Review Board standards at Wayne State University.

Informed consent statement: Formal consent not required for case reports that have all 18 protected health information de-identified.

Conflict-of-interest statement: The authors have no conflicts of interest to disclose.

Manuscript source: Unsolicited manuscript

Correspondence to: Choichi Sugawa, MD, Professor, Michael and Marian Ilitch Department of Surgery, 6-C University Health Center, 4201 Saint Antoine St., Detroit, MI 48201, United States. csugawa@med.wayne.edu
Telephone: +1-313-5775001
Fax: +1-313-5775310

Received: March 28, 2017
Peer-review started: March 31, 2017
First decision: June 16, 2017
Revised: July 6, 2017
Accepted: August 2, 2017
Article in press: August 3, 2017
Published online: October 16, 2017

Abstract

Hydrogen peroxide is a common over-the-counter solution that has developed a growing body of literature regarding toxic ingestion. Intentional ingestion of high concentration hydrogen peroxide for health purposes has gained popularity in certain patient populations; purported benefits are due to the increased oxygen released into the blood stream. We present for evaluation one such case with associated imaging that presented to our urban medical center. A brief review of the literature was also performed noting current recommendations regarding both outcomes and indications for endoscopy as well as hyperbaric oxygen therapy following ingestion of hydrogen peroxide. Our patient was a 51-year-old white female who presented with foamy hematemesis after ingesting 10 drops of 35% hydrogen peroxide as part of a home remedy to cleanse her colon and improve blood oxygenation. In addition to hematemesis, she also reported diffuse abdominal pain with sore throat and hoarse voice. Her imaging demonstrated portal venous gas and gastric edema. She was admitted for hyperbaric oxygen therapy and underwent upper endoscopy demonstrating diffuse esophagitis and gastritis with white exudate and multiple petechiae. She was later discharged home in stable condition and was lost to follow-up.

Key words: Hydrogen peroxide; Caustic injury; Hyperbaric oxygen therapy; Ingestion of hydrogen peroxide; Arterial gas emboli

Core tip: In patients presenting with unresolving epigastric and hematemesis following ingestion of hydrogen peroxide, evaluation with endoscopy is indicated. Computed tomography and/or magnetic resonance imaging are also indicated to evaluate for formation of arterial gas emboli. Therapy is primarily supportive, ± hyperbaric oxygen therapy depending on presence of neurological symptoms, presence of gas emboli, and

availability of resources.

Martin JV, Sugawa C. Hydrogen peroxide ingestion with injury to upper gastrointestinal tract. *World J Clin Cases* 2017; 5(10): 378-380 Available from: URL: http://www.wjgnet.com/2307-8960/full/v5/i10/378.htm DOI: http://dx.doi.org/10.12998/wjcc.v5.i10.378

INTRODUCTION

Hydrogen peroxide is a common over-the-counter solution that has developed a growing body of literature regarding toxic ingestion[1-5]. The main mechanisms for toxicity include direct lipid peroxidation, oxygen gas production, and corrosive injury[1]. Reported toxicities and fatalities tend to involve higher concentrations (> 35%) and pediatric patients[1].

Intentional ingestion of high concentration hydrogen peroxide for health purposes has gained popularity in certain patient populations; purported benefits are due to the increased oxygen released into the blood stream. We present for evaluation one such case with associated imaging.

CASE REPORT

A 51-year-old white female presented to our urban medical center with foamy hematemesis after ingesting 10 drops of 35% hydrogen peroxide as part of a home remedy to cleanse her colon and improve blood oxygenation. In addition to hematemesis, she also reported diffuse abdominal pain with sore throat and hoarse voice.

At the time of presentation, vitals were normal and stable. Her initial abdominal exam was benign and she was neurologically intact. Labs were within normal limits save for a leukocytosis of 12.6 thousand/mm^3. CT imaging obtained at admission demonstrated portal venous gas, gastric pneumatosis, and gastric edema (Figure 1). She was given a proton-pump inhibitor and admitted for hyperbaric oxygen therapy (HBT) to be followed by upper endoscopy evaluation.

Esophagogastroduodenoscopy performed the following morning revealed a small hiatal hernia, diffuse esophagitis and gastritis with white exudate and multiple petechiae, and two areas of duodenitis (Figures 2 and 3). Gastric biopsies later demonstrated only active, chronic gastritis with marked congestion and extravasated blood. Following her endoscopy and hyperbaric oxygen therapy, patient tolerated a liquid diet and was deemed stable for discharge home later that day. Patient was lost to follow-up.

DISCUSSION

Mortality associated with hydrogen peroxide ingestion

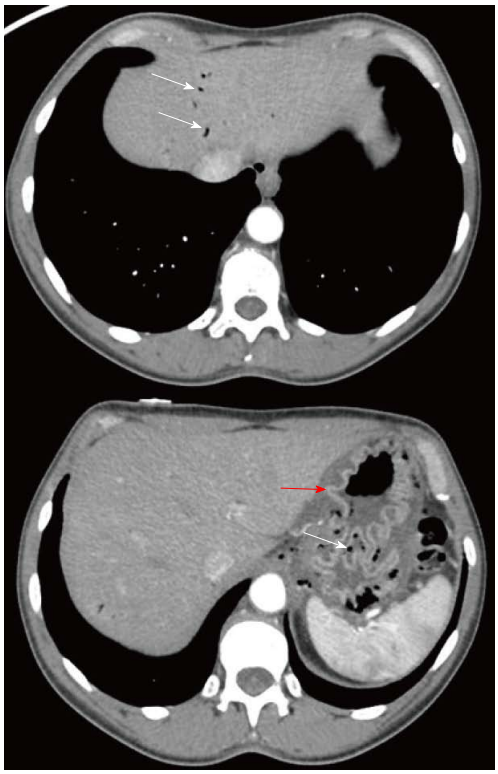

Figure 1 Computed tomography abdomen demonstrating portal venous gas as well as gastric pneumatosis and edema (portal venous gas and gastric pneumatosis noted with white arrows, gastric edema noted with red arrow).

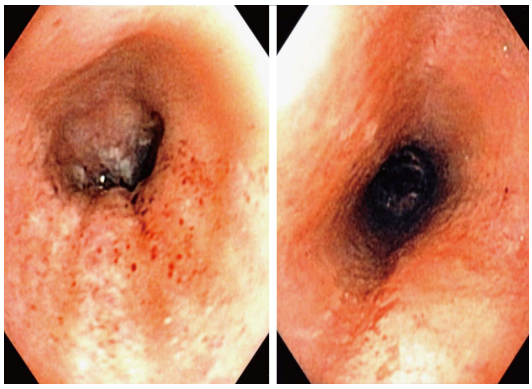

Figure 2 Esophagogastroduodenoscopy demonstrating esophagitis with multiple petechiae and white exudate.

usually involves the formation of arterial gas emboli (AGE) and the development of cerebral embolism[1-3]. Perforation may occur, but is not as commonly described as AGE. The most common injury noted on upper endoscopy following ingestion is a Grade I caustic mucosal injury which tends to resolve spontaneously without further sequelae[6]. The "snow-white" sign may be visualized, an area of mucosa that has a blanched appearance secondary to blood being driven away by rapid oxygen production; this is demonstrated on our endoscopic image (Figure 2 left panel)[1].

