DOI: https://doi.org/10.5114/pm.2023.133594

Menopause Rev 2023; 22(4): 179-185 ORIGINAL PAPER

Menstrual changes after the thrombo-prophylaxis or anticoagulants used during the COVID-19 infection

Omnia B. Bakr, Alaa H. El-Feky, Ibrahim A. Abdelazim, Rania G. El-Skaan

Department of Obstetrics and Gynaecology, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Abstract

Introduction: To detect the menstrual changes after the thrombo-prophylaxis or anticoagulants used during the COVID-19 infection.

Material and methods: A total of 176 diagnosed with COVID-19 infection, were included in this retrospective study after giving informed consent. Participants were asked to complete an online questionnaire, and the collected participants` data were analysed using the χ^2 test to detect the menstrual changes after the thrombo-prophylaxis or anticoagulants used during the COVID-19 infection.

Results: The number of participants` number who reported menstrual flow for 2 to < 5 days, and menstrual flow > 7 days after the COVID-19 infection [31/176 (17.6%), and 42/176 (23.9%), respectively] was significantly higher compared to the number of participants` who reported menstrual flow for 2 to < 5 days, and menstrual flow > 7 days before the COVID-19 infection [12/176 (6.8%), and 15/176 (8.5%), respectively], (p = 0.005, and 0.0009, respectively). The use of thrombo-prophylaxis or anticoagulants during the COVID-19 infection was also associated with significant menstrual pattern changes (37.8% increased menstrual flow, 18.5% menstrual flow for 2 to < 5 days, 59.7% menstrual flow > 7 days, 5.9% contact bleeding, and 6.7% abnormal menstrual pattern for one cycle).

Conclusions: Significant menstrual changes were observed in this study after the COVID-19 infection infection (17.6% reported menstrual flow for 2 to < 5 days, and 23.9% reported menstrual flow > 7 days). The use of thrombo-prophylaxis or anticoagulants during the COVID-19 infection infection was associated with significant menstrual changes (37.8% increased menstrual flow, 18.5% menstrual flow for 2 to < 5 days, 59.7% menstrual flow > 7 days, 5.9% contact bleeding, and 6.7% abnormal menstrual pattern for one cycle).

Key words: menstrual changes, thrombo-prophylaxis, anticoagulants, COVID-19 infection.

Introduction

In 2019, several cases of pneumonia were reported in Wuhan, China. The pneumonia was later diagnosed to be caused by a novel Coronavirus Disease-19 infection (COVID-19) by the World Health Organization (WHO). In February 2020, after the spread of COVID-19 infection outside China, the COVID-19 infection outbreak was declared by the WHO [1].

Previous studies reported an abnormal coagulation (i.e. hypercoagulation status), affecting individuals infected with COVID-19 infection [2, 3]. The prevalence of venous thrombo-embolism has increased in critically ill COVID-19 infection individuals, despite prophylactic anticoagulants [4, 5]. Elevated D-dimer was reported in critically ill COVID-19 individuals; therefore, prophylactic (thromboprophylaxis) or therapeutic anticoagulants were recommended during the COVID-19 infection [6].

The causes of abnormal coagulation (i.e. hypercoagulation status) during the COVID-19 infection are not clearly understood, but it can be explained by the endothelial injury, and immobilization of the critically ill COVID-19 infected individuals [7–9].

Endothelial injury can occur following invasion of the endothelial cells by severe acute respiratory syndrome coronavirus-2 [SARS-CoV-2 (COVID-19)] or following activation of the individual's immune inflammatory response with subsequent elevated interleukin-6 (IL-6) and markers of complement activation (i.e. C5b-9) [3, 7].

Moreover, several changes in the circulating prothrombotic factors have been reported in critically ill COVID-19 infection individuals such as elevated factor VIII and fibrinogen, circulating prothrombotic microparticles, and neutrophil extracellular traps [10].

All hospitalized COVID-19 individuals should receive thromboprophylaxis unless contraindicated according to guidelines from the American Society of Haematology, and preferably low molecular weight heparin [11].

