Vault Haematoma following Hysterectomy: Three-year Experience

Shuk-Tak KWOK MBBS
Department of Obstetrics and Gynaecology, Pamela Youde Nethersole Eastern Hospital, Hong Kong

Objectives: To examine the incidence of vault haematoma following different types of hysterectomy and to identify any risk factors related to its occurrence.
Methods: This was a retrospective analysis of patients with vault haematoma over a 3-year period (January 2012 to December 2014) at the Department of Obstetrics and Gynaecology of Pamela Youde Nethersole Eastern Hospital, Hong Kong. A total of 801 hysterectomies were performed during the above period and 56 vault haematomas were identified. Five cases of laparoscopic-assisted supracervical hysterectomy and subtotal hysterectomy were excluded.
Results: The overall incidence of symptomatic vault haematoma was 7.04%. The occurrence of vault haematoma was associated with route of hysterectomy (p=0.03). Among routes of hysterectomy, vaginal hysterectomy was significantly associated with vault haematoma (p=0.004). Patient factors were not associated with occurrence of vault haematoma, which included taking antiplatelet agents (p=0.99) or anticoagulants (p=0.19) that were related to a bleeding tendency, a history of diabetes mellitus (p=0.81) or menopausal status (p=0.18) that could influence wound healing ability, parity (p=0.51), history of lower segment Caesarean section (p=0.65), and uterine size (p=0.72) that could affect degree of difficulty of operation.
Conclusion: Vaginal hysterectomy is more likely to be associated with occurrence of vault haematoma than hysterectomy performed via other routes. It is important to consider the possibility of vault haematoma in patients with persistent fever and vaginal bleeding after vaginal hysterectomy. No other definite risk factors were identified in this study.
Hong Kong J Gynaecol Obstet Midwifery 2016; 16(2):121-8

Keywords: Hematoma; Hysterectomy; Risk factors

Introduction

Hysterectomy is the most common major gynaecological procedure. Postoperative vault haematoma is known to be associated with higher morbidity and longer recovery. A review showed that the presence of postoperative vault haematoma is associated with increased febrile morbidity and other morbid factors, e.g. need for blood transfusion, a greater drop in haemoglobin level, longer length of postoperative hospital stay, and greater number of readmissions[1]. Nonetheless, data on the incidence of vault haematoma after different types of hysterectomy are scarce. The incidence of vault hematoma after vaginal hysterectomy (VH) is apparently better studied than following other types of hysterectomy, but the literature reports a wide range of incidence varying from 19.4% to 98%[2,3]. According to the review by Thomson and Farquharson[1], bleeding tendency or difficulty achieving haemostasis during surgery may contribute to formation of haematoma after hysterectomy. There is a need to identify the risk factors for vault haematoma in order to minimise its occurrence. A local retrospective review of experience in laparoscopic-assisted vaginal hysterectomy (LAVH) reported the rate of vault haematoma to be 31.0%[4]. A retrospective review of vaginal hysterectomies in the absence of uterine prolapse showed a significant decrease in rate of vault haematoma from 12% to 1% (p=0.002) in the second study period[5]. The authors[5] suggested that surgeon experience was an important factor in occurrence of vault haematoma: paying particular attention to potential bleeders during operation was especially important. To the best of our knowledge, no study has examined the incidence and risk factors related to patient characteristics associated with the formation of vault haematoma.

This study aimed to examine the incidence of vault haematoma following hysterectomies performed via different routes to determine whether there is an association between route and incidence of vault haematoma, and to identify any patient risk factors for vault haematoma.

Correspondence to: Dr Shuk-Tak Kwok
Email: kst636@ha.org.hk

Methods

This was a retrospective analysis of patients with vault haematoma over a 3-year period (January 2012 to December 2014) at the Department of Obstetrics and Gynaecology of Pamela Youde Nethersole Eastern Hospital, Hong Kong.