Management of hydrogen peroxide ingestion consists

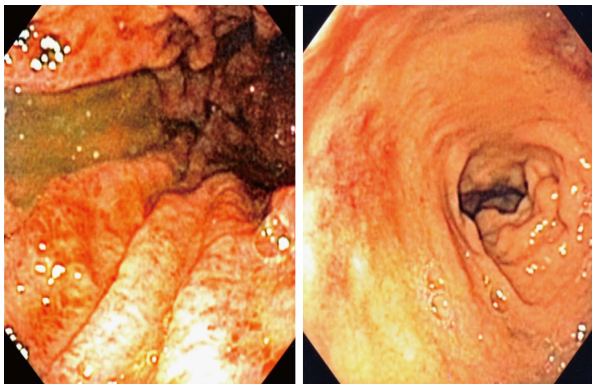

Figure 3 Esophagogastroduodenoscopy demonstrating diffuse gastritis (Left) and areas of duodenitis (Right).

mainly of supportive care and endoscopic evaluation if hematemesis or unresolving epigastric pain develops, typically in association with concentrated doses[1]. CT/MRI imaging is indicated to evaluate for formation of AGE, especially with the development of neurological symptoms. HBT has been shown to be helpful in such cases and is generally associated with complete resolution of symptoms; delayed therapy may contribute to mortality[2-4].

While neurological symptoms are definitive indications for HBT, its role in the presence of portal venous gas is still being evaluated[2,3]. Several centers with ready access to HBT have suggested that the mere presence of portal venous gas indicates need for HBT. While it would seem a prudent measure to prevent further progression of gas emboli, a case report does exist of conservatively managed portal venous gas without HBT and without subsequent negative sequelae[7].

COMMENTS

Case characteristics

The patient presented with epigastric pain, foamy hematemesis, sore throat, and hoarseness.

Clinical diagnosis

Physical exam demonstrated a benign abdomen and no neurological deficits.

Differential diagnosis

Presentation concerning for perforation of gastrointestinal tract with possible arterial gas emboli, evaluated by computed tomography and esophagogastroduodenoscopy (EGD).

Laboratory diagnosis

Electrolytes and complete blood count obtained demonstrating only leukocytosis of 12.6 thousand/mm^3.

Imaging diagnosis

Computed tomography abdomen demonstrated portal venous gas, gastric pneumatosis, and gastric edema.

Pathological diagnosis

Gastric biopsy demonstrated active, chronic gastritis with marked congestion and extravasated blood.

Treatment

Patient was kept NPO; treated with IV fluids, a proton-pump inhibitor, and hyperbaric oxygen therapy; and evaluated by EGD.

Related reports

EGD demonstrated a small hiatal hernia, diffuse esophagitis and gastritis with white exudate and multiple petechiae, and two areas of duodenitis.

Experiences and lessons

Hydrogen peroxide ingestion generally requires conservative management and may benefit from hyperbaric oxygen therapy.

Peer-review

The authors demonstrated a case of 51-year-old white female presented to our urban medical center with foamy hematemesis after ingesting 10 drops of 35% hydrogen peroxide. The present study was well investigated and will give us an important information in the field of clinical gastroenterology.

REFERENCES

1 **Watt BE**, Proudfoot AT, Vale JA. Hydrogen peroxide poisoning. *Toxicol Rev* 2004; **23**: 51-57 [PMID: 15298493]

2 **Byrne B**, Sherwin R, Courage C, Baylor A, Dolcourt B, Brudzewski JR, Mosteller J, Wilson RF. Hyperbaric oxygen therapy for systemic gas embolism after hydrogen peroxide ingestion. *J Emerg Med* 2014; **46**: 171-175 [PMID: 24268898 DOI: 10.1016/j.jemermed.2013.08.091]

3 **Hendriksen SM**, Menth NL, Westgard BC, Cole JB, Walter JW, Masters TC, Logue CJ. Hyperbaric oxygen therapy for the prevention of arterial gas embolism in food grade hydrogen peroxide ingestion. *Am J Emerg Med* 2017; **35**: 809.e5-809.e8 [PMID: 28069419 DOI: 10.1016/j.ajem.2016.12.027]

4 **Ikiz MA**, Yakut HI, Kurt F, Sahin S, Yalçin HN, Baştemur M, Kalkan G. Hydrogen peroxide solution ingestion caused brain death of a 3-year-old girl. *Pediatr Emerg Care* 2013; **29**: 502-503 [PMID: 23558268 DOI: 10.1097/PEC.0b013e31828a387b]

5 **Indorato F**, Raffino C, Tropea FM, Barbera N, Grieco A, Bartoloni G. Fatal accidental ingestion of 35 % hydrogen peroxide by a 2-year-old female: case report and literature review. *Forensic Sci Med Pathol* 2014; **10**: 443-447 [PMID: 24692088 DOI: 10.1007/s12024-014-9560-9]

6 **Tohda G**, Sugawa C, Gayer C, Chino A, McGuire TW, Lucas CE. Clinical evaluation and management of caustic injury in the upper gastrointestinal tract in 95 adult patients in an urban medical center. *Surg Endosc* 2008; **22**: 1119-1125 [PMID: 17965918 DOI: 10.1007/s00464-007-9620-2]

7 **Zengin S**, Al B, Genç S, Yarbil P, Yilmaz DA, Gulsen MT. A rare case of portal vein gas: accidental hydrogen peroxide ingestion. *BMJ Case Rep* 2012; **2012**: bcr0120125602 [PMID: 22669852 DOI: 10.1136/bcr.01.2012.5602]

P- Reviewer: Naito Y **S- Editor**: Qi Y **L- Editor**: A
E- Editor: Lu YJ

World Journal of Clinical Cases

Submit a Manuscript: http://www.f6publishing.com

World J Clin Cases 2017 October 16; 5(10): 381-383

DOI: 10.12998/wjcc.v5.i10.381

ISSN 2307-8960 (online)

CASE REPORT

Juvenile hemochromatosis: *HAMP* mutation and severe iron overload treated with phlebotomies and deferasirox

Manuel A Lescano, Letícia C Tavares, Paulo C J L Santos

Manuel A Lescano, Institute of Digestive Tract of Southwestern Bahia, Bahia, BA 45023-145, Brazil

Letícia C Tavares, Paulo C J L Santos, Laboratory of Genetics and Molecular Cardiology, Heart Institute (InCor), University of Sao Paulo Medical School, São Paulo, SP 05403-900, Brazil

Author contributions: Lescano MA, Tavares LC and Santos PCJL make substantial contributions to conception and design of the case report, acquisition, analysis, and interpretation of data; all authors participate in drafting the article and revising it critically for important intellectual content.