Uterine bleeding is less common in women infected with COVID-19 infection, but it may occur, especially

Corresponding author:
Ibrahim A. Abdelazim, MD, Prof., Department of Obstetrics and Gynaecology, Faculty of Medicine, Ain Shams University, Cairo, Egypt, e-mail: dr.ibrahimanwar@gmail.com

Submitted: 06.04.2023
Accepted: 10.05.2023

after the use of thrombo-prophylaxis or therapeutic anticoagulants [12, 13]. Abnormal uterine bleeding (AUB) is one of the common complications of anticoagulants; it causes iron deficiency anaemia, [14], and occurs in 70% of reproductive-age women receiving anticoagulants [15].

Recently a cross-sectional study found that COVID-19 infection could affect the menstrual flow pattern, and it recommended future studies to confirm this finding [16].

Therefore, the current study was designed to detect the menstrual changes after the thrombo-prophylaxis or anticoagulants used during the COVID-19 infection.

Material and methods

A total of 176 women infected with COVID-19 infection were included in this questionnaire-based retrospective study, which was conducted from January 2021 to March 2021 at Ain Shams University, Maternity Hospital (ASMH), after approval of the study protocol by the local Institutional Review Board.

Participants were included in this questionnaire-based retrospective study, after giving their consent, following the Helsinki regulation.

COVID-19 infection was diagnosed by nasopharyngeal swab and chest CT (computerized tomography), with/without clinical findings (i.e. anosmia, dyspnoea, dry cough, and/or gastrointestinal troubles).

Inclusion criteria include reproductive-age women (> 20 and < 40 years old), who were infected with of COVID-19, regardless of whether they received thromboprophylaxis or therapeutic anticoagulants during the COVID-19 infection.

Exclusion criteria include women < 20 or > 40 years old, menopausal women, women diagnosed with AUB before the COVID-19 infection, or received thromboprophylaxis or anticoagulants within 3–6 months before this study, and refused to participate.

The PALM (defines structural AUB: polyp, adenomyosis, leiomyoma, and malignancy), and COEIN (defines functional AUB: coagulopathy, ovulatory, endometrial, iatrogenic, and non-classified) classification of AUB was used to diagnose AUB [15]. A pictorial chart was used to estimate the menstrual blow flow [15].

Participants were asked to complete an online questionnaire (available at: https://docs.google.com/forms/d/e/1FAIpQLScjV2JA35_QdAhWqaoQsPPyfR33HXpHVc0mv1hDlVFh9XQd2Q/viewform?vc=0&c=0&w=1&flr=0&usp=mail_form_link), after giving informed consent.

The online questionnaire included the participants' demographic characteristics (i.e. age, marital condition, education, socio-economic level, job, and special habits); obstetric history (i.e. number of deliveries, mode of deliveries, and number of miscarriages); menstrual history (i.e. age of menarche, menstrual regularity, duration of flow, number of pads used/day, associated symptoms, and average cycle length); contraceptive history (i.e. last contraceptive method used, when started, and when stopped); chronic medication history, thrombo-embolic disorders, and/or bleeding disorders; COVID-19 infection (i.e. date and method of COVID-19 diagnosis, symptoms, history of hospital, and/or intensive care unit [ICU] admission); abnormal laboratory findings; thromboprophylaxis or the anticoagulants given; and menstrual changes after COVID-19 infection (i.e. menstrual flow days, number of pads used/day, menstrual regularity, and its duration).

The collected data were analysed using the χ^2 test to detect the menstrual changes after the thromboprophylaxis or anticoagulants used during the COVID-19 infection.

Sample size and statistical analysis

The sample size was calculated using G Power software version 3.1.9.7 [17], and χ^2 test. The qualitative variables were analysed using the χ^2 test to detect the menstrual changes after the thromboprophylaxis or anticoagulants used during the COVID-19 infection. $P < 0.05$ was considered significant.