Electronic records and medical records that included operation notes, ultrasound records, and progress notes of 801 women who underwent hysterectomy were reviewed through the hospital's Clinical Management System and Operating Theatre Management System. All patients with an ultrasound record showing vault haematoma were included. Vault haematoma was defined as a non-peristaltic complex echogenic mass on ultrasound[2]. Those with an intra-abdominal haematoma instead of vault haematoma diagnosed by more advanced imaging modality were excluded. Ultrasound examination to look for vault haematoma was performed postoperatively when clinically indicated, in accordance with our protocol. Ten types of hysterectomy were performed during the study period: total abdominal hysterectomy (TAH, n=449), VH (n=100), LAVH (n=22), subtotal hysterectomy (STH, n=3), radical abdominal hysterectomy (RAH, n=3), Wertheim's hysterectomy (WH, n=4), total laparoscopic hysterectomy (TLH, n=122), laparoscopic-assisted supracervical hysterectomy (LA supracervical hysterectomy, n=2), robotic-assisted total laparoscopic hysterectomy (RATLH, n=89), and robotic-assisted radical hysterectomy (RA radical hysterectomy, n=7). The five hysterectomies that were excluded in this study were STH and LA supracervical hysterectomy, as the cervix was not removed in these surgeries. A total of 56 cases of vault haematoma in 796 patients were identified. They were divided into five groups according to the route of hysterectomy, including abdominal, VH, LAVH, robotic-assisted and laparoscopic-assisted, to determine whether route of hysterectomy was associated with occurrence of vault haematoma (Table 1). The patients were further divided into those with and without vault haematoma to identify other patient risk factors for vault haematoma. The characteristics examined included menopausal status, parity, use of antiplatelet agents (e.g. aspirin and plavix) or anticoagulants (e.g. warfarin), presence of diabetes mellitus (DM), and uterine size. For DM, we included those with a history of DM who were prescribed either oral hypoglycaemic agents or insulin.

Demographic data extracted from the medical records for those with vault haematoma included age, body mass index (BMI), obstetric history, menopausal status, and indication for surgery. To gauge the potential risk factors influencing the formation of vault haematoma, the following data were extracted:

1. operation notes for duration of surgery, choice of antibiotic prophylaxis, and blood loss;
2. perioperative morbidities and length of hospital stay;
3. the rate of readmission and the reason;
4. the symptom(s) for which ultrasound was performed to look for vault haematoma;
5. the size of the vault haematoma on transvaginal ultrasound; and
6. the management of the vault haematoma.

Data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences Windows version 23 (SPSS Inc., Chicago [IL], US). Chi-square test was used to determine any association between various factors and occurrence of vault haematoma. In assessing the association between the route of hysterectomy with vault haematoma, TAH, RAH, and WH were pooled together as these three routes of hysterectomy were via an abdominal approach. RATLH and RA radical hysterectomy were pooled together as these two routes involved robotic

Table 1. Routes of hysterectomy (n=796)

Route	Vault haematoma	No vault haematoma
Abdominal (TAH, WH, radical abdominal hysterectomy) [n=456]	27 (5.9%)	429 (94.1%)
VH (n=100)	14 (14%)	86 (86%)
LAVH (n=22)	0	22 (100%)
Robotic-assisted (RATLH, RA radical hysterectomy) [n=96]	8 (8.3%)	88 (91.7%)
TLH [n=122]	7 (5.7%)	115 (94.3%)
Total	**56 (7.0%)**	**740 (93.0%)**

Abbreviations: LAVH = laparoscopic-assisted vaginal hysterectomy; RATLH = robotic-assisted total laparoscopic hysterectomy; TAH = total abdominal hysterectomy; TLH = total laparoscopic hysterectomy; VH = vaginal hysterectomy; WH = Wertheim's hysterectomy