Institutional review board statement: The study protocol was approved by the Ethics Committee of Hospital das Clinicas (HC), Heart Institute (InCor), Faculdade de Medicina FMUSP, Universidade de Sao Paulo, Brazil (SDC: 4027/14/007).

Informed consent statement: The study participants provided informed consent prior to study enrollment.

Conflict-of-interest statement: The authors declare that there is no conflict of interest in this study.

Manuscript source: Unsolicited manuscript

Correspondence to: Paulo C J L Santos, PhD, Adjunct Professor (Department of Pharmacology, Universidade Federal de Sao Paulo - UNIFESP), Collaborator Researcher, Laboratory of Genetics and Molecular Cardiology, Heart Institute (InCor), University of Sao Paulo Medical School, 03 de Maio, St. INFAR, 4th floor, Vila Clementino, São Paulo, SP 05403-900, Brazil. pacaleb@usp.br
Telephone: +55-11-55764848

Received: March 21, 2017
Peer-review started: March 23, 2017
First decision: June 15, 2017
Revised: June 23, 2017
Accepted: August 2, 2017
Article in press: August 3, 2017
Published online: October 16, 2017

Abstract

Juvenile hemochromatosis (JH) is a rare condition classified as an autosomal recessive disorder that leads to severe iron absorption. JH usually affects people under the age of 30 and presents symptoms such as chronic liver damage, hypogonadotropic hypogonadism, cardiac diseases and endocrine dysfunctions. The present case reports a 29-year-old Brazilian woman with JH condition due to *HAMP* mutation (g.47G>A), treated with phlebotomies and deferasirox. She presented symptoms such as weakness, skin hyperpigmentation, joint pain in the shoulders and hands and amenorrhea. First laboratory tests showed altered biochemical parameters [serum ferritin (SF): 5696 ng/mL, transferrin saturation (TS): 85%]. After sessions of phlebotomies (450 mL every 15 d), the patient presented partial symptomatic improvements and biochemical parameters (SF: 1000 ng/mL, Hb: 11 g/dL). One year later, deferasirox (15 mg/kg per day) was introduced to the treatment, and the patient showed total symptomatic improvement, with significant clearing of the skin, SF: 169 ng/mL, and TS: 50%. Furthermore, after the combined deferasirox-phlebotomy therapy, magnetic resonance imaging measurements revealed normalized level for liver iron (30 μmol/g; reference value < 36 μmol/g). In conclusion, combined deferasirox-phlebotomy treatment was able to normalize iron levels and improve symptoms.

Key words: Genetic disease; Juvenile hemochromatosis; *HAMP* gene; Mutation; Iron chelation

Core tip: A 29-year-old Brazilian woman, from a city in the countryside of the State of Bahia, Brazil, was referred to our service in 2015 because of a hepatomegaly clinical condition, detected by imaging exam. This case study reports a patient with juvenile hemochromatosis condition due to *HAMP* mutation (g.47G>A) treated with phlebotomies and deferasirox, which were able to normalize iron levels and improve symptoms.

Lescano MA, Tavares LC, Santos PCJL. Juvenile hemochromatosis: *HAMP* mutation and severe iron overload treated with phlebotomies and deferasirox. *World J Clin Cases* 2017; 5(10): 381-383 Available from: URL: http://www.wjgnet.com/2307-8960/full/v5/i10/381.htm DOI: http://dx.doi.org/10.12998/wjcc.v5.i10.381

INTRODUCTION

Juvenile hemochromatosis (JH), also known as type 2 hemochromatosis, is a rare condition classified as an autosomal recessive disorder that leads to severe iron absorption. JH usually affects people under the age of 30 and presents symptoms such as chronic liver damage, hypogonadotropic hypogonadism, cardiac diseases and endocrine dysfunctions. JH is subdivided into two groups: Type 2A (associated to *HJV* - hemojuvelin gene mutation) and type 2B (associated to *HAMP* - hepcidin gene mutation). Both genes are involved in the production of hepcidin, a peptide that regulates iron homeostasis by adjusting its absorption and storage. *HJV* and *HAMP* mutations, therefore, lead to decreased hepcidin levels, and consequently to iron overload in the body[1-3].

CASE REPORT

A 29-year-old Brazilian woman, from a city in the countryside of the State of Bahia, Brazil, was referred to our service in 2015 because of a hepatomegaly clinical condition, detected by imaging exam. In the anamnesis, symptoms such as weakness, skin hyperpigmentation and joint pain in the shoulders and hands were observed. The patient had reported amenorrhea since she was 25 years old, whereas transvaginal ultrasound showed uterus and ovaries were not developed. She also reported that her father died before the age of 50 because of non-alcoholic cirrhosis and diabetes. Furthermore, one of her three brothers, who was 31 years old, died because of the same reported father diseases. The patient's other two brothers, on the other hand, are healthy.

The patient's first laboratory tests results were: Serum ferritin (SF) of 5696 ng/mL, transferrin saturation (TS) of 85%, hemoglobin (Hb) of 13.3 g/dL, international normalized ratio of 1.3, aspartate transaminase of 91 U/L, alanine transaminase of 69 U/L, alkaline phosphatase of 288 U/L, gamma-glutamyl transferase of 84 U/L, blood glucose of 72 mg/dL, creatinine of 0.7 mg/dL and albumin of 4.3 g/dL. Her echocardiogram was normal and secondary causes of iron overload (hepatitis, chronic hemolysis, oral or parenteral iron overload, metabolic syndrome and alcohol abuse) were excluded. Genetic analysis for mutations in the *HFE* gene (p.C282Y, p.H63D and p.S65C) revealed a heterozygous genotype for the p.H63D. Taking in account the patient's age and the absence of relevant genetic alteration for hereditary hemochromatosis (HH), the *HJV* (exons 1-4) and *HAMP* (exons 1-3) genes were sequenced[4], as iron overload in a young individual who presents endocrine dysfunctions is suggestive of a JH diagnosis. The *HAMP* sequencing revealed the homozygous genotype for the mutation 5'-UTR G>A at position +14 (g.47G>A), confirming the prior suspicious.