Ethical considerations

Declaration of consent: The current study was conducted after approval of the study protocol by the local Institutional Review Board. Participants were included in this questionnaire-based retrospective study after giving their consent following the Helsinki regulation

Results

A total of 176 women infected with COVID-19 were included in this questionnaire-based retrospective study to detect menstrual changes after the use of thromboprophylaxis or anticoagulants during COVID-19 infection.

The characteristics of the studied participants are listed in Table 1. Table 2 shows the studied participants' menstrual patterns and the last contraceptive methods used before COVID-19 infection.

The most common participants' symptoms during the COVID-19 infection were body aches and myalgia (21.6%), followed by fever (20.5%), and loss of taste and smell (17%).

About 26.1% (46/176) the studied women were hospitalized, 4.5% (8/176) of them were admitted to the ICU, and C-reactive protein (CRP) and lactate dehydrogenase (LDH) were the most common abnormal laboratory findings observed among the studied partici-

Table 1. Demographic characteristics of the studied participants

Parameters	Studied women, *N* = 176 (%)
Marital status	
Single	72 (40.9)
Married	102 (58.0)
Divorced	2 (1.1)
Level of education	
Intermediate school	17 (9.7)
High school	22 (12.5)
Higher education	137 (77.8)
Socioeconomic status	
Average	142 (80.7)
Above average	24 (13.6)
Below average	10 (5.7)
Job	
Medical staff	80 (45.4)
Employee	45 (25.6)
Medical student	32 (18.2)
Housewife	19 (10.8)
Special habits	
No	132 (75.0)
Smoking	44 (25.0)
Number of deliveries	
NG	74 (42.0)
Primpara	22 (12.5)
Previous 2 deliveries	36 (20.5)
Previous 3 deliveries	22 (12.5)
Previous 4 deliveries	14 (8.0)
Previous 5 deliveries	8 (4.5)
Mode of delivery	
No	76 (43.2)
Vaginal delivery	54 (30.7)
Cesarean section	46 (26.1)
Number of miscarriages	
No	130 (73.9)
One	26 (14.8)
Two	16 (9.1)
Three	2 (1.1)
Four	2 (1.1)
Medical disorders	
No	171 (97.2)
Bleeding disorders	2 (1.1)
Thrombotic disorders	3 (1.7)
Chronic medications	
No	126 (71.6)
Medications for bronchial asthma	28 (15.9)
Insulin for Diabetes	10 (5.7)
Thyroid Medications	12 (6.8)

N – number, NG – nulligravida
Data presented as number and percentage (%).

pants [31.3% (55/176) and 30.1% (53/176), respectively] (Table 3).

Regarding the thromboprophylaxis or the anticoagulant used during the COVID-19 infection, 32.4% (57/176) of the studied participants did not receive any thromboprophylaxis and/or anticoagulants, while 43.2% (76/176) of them received thromboprophylaxis, and 24.4% (43/176) received therapeutic anticoagulant during the COVID-19 infection (Table 3).

The factor Xa inhibitor, (Xalerto®, Janssen Pharma., USA or Rivarospire®, Atico Pharm., Egypt) were used as thromboprophylaxis in 38.2% (29/76) of the studied participants during the COVID-19 infection, and acetylsalicylic acid (antiplatelet), (Aspocid®, CID Pharm., Egypt) was used as thromboprophylaxis in 30.3% (23/76) of them. Rivarospire® was used as a therapeutic anticoagulant in 41.9% (18/43) of the studied participants during the COVID-19 infection (Table 3).

Menstrual changes during the COVID-19 infection

The number of participants who reported menstrual flow for 2 to < 5 days, and menstrual flow > 7 days after the COVID-19 infection [31/176 (17.6%) and 42/176 (23.9%), respectively] was significantly higher compared to the number of participants who reported menstrual flow for 2 to < 5 days, and menstrual flow > 7 days before the COVID-19 infection [12/176 (6.8%) and 15/176 (8.5%), respectively], (p = 0.005 and 0.0009, respectively) (Fig. 1, Table 4).