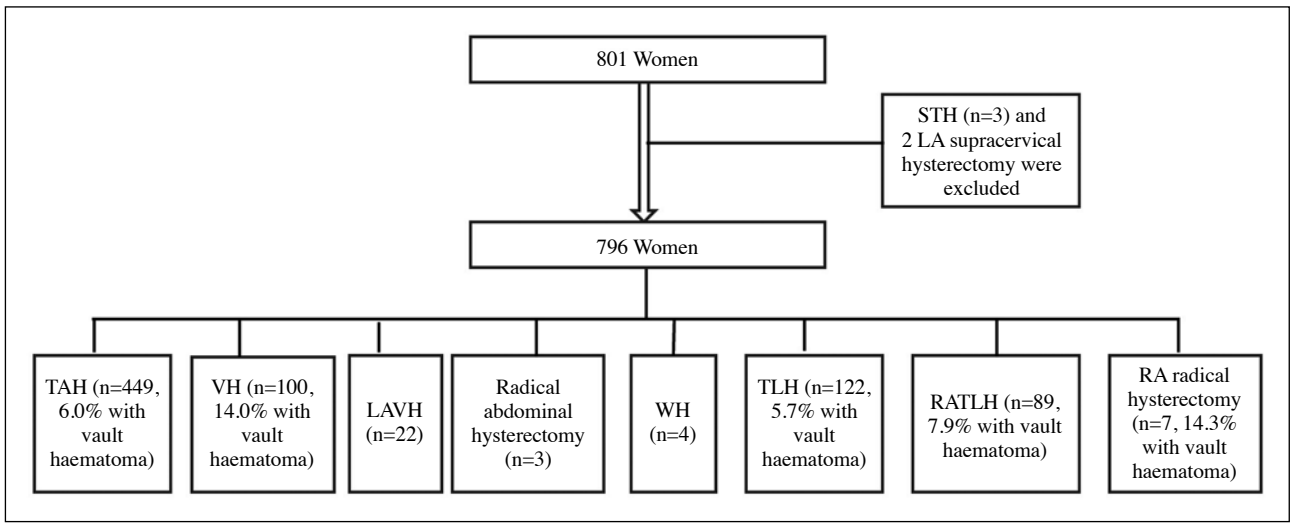

Figure 1. Flowchart showing various types of hysterectomy for study subjects and those with vault haematoma

Abbreviations: LA supracervical hysterectomy = laparoscopic-assisted supracervical hysterectomy; LAVH = laparoscopic-assisted vaginal hysterectomy; RA radical hysterectomy = robotic-assisted radical hysterectomy; RAH = radical abdominal hysterectomy; RATLH = robotic-assisted total laparoscopic hysterectomy; STH = subtotal hysterectomy; TAH = total abdominal hysterectomy; TLH = total laparoscopic hysterectomy; VH = vaginal hysterectomy; WH = Wertheim's hysterectomy

assistance. Student's *t* test was used to assess presence of association between uterine size and occurrence of vault haematoma. A p value <0.05 was considered statistically significant. This study was approved by the Hong Kong East Cluster Ethics Committee and conducted in full compliance with the International Council for Harmonisation E6 Good Clinical Practice and the Declaration of Helsinki.

Results

Among 796 hysterectomies, 56 cases of vault haematoma were documented, giving an overall incidence of 7.04%. Vault haematoma was found in TAH (27/449, 6.0%), VH (14/100, 14.0%), TLH (7/122, 5.7%), RA radical hysterectomy (1/7, 14.3%), and RATLH (7/89, 7.9%) [Figure 1]. The vault was closed by intracorporeal continuous suture Vicryl O (Ethicon, Mexico) in all laparoscopic hysterectomies, including TLH, RATLH, and RA radical hysterectomies. All VHs were performed for genital prolapse. The route of hysterectomy was significantly associated with occurrence of vault haematoma (p=0.03). Subgroup analysis revealed that VH was significantly associated with the occurrence of vault haematoma among the five routes of hysterectomy (p=0.004). The indications for hysterectomies complicated by vault haematoma are shown in Table 2. Most were performed for a benign condition.

The details of operations complicated by vault haematoma are shown in Table 3. The shortest time in surgery was for a patient undergoing VH for genital prolapse, the longest for a patient undergoing TAH and staging for carcinoma of the cervix complicated by ureteric injury requiring psoas hitch for repair. The minimal blood loss of 10 ml was in a case of RA radical hysterectomy for carcinoma of the cervix. The maximum blood loss of 3200 ml was following TAH for fibroid. All patients were prescribed antibiotic prophylaxis, in most cases cefazolin, a broad-spectrum, first-generation cephalosporin. Other

Table 2. Indications for hysterectomies complicated by vault haematoma (n=56)

Indication	No. of patients
Benign (n=43)	
Fibroid	22
Adenomyosis	4
Ovarian cyst	2
Genital prolapse	14
Abnormal pap smear	1
Premalignant (n=6)	
Atypical complex hyperplasia	6
Malignant (n=7)	
CA corpus	4
CA cervix	1
CA ovary	2

Abbreviation: CA = carcinoma

factors influencing the choice of antibiotic prophylaxis included a history of drug allergy and preference of the chief surgeon who made the final choice.