In January 2015, the patient started phlebotomies of 450 mL every 15 d. After 12 mo of treatment, there was partial improvement of weakness, skin hyperpigmentation and joint pain symptoms. In addition, the hemoglobin level was never below 11 g/dL and, despite an observed decrease in ferritin level, the values were always above 1000 ng/mL. In January 2016, deferasirox (15 mg/kg per day) was introduced to the treatment, concomitantly with the phlebotomies. No side effects were observed and the serum creatinine values remained normal. In September 2016, the patient showed total symptomatic improvement, with significant clearing of the skin, SF values of 169 ng/mL and TS of 50%. The study protocol was approved by the Ethics Committee of Hospital das Clinicas (HC) of University of Sao Paulo Medical School (FMUSP), Brazil, and consent was obtained from the participants prior to entering the study.

DISCUSSION

When compared with *HFE*-hemochromatosis, the frequency of the JH condition with *HAMP* gene mutation is considered very rare. However, some cases were reported[5,6]. Here, we report one case of a Brazilian patient with JH condition due to *HAMP* mutation (g.47G>A), first identified in a Portuguese family[7]. She presented significant improvement of symptoms through combined treatment with deferasirox and phlebotomies.

Phlebotomy is the choice treatment for hemochromatosis. However, iron chelator has been suggested as an alternative treatment option for iron overload, especially when patients have severe iron overload, did not have tolerance to phlebotomies or where it is contraindicated. The dose used in the present case report was previously evaluated in hemochromatosis patients[8]. Cançado *et al*[9] (2015) evaluated the efficacy and effectiveness of deferasirox (doses of 5-10 mg/kg per day) for treatment of hemochromatosis patients. They showed that chelation was safe and effective[9].

It is possible to estimate the quantity of liver iron removed using magnetic resonance imaging (MRI) measurements (given as mg of Fe/*g* of liver). Santos *et al*[10] (2010) performed a study that measured liver iron concentration before and after combined deferasirox-

phlebotomy treatment. They observed that approximately two-thirds (5.55 g) of the iron removed from the liver could be attributed to the action of deferasirox[10]. In the present case, however, we were not able to perform MRI measurements before and after inclusion of the deferasirox as an adjuvant. Nevertheless, we estimated that phlebotomies were able to remove approximately 8.0 *g* of liver iron (40 phlebotomies and about 200 mg Fe/phlebotomy) in 20 mo. After this period of combined therapy, the MRI showed normal value for liver iron of 30 μmol/g (reference value < 36 μmol/g).

In conclusion, combined deferasirox-phlebotomy treatment was able to promote decrease and normalization of iron levels, besides significant symptomatic improvements.

ACKNOWLEDGMENTS

We mostly thank the participants of the study. We are also thankful for the technical assistance provided by the staff of the Laboratory of Genetics and Molecular Cardiology, Heart Institute (InCor).

COMMENTS

Case characteristics

A 29-year-old Brazilian woman, with non-alcoholic cirrhosis and diabetes in the familiar medical history, presented symptoms such as weakness, skin hyperpigmentation, joint pain in the shoulders and hands and amenorrhea.

Clinical diagnosis

HAMP sequencing indicated juvenile hemochromatosis (JH) condition due to g.47G>A mutation.

Differential diagnosis

Patient's age (29) and absence of relevant genetic alteration for hereditary hemochromatosis (HH) led to sequencing of *HJV* (exons 1-4) and *HAMP* (exons 1-3) genes, as iron overload in a young individual who presents endocrine dysfunctions is suggestive of a JH diagnosis.

Laboratory diagnosis

Laboratory tests indicated altered iron biochemical parameters: SF = 5696 ng/mL and TS = 85%.

Treatment

Patient's treatment was performed with phlebotomies (450 mL every 15 d) for 20 mo, and the iron chelator deferasirox (15 mg/kg per day) was introduced as adjuvant in the last 8 mo of treatment.

Related reports

The dose used in the present case report was previously evaluated in hemochromatosis patients. Cançado *et al* (2015) evaluated the efficacy and effectiveness of deferasirox (doses of 5-10 mg/kg per day) for treatment of hemochromatosis patients. They showed that chelation was safe and effective. Besides that, Santos *et al* (2010) performed a study that measured liver iron concentration before and after combined deferasirox-phlebotomy treatment. They observed that approximately two-thirds (5.55 g) of the iron removed from the liver could be attributed to the action of deferasirox.

Experiences and lessons

Phlebotomy is the choice treatment for hemochromatosis. However, iron chelator has been suggested as an alternative treatment option for iron overload, especially when patients have severe iron overload, did not have tolerance to phlebotomies or where it is contraindicated.

Peer-review

In the present case, we have reported a clinical case of a patient with a very rare disorder: juvenile hemochromatosis due to *HAMP* mutation (g.47G>A). The authors presented a successful combined therapy for the iron overload and symptoms caused by the JH condition, performed with the conventional phlebotomies and the iron chelator deferasirox as an adjuvant.

REFERENCES

1 **Wallace DF**, Subramaniam VN. Non-HFE haemochromatosis. *World J Gastroenterol* 2007; **13**: 4690-4698 [PMID: 17729390 DOI: 10.3748/wjg.v13.i35.4690]
2 **Santos PC**, Krieger JE, Pereira AC. Molecular diagnostic and pathogenesis of hereditary hemochromatosis. *Int J Mol Sci* 2012; **13**: 1497-1511 [PMID: 22408404 DOI: 10.3390/ijms13021497]
3 **Brissot P**, Loréal O. Iron metabolism and related genetic diseases: A cleared land, keeping mysteries. *J Hepatol* 2016; **64**: 505-515 [PMID: 26596411 DOI: 10.1016/j.jhep.2015.11.009]
4 **Santos PC**, Cançado RD, Pereira AC, Schettert IT, Soares RA, Pagliusi RA, Hirata RD, Hirata MH, Teixeira AC, Figueiredo MS, Chiattone CS, Krieger JE, Guerra-Shinohara EM. Hereditary hemochromatosis: mutations in genes involved in iron homeostasis in Brazilian patients. *Blood Cells Mol Dis* 2011; **46**: 302-307 [PMID: 21411349 DOI: 10.1016/j.bcmd.2011.02.008]
5 **Fonseca PF**, Cançado RD, Uellendahl Lopes MM, Correia E, Lescano MA, Santos PC. HAMP Gene Mutation Associated with Juvenile Hemochromatosis in Brazilian Patients. *Acta Haematol* 2016; **135**: 228-231 [PMID: 27007796 DOI: 10.1159/000444119]
6 **Santos PC**, Dinardo CL, Cançado RD, Schettert IT, Krieger JE, Pereira AC. Non-HFE hemochromatosis. *Rev Bras Hematol Hemoter* 2012; **34**: 311-316 [PMID: 23049448 DOI: 10.5581/1516-8484.20120079]
7 **Matthes T**, Aguilar-Martinez P, Pizzi-Bosman L, Darbellay R, Rubbia-Brandt L, Giostra E, Michel M, Ganz T, Beris P. Severe hemochromatosis in a Portuguese family associated with a new mutation in the 5'-UTR of the HAMP gene. *Blood* 2004; **104**: 2181-2183 [PMID: 15198949]
8 **Phatak P**, Brissot P, Wurster M, Adams PC, Bonkovsky HL, Gross J, Malfertheiner P, McLaren GD, Niederau C, Piperno A, Powell LW, Russo MW, Stoelzel U, Stremmel W, Griffel L, Lynch N, Zhang Y, Pietrangelo A. A phase 1/2, dose-escalation trial of deferasirox for the treatment of iron overload in HFE-related hereditary hemochromatosis. *Hepatology* 2010; **52**: 1671-1779 [PMID: 20814896 DOI: 10.1002/hep.23879]
9 **Cançado R**, Melo MR, de Moraes Bastos R, Santos PC, Guerra-Shinohara EM, Chiattone C, Ballas SK. Deferasirox in patients with iron overload secondary to hereditary hemochromatosis: results of a 1-yr Phase 2 study. *Eur J Haematol* 2015; **95**: 545-550 [PMID: 25684349 DOI: 10.1111/ejh.12530]
10 **Santos PC**, Cançado RD, Pereira AC, Chiattone CS, Krieger JE, Guerra-Shinohara EM. HJV hemochromatosis, iron overload, and hypogonadism in a Brazilian man: treatment with phlebotomy and deferasirox. *Acta Haematol* 2010; **124**: 204-205 [PMID: 21071928 DOI: 10.1159/000321493]