Moreover, the number of participants who reported normal menstrual flow days (5–7 days) after the COVID-19 infection [103/176 (58.5%)] was significantly lower compared to the number of the participants who reported normal menstrual flow days before the COVID-19 infection [149/176 (84.7%)] (p = 0.02) (Table 4).

The number of pads used/day did not show any significant difference before or after the COVID-19 infection (Fig. 2, Table 4).

Menstrual changes after the thrombo-prophylaxis or anticoagulants used during the COVID-19 infection

The number of participants who reported increased menstrual flow, menstrual flow for 2 to < 5 days, and menstrual flow > 7 days after the thromboprophylaxis or anticoagulants during the COVID-19 infection [45/119 (37.8%), 22/119 (18.5%), and 71/119 (59.7%), respectively] was significantly higher compared to those who did not use thromboprophylaxis or anticoagulants during the COVID-19 infection [15/57 (26.3%), 9/57 (15.8%), and 32/57 (56.1%), respectively], (p = 0.0002, 0.02, and 0.0007, respectively).

Table 2. The studied participants' menstrual pattern and the contraceptive methods used before COVID-19 infection

Parameters	Studied women, *N* = 176 (%)
Age of menarche	
10–16	163 (92.6)
> 16	13 (7.4)
Menstrual pattern	
Irregular	28 (15.9)
Regular	148 (84.1)
Number of menstrual flow/days	
>2 < 5 days	12 (6.8)
5–7 days	149 (84.7)
<7 days	15 (8.5)
Number of pads used/day	
2–5	155 (88.1)
> 5	21 (11.9)
Average cycle length	
21–35	145 (82.4)
> 35	31 (17.6)
Associated symptoms	
No symptoms	3 (1.7)
Dysmenorrhea	58 (33.0)
Breast tenderness	84 (47.7)
Headache	5 (2.8)
Mode changes	20 (11.4)
Others	6 (3.4)
Last contraception method used before COVID-19 infection	
No	82 (46.6)
Barrier method	4 (2.3)
Intradermal implants	22 (12.5)
Cupper intrauterine contraceptive device	34 (19.3)
Hormonal intrauterine contraceptive device	7 (4.0)
Oral contraceptive pills	16 (9.1)
Injectable	2 (1.1)
Natural methods	9 (5.1)
The start of the last contraception method used	
1999	106 (60.2)
2009	2 (1.1)
2011	2 (1.1)
2012	8 (4.6)
2013	3 (1.7)
2014	3 (1.7)
2015	4 (2.3)
2016	6 (3.4)
2018	8 (4.6)
2019	12 (6.8)
2020	12 (6.8)
2021	10 (5.7)
The stoppage of the last contraception method used	
Not yet stopped	148 (84.1)
2015	2 (1.1)
2019	2 (1.1)
2020	8 (4.6)
2021	16 (9.1)

Data presented as number and percentage (%).

Table 3. Hospital and ICU admissions, abnormal laboratory findings, thromboprophylaxis, and therapeutic anticoagulant used during COVID-19 infection

Parameters	Studied women, *N* = 176 (%)
Hospital admission	
Yes	46 (26.1)
No	130 (73.9)
Intensive care unit admission	
Yes	8 (4.5)
No	168 (95.5)
Abnormal laboratory tests during active COVID-19 infection	
Complete blood count	7 (4.0)
C-reactive protein	55 (31.3)
Lactate dehydrogenase	53 (30.1)
D-dimer	35 (19.9)
Serum ferritin	24 (13.6)
Liver enzymes	2 (1.1)
Anticoagulant	–
No	**57 (32.4)**
Thrombo-prophylaxis	**76 (43.2)**
Clexane 40 IU/24	10 (13.2)
Clexane 60 IU/24	7 (9.2)
Clexane 80 IU/24	3 (3.9)
Rivaroxaban (Rivarospire or Xalerto)	**29 (38.2)**
Acetylsalicylic acid (Aspocid)	**23 (30.3)**
Eliquis (Apixaban)	4 (5.2)
Therapeutic anticoagulants	**43 (24.4)**
Clexane 40 IU/12	2 (4.6)
Clexane 80 IU/12	3 (7.0)
Rivarospire (Rivaroxaban)	**18 (41.8)**
Eliquis (Apixaban)	10 (23.3)
Asposid (Acetylsalicylic Acid)	10 (23.3)

Data presented as number and percentage (%).