Among the 56 cases of vault haematoma, 14 (25%) required blood transfusion during or after surgery, and two (3.6%) required transfusion of other blood products such as platelets or fresh frozen plasma. Of these patients who required transfusion, 11 had undergone TAH, two had VH, and one had RATLH.

The length of postoperative hospital stay in this group ranged from 3 to 15 days. Two patients had the longest hospital stay of 15 days, including the first patient undergoing RA radical hysterectomy and pelvic lymph node dissection for carcinoma of cervix, and the second undergoing TAH and bilateral salpingo-ophorectomy, pelvic lymph node and para-aortic lymph node dissection for carcinoma of corpus. In both patients, the postoperative period was complicated by postoperative fever requiring intravenous antibiotics.

Table 3. Details of hysterectomies complicated by vault haematoma (n=56)

	Data
Mean (range) duration of operation (mins)	142 (45-426)
Mean (range) blood loss (ml)	393 (10-3200)
Antibiotic prophylaxis	
Cefazolin	52 (92.9%)
Augmentin	2 (3.6%)
Clindamycin	1 (1.8%)
Rocephin	1 (1.8%)
Blood transfusion	14 (25%)
Blood product transfusion	2 (3.6%)
Mean (range) duration of postoperative hospital stay (days)	6.3 (3-15)

The diagnosis of vault haematoma on ultrasound was made from postoperative day 2 to day 40 (Figure 2). Vault haematoma was diagnosed within 5 days of surgery in one third of the patients.

Comparison of baseline characteristics of patients with or without vault haematoma is shown in Table 4. With regard to patient factors related to bleeding tendency or ease of haemostasis during operation, neither use of antiplatelet agents nor anticoagulants was associated with occurrence of vault haematoma (p=0.99 and p=0.19, respectively). With respect to factors influencing wound healing ability, neither a history of DM (p=0.81) nor menopausal status (p=0.18) was associated with occurrence of vault haematoma. For