P- Reviewer: Pantopoulos K **S- Editor**: Qi Y
L- Editor: A **E- Editor**: Lu YJ

World Journal of Clinical Cases

Submit a Manuscript: http://www.f6publishing.com

World J Clin Cases 2017 October 16; 5(10): 384-389

DOI: 10.12998/wjcc.v5.i10.384

ISSN 2307-8960 (online)

CASE REPORT

Prosthodontic management of hemimandibulectomy patients to restore form and function - A case series

Deenadayalan Lingeshwar, Rajendran Appadurai, Ujjayanthi Sswedheni, Challa Padmaja

Deenadayalan Lingeshwar, Rajendran Appadurai, Ujjayanthi Sswedheni, Challa Padmaja, Government Royapettah Hospital, Chennai 600014, India

Author contributions: All authors equally contributed to the treatment and writing case report.

Institutional review board statement: This case report was exempt from the Institutional Review Board standards at Government Royapettah hospital, Chennai, India.

Informed consent statement: A letter of permission had been obtained from the patients no matter if the article appears in the published or in the online journal.

Conflict-of-interest statement: There is no conflict of interest or financial interests, direct or indirect, that exist or may be perceived to exist for individual contributors in connection with the content of this paper.

Manuscript source: Unsolicited manuscript

Correspondence to: Dr. Deenadayalan Lingeshwar, Assistant Professor, Government Royapettah Hospital, Westcott Road, Opposite YMCA Ground, Chennai 600014, India. grhdentalpublications@gmail.com
Telephone: +91-74-18314035

Received: May 23, 2017
Peer-review started: May 24, 2017
First decision: July 11, 2017
Revised: July 27, 2017
Accepted: August 2, 2017
Article in press: August 3, 2017
Published online: October 16, 2017

Abstract

Surgical resection of mandible owing to benign, malignant neoplasm, osteoradionecrosis is common. The resection can be total or segmental depending on the lesion. Loss of mandibular continuity causes deviation of remaining mandibular segment towards the resected side and rotation inferiorly due to muscle pull and scar contracture affecting mastication and esthetics. Surgical reconstruction may not be always possible. Prosthetic rehabilitation plays a major role in these patients. This case series describes different types of guiding flange (GF) prosthesis with modifications for three hemimandibulectomy patients at different time interval after surgery. The article details GF prosthesis combined with physiotherapy to correct deviation of mandible thereby improving mastication, esthetics and speech and thus enhancing the quality of life.

Key words: Hemimandibulectomy; Mandibular deviation; Guiding flange prosthesis; Palatal ramp

Core tip: Mandible is a significant structure in lower third of face constituting to esthetics and functions like speech, swallowing and mastication. Surgical resection owing to various reasons disrupts these functions. Both form and function should be considered in rehabilitating hemimandibulectomy patients. This article describes prosthetic rehabilitation that comprises of different types of guiding flange prosthesis with modifications for three hemimandibulectomy patients at different time interval after surgery.

Lingeshwar D, Appadurai R, Sswedheni U, Padmaja C. Prosthodontic management of hemimandibulectomy patients to restore form and function - A case series. *World J Clin Cases* 2017; 5(10): 384-389 Available from: URL: http://www.wjgnet.com/2307-8960/full/v5/

i10/384.htm DOI: http://dx.doi.org/10.12998/wjcc.v5.i10.384

INTRODUCTION

Mandible is a significant structure in lower third of face constituting to function and esthetics. It is a single bone that creates peripheral boundaries of the floor of the mouth, facial form (lower third), speech, swallowing, mastication and respiration. Disruption of mandible due to trauma, surgical resection for benign and malignant neoplasm disrupts any of these functions. Both form and function should be considered in rehabilitating hemimandibulectomy patients. Loss of mandibular continuity causes deviation of the remaining mandibular segments towards the defect and rotation of the mandibular occlusal plane inferiorly due to muscle pull and scar contracture. Mandibulectomy with radical neck dissection increases this deviation. This results in facial disfigurement, loss of occlusal contact, in many cases, loss of lip competency for saliva control and to initiate the swallowing process[1]. Literature shows techniques to correct mandibular deviation that can vary from intermaxillary fixation with elastics, palatal or mandibular guiding flange (GF) prosthesis anchored on natural teeth or the dental flange[2]. The GF is probably the simplest and most useful in maintaining position of the remaining jaw[3]. This article describes different types of GF prosthesis with modifications for three hemimandibulectomy patients at different time interval after surgery.

CASE REPORT

Case report 1

A 36 years old male patient was referred to the hospital with the history of carcinoma left buccal mucosa for which he underwent hemimandibulectomy and modified radical neck dissection one month back and reconstructed with pectoralis major myocutaneous flap. Patient complained of difficulty in mastication and speech.

Extra oral examination revealed facial asymmetry and deviation of mandible towards the resected site and the deviation increased on opening the mouth. The mouth opening was reduced to 25 mm. Intra oral examination revealed partially edentulous mandible and loss of occlusal contact (Figure 1).The mandibular defect was classified as Cantor and Curtis Class Ⅱ that is lateral resection of the mandible distal to cuspid[4]. It was noted that mandible can be guided to centric occlusion manually but the patient could not achieve this position consistently on his own. So the treatment objective was to correct the deviation of mandible and to restore proper occlusion for mastication.