In addition, the number of participants who reported contact bleeding, and abnormal menstrual pattern for one cycle after the thromboprophylaxis or anticoagulants during the COVID-19 infection [7/119 (5.9%) and 8/119 (6.7%), respectively] was significantly higher compared to those who did not use thromboprophylaxis or anticoagulants during the COVID-19 infection [1/57 (1.8%) and 0/57 (0%), respectively], (p = 0.2 and 0.0009, respectively) (Table 5).

Discussion

A total of 176 women infected with COVID-19 were included in this questionnaire-based retrospective study, which was conducted at ASMH to detect menstrual changes after the use of thromboprophylaxis or anticoagulants during the COVID-19 infection.

External stimuli, including infections, medication, and organ dysfunctions, can easily disrupt the typical menstrual rhythm [18]. Previous studies reported menstrual abnormalities among women infected with viral infections, including hepatitis B virus (HBV), and hepatitis B virus (HCV) [19], as well as human immunodeficiency virus (HIV) [20].

Menstrual changes during the COVID-19 infection

The number of participants who reported menstrual flow for 2 to < 5 days, and menstrual flow > 7 days after the COVID-19 infection [31/176 (17.6%) and 42/176 (23.9%), respectively] was significantly higher compared to the number of participants who reported menstrual flow for 2 to < 5 days, and menstrual flow > 7 days before the COVID-19 infection [12/176 (6.8%) and 15/176 (8.5%), respectively], (p = 0.005 and 0.0009, respectively).

A retrospective cohort study including 18.076 women and examining the ovulatory and menstrual changes during the COVID-19 pandemic found that 7.7% and 19.5% of the studied participants had anovulation and abnormal menstrual cycle length, respectively, during the COVID-19 pandemic [21].

Another recent retrospective study, conducted to evaluate the menstrual changes after COVID-19 infection, found that 56.9% of the studied participants reported a change of their menstrual blood loss, and 47.2% of them reported a change of their menstrual blood loss and the number of days between 2 consecutive cycles [16].

A retrospective, cross-sectional study including 237 reproductive-age women infected with COVID-19 found that 25% of the studied women had menstrual volume changes, and 28% of them had menstrual cycle changes (mainly decreased menstrual volume or prolonged cycles) [22].

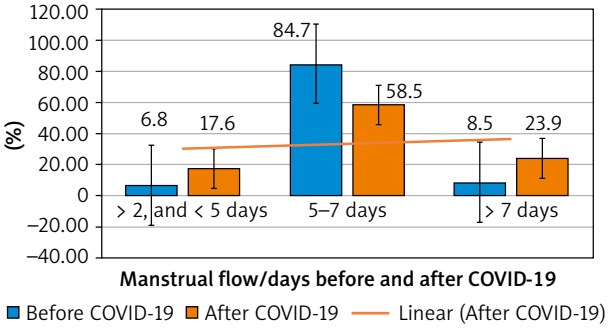

Fig. 1. Menstrual flow/days before and after COVID-19 infection

Table 4. Menstrual flow days and number of pads used/days before and after COVID-19 infection

Parameters	Before COVID-19, N = 176 (%)	After COVID-19, N = 176 (%)	p-value (χ^2 test)
Days of menstrual flow			
2 to <5 days	12 (6.8)	31 (17.6)	0.005*
5–7 days	149 (84.7)	103 (58.5)	0.02*
> 7 days	15 (8.5)	42 (23.9)	0.0009*
Number of pads used/day			
2–5 pads/day	155 (88.1)	142 (80.7)	0.6
> 5 pads/day	21 (11.9)	34 (19.3)	0.1

* Significant difference
Data presented as number and percentage (%)
χ^2 test used for statistical analysis

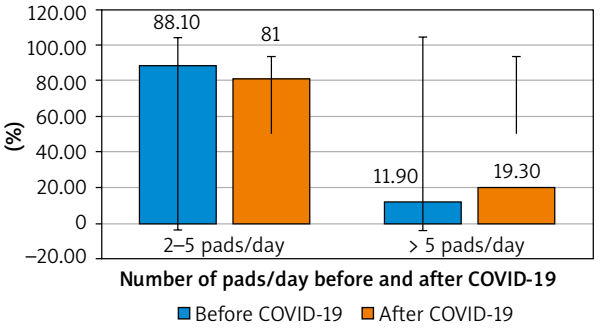

Fig. 2. Number of pads used/day before and after COVID-19 infection

The menstrual abnormalities were also reported after receiving mRNA or adenovirus vector COVID-19 vaccines, which suggest a relationship between the menstrual changes, and the host immune response rather than the virus or the vaccine components [23].

Menstrual changes after the thrombo-prophylaxis or anticoagulants used during the COVID-19 infection

The number of participants who reported increased menstrual flow, menstrual flow for 2 to < 5 days, and

Table 5. The studied participants' menstrual pattern after COVID-19 infection with or without use of thromboprophylaxis or anticoagulants

Parameters	Number of studied participants, *N* = 176 (%)	Without thrombo-prophylaxis or anticoagulants, *N* = 57 (%)	With thrombo-prophylaxis or anticoagulants, *N* = 119 (%)	*p*-value (χ^2 test)
Effect of COVID-19 infection on menstrual flow				
Increased	60 (34.1)	15 (26.3)	45 (37.8)	0.0002*
Same	77 (43.7)	29 (50.9)	48 (40.3)	0.04
Decreased	39 (22.2)	13 (22.8)	26 (21.9)	0.04
Menstrual flow days after COVID-19 infection				
2 to <5 days	31 (17.6)	9 (15.8)	22 (18.5)	0.02*
5–7 days	103 (58.5)	32 (56.1)	71 (59.7)	0.0007*
> 7 days	42 (23.9)	16 (28.1)	26 (21.8)	0.14
Number of pads used/day after COVID-19 infection				
2–5	142 (80.7)	43 (75.4)	99 (83.2)	0
> 5	34 (19.3)	14 (24.6)	20 (16.8)	0.3
Menstrual irregularities after COVID-19 infection				
No	116 (65.9)	36 (63.2)	80 (67.2)	–
Intermenstrual bleeding	27 (15.3)	12 (21.0)	15 (12.6)	0.5
Contact bleeding	8 (4.6)	1 (1.8)	7 (5.9)	0.02*
Others	25 (14.2)	8 (14.0)	17 (14.3)	0.08
Duration of abnormal menstrual pattern after COVID-19 infection				
No abnormal pattern	136 (77.3)	45 (78.9)	91 (76.5)	–
One menstrual cycle	8 (4.6)	0 (0)	8 (6.7)	0.0009*
Two menstrual cycles	24 (13.6)	9 (15.8)	15 (12.6)	0.2
Three menstrual cycles	3 (1.7)	1 (1.8)	2 (1.7)	0.5
Four menstrual cycles	4 (2.3)	2 (3.5)	2 (1.7)	1.0
Stopped after COVID-19 infection	1 (0.5)	0 (0)	1 (0.8)	0.2

* Significant difference
Data presented as number and percentage (%).
χ^2 test used for statistical analysis

menstrual flow > 7 days after the thromboprophylaxis or anticoagulants during the COVID-19 infection [45/119 (37.8%), 22/119 (18.5%), and 71/119 (59.7%), respectively] was significantly higher compared to those who did not use thromboprophylaxis or anticoagulants during the COVID-19 infection [15/57 (26.3%), 9/57 (15.8%), and 32/57 (56.1%), respectively], (p = 0.0002, 0.02, and 0.0007, respectively).