Impressions were made with modified stainless steel stock tray and irreversible hydrocolloid (Tropicalgin, IDS DENMED Pvt. Ltd.) followed by pouring cast with

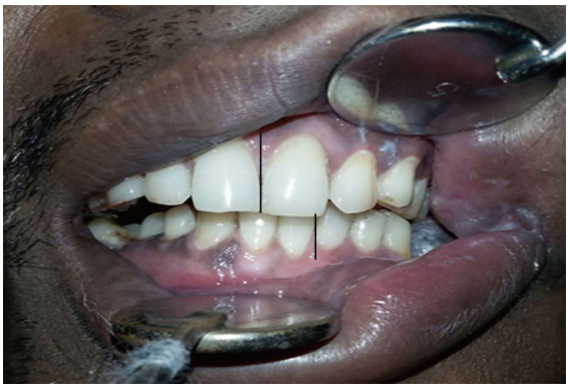

Figure 1 Midline shift and loss of occlusal contact.

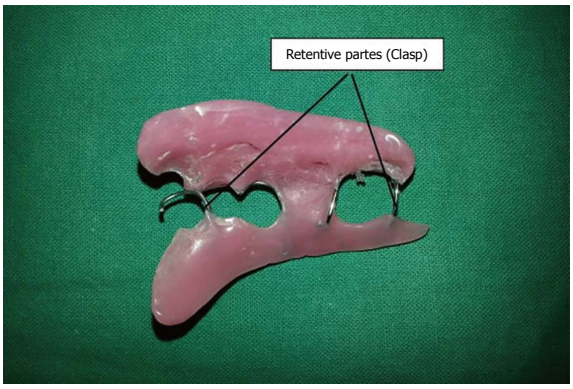

Figure 2 Mandibular guiding flange prosthesis.

Type Ⅲ Dental stone (Goldstone, mfg. by ASIAN CHEMICALS). Interocclusal record was made with modelling wax (the Hindustan dental products) by asking the patient to move the mandible away from resected site as far as possible and manually guiding the mandible to centric occlusion. This record was transferred to a mean value articulator. Three clasps were made using 21 gauge wire - "C" clasp on canine and premolar; adams clasp on molar for retention purpose. Considering the amount of deviation and reduced mouth opening, mandibular GF prosthesis was fabricated on the nondefect side using autopolymerising acrylic resin (DPI Cold Cure pink; Dental products of India). After applying sufficient separating medium, the resin was added on buccal and lingual aspect of nondefect side of mandible and on the buccal side the extension was till the maxillary buccal vestibule. The prosthesis was tried in patient mouth and checked for retention and stability. It was trimmed and adjusted so that the mandible is guided to centric occlusion without delivering excessive force to maxillary teeth. Acrylic resin was added little by little to the guide flange until there was smooth guidance of the mandible to proper occlusion without any interference. The prosthesis was finished and polished (Figure 2). After insertion of the prosthesis, midline coincided and occlusion was achieved (Figure 3). The patient was advised to use the GF throughout the day except at night and during

Figure 3 Correction of deviation after insertion of the prosthesis.

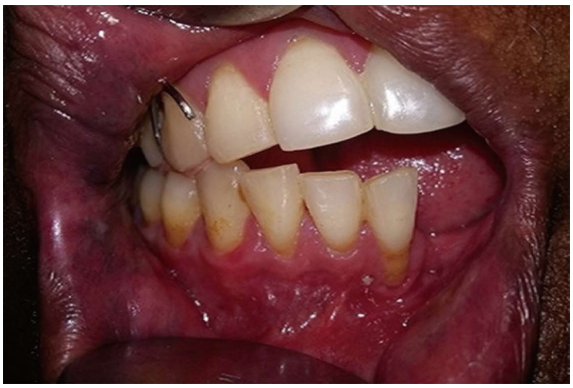

Figure 5 Occlusion contacts established with prosthesis.

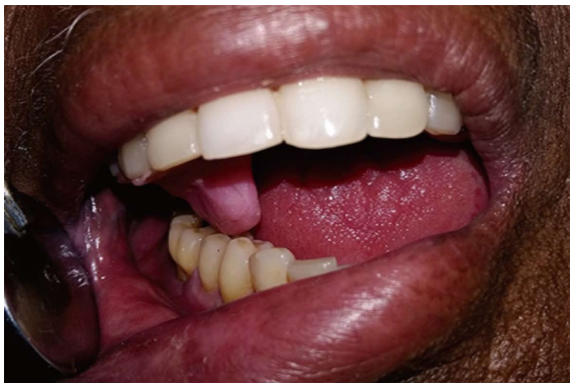

Figure 4 Palatal guiding flange prosthesis.

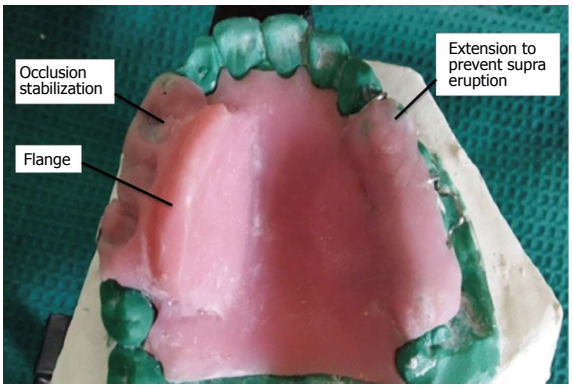

Figure 6 Palatal guiding flange prosthesis with functionally generated acrylic occlusal table on non-resected site and stabilization ramp for resected side.

meals. Physiotherapy exercises were also insisted. It included maximum mouth opening and grasping the chin to move the mandible away from surgical side. This will help in reducing trismus, minimize scar contracture and improve occlusion[1]. Review after a month, there was trivial reduction in the deviation. Hence, palatal GF prosthesis was made which wouldn't affect esthetics.

Case report 2

A 49 years old male patient presented to the hospital with the complaint of difficulty in mastication and facial disfigurement for the past three years owing to carcinoma left buccal mucosa for which he underwent composite resection of mandible and reconstructed with Pectoralis major myocutaneous flap following preoperative chemotherapy and radiotherapy. On clinical examination, there was deviation of remaining mandible towards the resected site and also downward rotation of mandible. It was noted that intermaxillary fixation was not done at the time of surgery. The mandibular defect was classified as Cantor and Curtis type Ⅲ[4]. Since it was resected till the midline the deviation and downward rotation of mandible was more due to loss of muscular support. The mouth opening was 35 mm. Intra oral examination revealed generalized attrition, supraeruption and partially edentulous mandible. Patient was able to bring remaining mandible to centric occlusion with guidance and he was not able to achieve this position consistently. Since mouth opening was normal compared to previous case, an acrylic GF on maxilla was planned as interim prosthesis.