In addition, the number of participants who reported contact bleeding, and abnormal menstrual pattern for one cycle after the thromboprophylaxis or anticoagulants during the COVID-19 infection [7/119 (5.9%) and 8/119 (6.7%), respectively] was significantly higher compared to those who did not use thromboprophylaxis or anticoagulants during the COVID-19 infection [1/57 (1.8%) and 0/57 (0%), respectively] (p = 0.2 and 0.0009, respectively).

The use of anticoagulants was listed as one of the causes of AUB in the PALM and COEIN classification of AUB [15], and it is one of the common causes of AUB [24]. The usage of thromboprophylaxis or anticoagulants in COVID-19-infected women remains an area of debate, and there are no available guidelines regulating the use of thromboprophylaxis or anticoagulants during COVID-19 infection [25].

This study was the first questionnaire-based retrospective study conducted at ASMH, including 176 women with COVID-19 to detect the menstrual changes after the use of thromboprophylaxis or anticoagulants during the COVID-19 infection.

Significant menstrual changes were observed in this study after COVID-19 infection (17.6% of the participants reported menstrual flow for 2 to < 5 days, and 23.9% reported menstrual flow > 7 days). The use of thromboprophylaxis or anticoagulants during COVID-19 was associated with significant menstrual changes (37.8% increased menstrual flow, 18.5% menstrual flow for 2 to < 5 days, 59.7% menstrual flow > 7 days, 5.9% contact bleeding, and 6.7% abnormal menstrual pattern for one cycle). The retrospective

nature and the self-reported data were the limitations of the current study.

The menstrual changes after the COVID-19 infection and after the use of thromboprophylaxis or anticoagulants during the COVID-19 infection need to be confirmed in future studies. A guideline regulating the use of thromboprophylaxis or anticoagulants during the COVID-19 should be created and implemented.

Conclusions

Significant menstrual changes after COVID-19 infection were observed in this study (17.6% reported menstrual flow for 2 to < 5 days, and 23.9% reported menstrual flow > 7 days). The use of thromboprophylaxis or anticoagulants during COVID-19 was associated with significant menstrual changes (37.8% increased menstrual flow, 18.5% menstrual flow for 2 to < 5 days, 59.7% menstrual flow > 7 days, 5.9% contact bleeding, and 6.7% abnormal menstrual pattern for one cycle).

Disclosure

The authors report no conflict of interest.

References

1. Zhou P, Yang XL, Wang XG, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature 2020; 579: 270-273.
2. Abou-Ismail MY, Diamond A, Kapoor S, Arafah Y, Nayak L. The hypercoagulable state in COVID-19: incidence, pathophysiology, and management. Thromb Res 2020; 194: 101-115.
3. Kichloo A, Dettloff K, Aljadah M, et al. COVID-19 and hypercoagulability: a review. Clin Appl Thromb Hemost 2020; 26: 1076029620962853.
4. Wu C, Liu Y, Cai X, Zhang W, Li Y, Fu C. Prevalence of venous thromboembolism in critically Ill patients with coronavirus disease 2019: a meta-analysis. Front Med (Lausanne) 2021; 8: 603558.
5. Kunutsor SK, Laukkanen JA. Incidence of venous and arterial thromboembolic complications in COVID-19: a systematic review and meta-analysis. Thromb Res 2020; 196: 27-30.
6. Mouhat B, Besutti M, Bouiller K, et al. Elevated D-dimers and lack of anticoagulation predict PE in severe COVID-19 patients. Eur Respir J 2020; 56: 2001811.
7. Magro C, Mulvey JJ, Berlin D, et al. Complement associated microvascular injury and thrombosis in the pathogenesis of severe COVID-19 infection: a report of five cases. Transl Res 2020; 220: 1-13.
8. Shang Y, Pan C, Yang X, et al. Management of critically ill patients with COVID-19 in ICU: statement from front-line intensive care experts in Wuhan, China. Ann Intensive Care 2020; 10: 73.
9. Klok FA, Kruip MJHA, van der Meer NJM, et al. Confirmation of the high cumulative incidence of thrombotic complications in critically ill ICU patients with COVID-19: an updated analysis. Thromb Res 2020; 191: 148-150.
10. Panigada M, Bottino N, Tagliabue P, et al. Hypercoagulability of COVID-19 patients in intensive care unit: a report of thromboelastography findings and other parameters of hemostasis. J Thromb Haemost 2020; 18: 1738-1742.
11. Cuker A, Peyvandi F. Coronavirus disease 2019 (COVID-19): hypercoagulability. Up to Date. Available from: https://www.uptodate.com/contents/COVID-19-hypercoagulability. 2020 (accessed: 31.03.2023).
12. Singh B, Mechineni A, Kaur P, Reid RJ, Maroules M. COVID-19 and bleeding at unusual locations: report of four cases. Hematol Transfus Cell Ther 2021; 43: 214-218.
13. Helms J, Tacquard C, Severac F, et al. CRICS TRIGGERSEP Group (Clinical Research in Intensive Care and Sepsis Trial Group for Global Evaluation and Research in Sepsis). High risk of thrombosis in patients with severe SARS-CoV-2 infection: a multicenter prospective cohort study. Intensiv Care Med 2020; 46: 1089-1098.
14. Obaid MA, Abdelazim I, AbuFaza M, Al-Khatlan H, Al-Tuhoo A, Alkhaldi F. Efficacy of ferric carboxy maltose in treatment of iron deficiency/iron deficiency anaemia during pregnancy. Prz Menopauz 2023; 22: 16-20.
15. Hagras AM, Hussein NA, Abdelazim I, Elhamamy N. Ferric carboxymaltose for treatment of iron deficiency and iron deficiency anemia caused by abnormal uterine bleeding. Prz Menopauz 2022; 21: 223-228.
16. Al-Najjar MAA, Al-Alwany RR, Al-Rshoud FM, Abu-Farha RK, Zawiah M. Menstrual changes following COVID-19 infection: a cross-sectional study from Jordan and Iraq. PLoS One 2022; 17: e0270537.
17. Farghali MM, Abdelazim IA, El-Ghazaly TE. Relation between chronic endometritis and recurrent miscarriage. Prz Menopauz 2021; 20: 116-121.
18. Kala M, Nivsarkar M. Role of cortisol and superoxide dismutase in psychological stress induced anovulation. Gen Comp Endocrinol 2016; 225: 117-124.
19. Kurmanova AM, Kurmanova GM, Lokshin VN. Reproductive dysfunctions in viral hepatitis. Gynecol Endocrinol 2016; 32: 37-40.
20. Chen T, Wu D, Chen H, et al. Clinical characteristics of 113 deceased patients with coronavirus disease 2019: retrospective study. BMJ 2020; 368: m1091.
21. Nguyen BT, Pang RD, Nelson AL, et al. Detecting variations in ovulation and menstruation during the COVID-19 pandemic, using real-world mobile app data. PLoS One 2021; 16: e0258314.
22. Li K, Chen G, Hou H, et al. Analysis of sex hormones and menstruation in COVID-19 women of child-bearing age. Reprod Biomed Online 2021; 42: 260-267.
23. Medicines and Healthcare Products Regulatory Agency. Coronavirus vaccine – weekly summary of yellow card reporting. 2021. Available from: https://www.gov.uk/government/publications/coronavirus-COVID-19-vaccine-adverse-reactions/coronavirus-vaccine-summary-of-yellow-card-reporting#annex-1-vaccine-analysis-print (accessed: 31.03.2023).
24. Boonyawat K, O'Brien SH, Bates SM. How I treat heavy menstrual bleeding associated with anticoagulants. Blood 2017; 130: 2603-2609.
25. Tang N, Li D, Wang X, Sun Z. Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. J Thromb Haemost 2020; 18: 844-847.