Impression, cast, interocclusal record and articulation were made following the same procedure as in case report 1. Palatal GF prosthesis was planned for this case considering the stability of prosthesis, esthetics, occlusion and downward rotation of mandible. The guide flange extended till the lingual sulcus on the nondefect side. The prosthesis was tried in patient mouth. The inclination of the guide flange was adjusted until it guided the mandible to centric occlusion (Figure 4). But as both maxillary and mandibular teeth were attrited, functional cusps were worn out. The mandibular teeth glided beyond centric occlusion. To prevent this and to train the patient in centric occlusion, the acrylic resin was extended on the palatal cusps of maxillary teeth. A functionally generated path was recorded and an occlusal table was fabricated accordingly so as to stabilize the occlusion. The occlusal table was also extended on the maxillary teeth of defect side to prevent supraeruption as there were no opposing teeth (Figures 5 and 6). The patient was recalled after a month for review.

Case report 3

A 35 years old male patient came to the hospital with

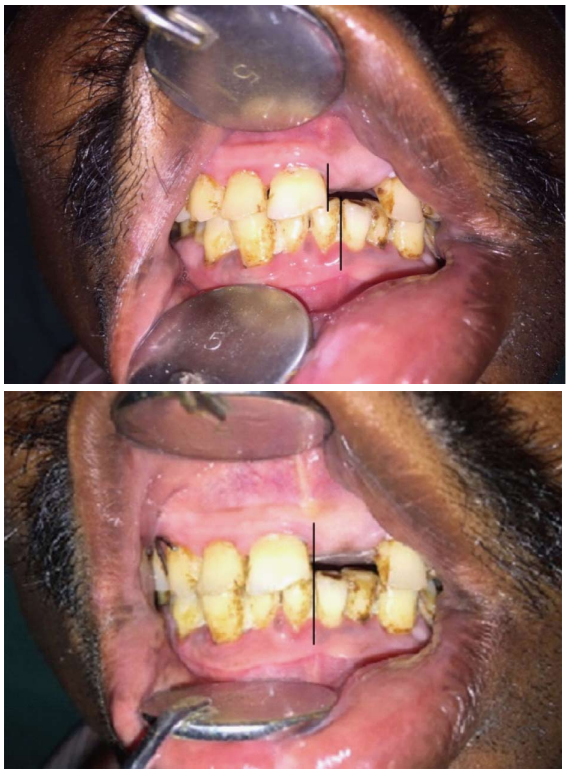

Figure 7 Note the midline before and after insertion of the prosthesis.

the history of hemimandibulectomy and left maxillary alveolectomy reconstructed with masseter flap done two weeks ago owing to carcinoma left buccal mucosa. Mouth opening was noted as 30 mm. It was noted that the deviation of mandible towards the resected side was minimum as the surgery was done only two weeks ago. If intervention with the GF was not done at this time, the deviation would worsen on healing process and scar formation. The procedure of impression making, cast, interocclusal record and articulation as in case report 1 was done. As the deviation was minimum, palatal GF prosthesis was planned for this case. As opposing teeth were present in the mandibular arch, the risk of supraeruption is nil. The prosthesis extended till the lingual sulcus on palatal non resected side. The prosthesis was tried in patient mouth and trimmed accordingly (Figure 7). The patient was able to guide the mandible into pre-existing occlusion (Figure 8). The patient was advised to wear the flange at all times except while eating and during nights and was asked to review after one week.

DISCUSSION

Segmental resection of mandible results in deviation of remaining segment towards the resected side due to uncompensated influence of contralateral musculature, particularly the internal pterygoid muscle. If this influence is uncompensated, the contraction of cicatricial tissue will fix the residual fragment in its deviated position[5]. The rotation of residual mandible in

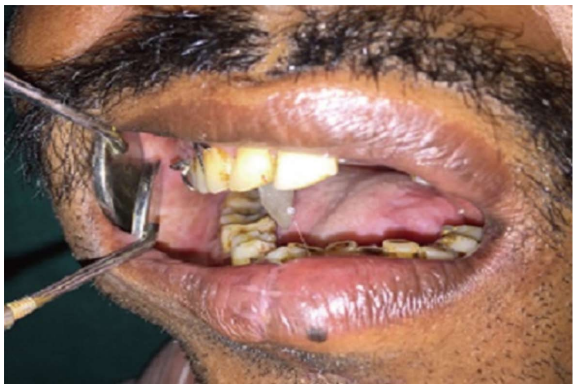

Figure 8 Mandibular first molar contacting the palatal ramp that guides the mandible to occlusion.

an inferior direction is caused by the pull of suprahyoid musculature and gravity due to loss of anchorage of elevator muscles[1]. The pathway of closure in a lateral resection of mandible starts from its medial, retruded position and closes in an upward diagonal manner into an occlusion which may or may not correspond with the patient's preoperative occlusion[6]. The amount of deviation and downward rotation depends on the extent of tissue loss. The more the mandible remaining, the better is the prosthetic prognosis. Retention of mandibular cuspids is especially beneficial[4].

The basic objective in rehabilitation is retraining the remaining mandibular muscles to provide an acceptable maxillo-mandibular relationship of the remaining portion of the mandible[7]. This would permit occlusion of remaining natural teeth or control of residual edentulous segments to provide for the reasonable placement and acceptable occlusion of the artificial teeth[7]. There are four significant factors that affect rehabilitation: The location and extent of surgery, the effect of radiation therapy, the presence or absence of teeth and the psychological aspect[6].

The time of initiation of the treatment is the key to success for restoring the form and function. The deviation after hemimandibulectomy will be difficult to correct after the healing phase of 6 to 8 wk due to scar contracture and the muscles adapting to this cicatricial tissue[1]. Patients usually have trismus following the surgery which will be a challenge for making an impression of maxilla and mandible. Hence preoperative casts should be advocated for all patients so that exact maxillo-mandibular relationship can be obtained postoperatively. Intermaxillary fixation can be advocated at time of surgery but for dressings and irrigation, it would be more advantageous to enable the patient to open and close the mouth. Temporary retainers can be made preoperatively so that it can immediately placed after surgery[8]. Robinson stated that temporary acrylic GF can be inserted on the third postoperative day[5]. In the above cases intermaxillary fixation was not done at the time of surgery and preoperative impressions were not made as they were referred only after surgery.

Table 1 Protocol for guiding flange

Based on time of referral		
1	Before surgery - 1 wk post-surgery	Intermaxillary fixation done with elastics
2	1 wk post-surgery - 1 mo	GF prosthesis and Physiotherapy
3	1 mo - 1 yr	Active physiotherapy, Counseling followed by GF prosthesis
4	> 1 yr	Surgical intervention
Based on amount of tissue resected		
1	Amount of hard and soft tissue	Directly influences success and difficulty in rehabilitation
2	Segmental resection of mandible distal to cuspid	Maxillary or Mandibular GF
2	Segmental resection of mandible that involves canine	Maxillary GF is the choice as the loss of mandibular canine results in more downward rotation of mandible and the mandibular GF might not be stable
Types of prosthesis		
1	Acrylic GF	Immediately after surgery and as training prosthesis
2	Definitive Cast metal GF	One year after training prosthesis
Modifications		
1	To prevent supraeruption	Occlusal table on Maxillary teeth on defect side
2	To stabilize occlusion	Functionally generated occlusal table on Maxillary teeth on nondefect side
	Intervention	Prognosis
1	From the time of planning and surgery	Better
2	Long time interval after surgery	Guarded

GF: Guiding flange.

Physiotherapy is recommended to reduce trismus and to loosen scar contracture. Without this, masticatory ability may decrease and lateral movement toward the nonresected side may not be possible[9]. It must be started two weeks postoperatively. Patient is asked to gently push the mandible away from the defect toward more normal position. While holding mandible in position, the patient should open the mouth as wide as possible to stretch the musculature at the resection site[1,4]. In all the three cases, physiotherapy was insisted.

Various literature shows different techniques for managing the deviation that include cast metal guidance prosthesis which is more technique sensitive, time consuming, expensive and require more number of patient visits. Acrylic GF is comparatively simple in design, cost effective, less patient visit and more importantly the ease of adjustability[10].

A common complaint without such an appliance is pain in the remaining temperomandibular joint which results from the abnormal position of the condyle[8]. Definitive treatment of these patients takes at least a year from the date of surgery as definitive treatment requires complete healing and no recurrence of cancer. Till then the acrylic GF prosthesis can be used as a training device for mandibular movements and to avoid further compilations.

In the cases presented above, acrylic GF was used as a training prosthesis. Out of three patients, one patient was referred immediately after surgery, one patient five years after surgery and other patient one month after surgery. In the first and third case report, resection was distal to canine. The amount of deviation was more in the first patient as the patient reported one month after surgery, mandibular GF was given for a period of three weeks later replaced with maxillary GF. The amount of deviation was trivial in the third patient as he reported one week following surgery, maxillary GF was given. In the second case report, the downward rotation of mandible was significant as the resection involved mandibular canine. For this case, maxillary GF was given with functionally generated occlusal table on non-defect side. For all the three patients, physiotherapy was insisted along with the insertion of GF. The patients had pain only due to scar contractures and deviation leading to pain on mandibular movements. This was addressed by correcting the deviation, and trying to maintain a stable occlusion. Guideline for GF is listed in Table 1.

Rehabilitation is an essential phase of cancer care and should be considered from the time of diagnosis in a complete and comprehensive treatment plan. The primary objective is restoration of function and appearance. GF prosthesis serves both the purpose. This article gives a comprehensive explanation about rehabilitation procedures carried out for three patients who were surgically treated for carcinoma with hemimandibulectomy and neck dissection.

ACKNOWLEDGMENTS

We thank the Department of surgical oncology, Government Royapettah hospital, Chennai, India and the Department of Plastic surgery, Rajiv Gandhi Government General hospital, Chennai, India for their valuable support.

COMMENTS

Case characteristics

All three cases complained of difficulty in mastication and facial disfigurement following hemimandibulectomy reconstructed with flap.

Clinical diagnosis
All three cases showed deviation of mandible towards the resected site, los of lip competency and occlusal contact and reduced mouth opening.

Treatment
Guiding flange (GF) prosthesis to correct deviation of mandible and to stablise occlusion enhancing mastication and esthetics.

Term explanation
GF prosthesis guides the remaining mandible to proper and stable occlusion and trains the mandibular movements after hemimandibulectomy.

Experiences and lessons
The time of initiation of treatment is the key to success. A common complaint without such prosthesis is pain in temperomandibular joint. This GF prosthesis alleviates pain and can be used as training device for mandibular movements after surgery.

Peer-review
This is a well written manuscript exposing the experience of the authors in such particular field.

REFERENCES

1 **Taylor TD**. Diagnostic considerations for Prosthodontic rehabilitation of the mandibulectomy patient. In: Clinical Maxillofacial Prosthetics, Chicago: Quintessence publishing, 2000: 155-170
2 **Schneider RL**, Taylor TD. Mandibular resection guidance prostheses: a literature review. *J Prosthet Dent* 1986; **55**: 84-86 [PMID: 3511245 DOI: 10.1016/0022-3913(86)90080-6]
3 **Edgerton** M, Pyott J. Surgery and prosthesis in Jaw reconstruction. *J Prosthet Dent* 1954; **4**: 257-262 [DOI: 10.1016/0022-3913(54)90103-1]
4 **Beumer J**, Curtis T, Marunick MT. Maxillofacial rehabilitation: Prosthodontic and surgical consideration Ishiyaku Euro America. 3rd edition. St. Luis, 1996: 184-188
5 **Robinson JE**, Rubright WC. Use of guide plane for maintain the residual fragment in partial or hemimandibulectomy. *J Prosthet Dent* 1964; **14**: 992-999 [DOI: 10.1016/0022-3913(64)90032-0]
6 **Curtis TA**, Cantor R. The forgotten patient in maxillofacial prosthetics. *J Prosthet Dent* 1974; **31**: 662-680 [PMID: 4524862 DOI: 10.1016/0022-3913(74)90122-X]
7 **Desjardins RP**. Occlusal considerations for the partial mandibulectomy patient. *J Prosthet Dent* 1979; **41**: 308-315 [PMID: 368320 DOI: 10.1016/0022-3913(79)90014-3]
8 **Ackerman AJ**. The prosthetic management of oral and facial defects following cancer surgery. *J Prosthet Dent* 1955; **5**: 413-432 [DOI: 10.1016/0022-3913(55)90050-0]
9 **Sahin N**, Hekimoğlu C, Aslan Y. The fabrication of cast metal guidance flange prostheses for a patient with segmental mandibulectomy: a clinical report. *J Prosthet Dent* 2005; **93**: 217-220 [PMID: 15775921 DOI: 10.1016/j.prosdent.2004.12.007]
10 **Kar S**, Tripathi A, Madhok R. Treatment outcome with guiding flange prosthesis in hemimandibulectomy patients: Case series of three patients. *Ann Maxillofac Surg* 2015; **5**: 266-270 [PMID: 26981486 DOI: 10.4103/2231-0746.175750]

P- Reviewer: Alimehmeti RH, Fourtounas C, Wang F **S- Editor**: Ji FF
L- Editor: A **E- Editor**: Lu YJ

Published by **Baishideng Publishing Group Inc**
7901 Stoneridge Drive, Suite 501, Pleasanton, CA 94588, USA
Telephone: +1-925-223-8242
Fax: +1-925-223-8243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.f6publishing.com/helpdesk
http://www.wjgnet.com