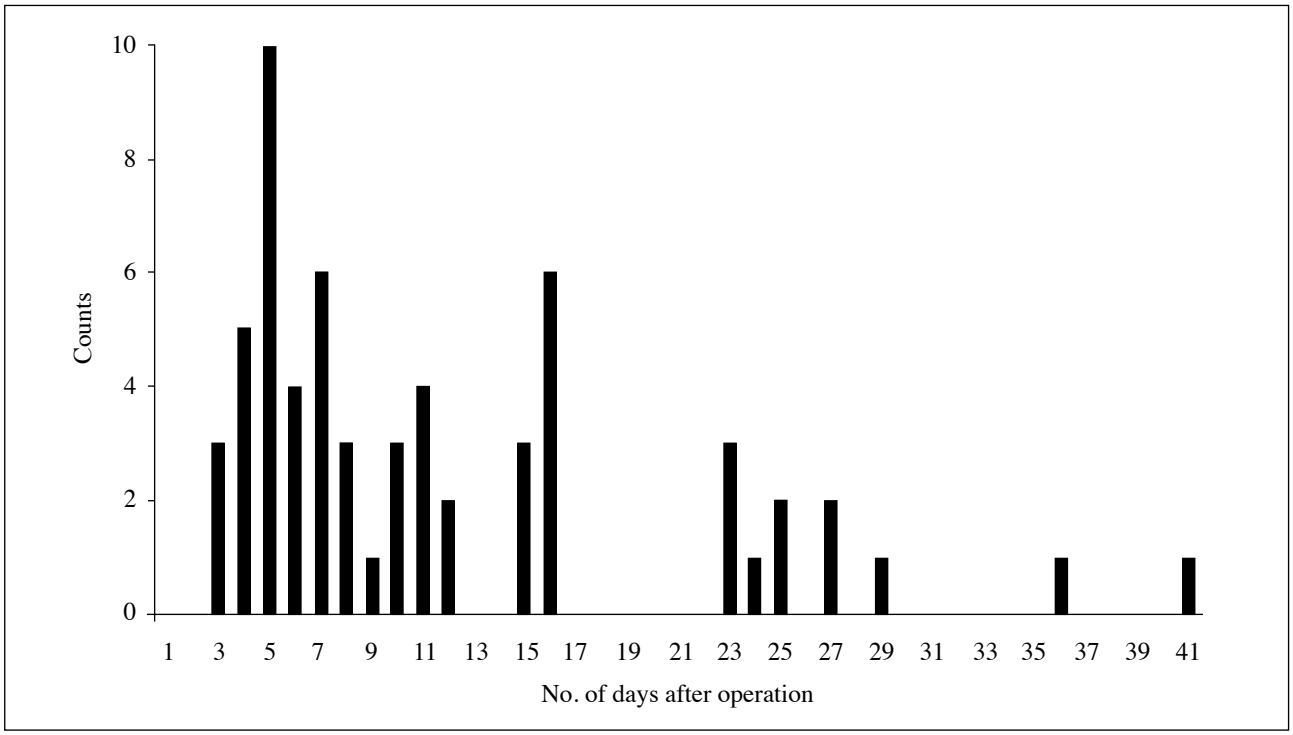

Figure 2. Time of diagnosis of symptomatic vault haematoma

Table 4. Comparison of patient characteristics in those with or without vault haematoma

	Vault haematoma (n=56)	No vault haematoma (n=740)	p Value
Mean (±SD, range) age (years)	52.75 (11.67, 33-77)	54.25 (10.85, 29-93)	0.47
Menopausal state (%)	18 (32.1%)	306 (41.4%)	0.18
Mean (range) parity	1.75 (0-5)	1.69 (0-10)	-
Grand multiparity ≥3	15 (26.8%)	169 (22.8%)	0.51
History of LSCS	8 (14.3%)	90 (12.2%)	0.65
Mean (range, 95% CI) uterine size (weeks)	10.1 (4-24, -1.33 to 1.95)	10.4 (0-36, -1.39 to 2.00)	0.72
History of diabetes mellitus	6 (10.7%)	87 (11.8%)	0.81
Antiplatelet agent	3 (5.4%)	40 (5.4%)	0.99
Anticoagulant	2 (3.6%)	10 (1.4%)	0.19

Abbreviations: 95% CI = 95% confidence interval; LSCS = lower segment Caesarean section; SD = standard deviation

BMI, the statistical analysis was aborted as data were missing in 32.1% of the 56 cases with vault haematoma. In examining factors related to ease of operation such as parity, patients were further divided into grand multiparity or not: parity was not associated with occurrence of vault haematoma (p=0.51). History of lower segment Caesarean section (LSCS) was not associated with occurrence of vault haematoma (p=0.65). Size of uterus was related to ease of operation but across all routes of hysterectomy showed no association with vault haematoma (p=0.72). Subgroup analysis also did not show any statistically significant difference in uterine size between patients with or without vault haematoma after VH (mean [±standard deviation] uterine size, 4.86±6.24 weeks vs. 5.56±5.95 weeks; p=0.22).

The main patient factors that prompted ultrasound examination to determine occurrence of vault haematoma are shown in Table 5. Postoperative fever was defined as presence of temperature >37.8°C for more than 24 hours. Among patients with vault haematoma, the most common presenting symptom was postoperative pyrexia (51.8%) followed by vaginal bleeding (28.6%). Other presentations included acute retention of urine (7.1%), other urinary symptoms like incomplete emptying or incontinence (5.4%), abdominal pain (3.6%), vaginal discharge (1.8%), and drop in haemoglobin (1.8%). Readmission for management of vault haematoma was required by 26 patients.

Treatment of vault haematoma (Table 5) with oral antibiotics alone resulted in resolution of vault haematoma in 55.3% of cases, but both drainage and intravenous antibiotics were required in three cases. The first patient had undergone VH and repair of cystocoele for genital prolapse. Transvaginal and transabdominal ultrasound was performed on postoperative day 2 when haemoglobin had fallen to 4.4 g/dl and revealed a vault haematoma of 267.59 ml. The second patient had TAH performed for fibroid and was readmitted with fever. Transvaginal and transabdominal ultrasound performed on postoperative day 8 revealed a vault haematoma of 32.75 ml. The third patient had TAH done for right broad ligament fibroid; transvaginal and transabdominal ultrasound on day 2 after operation for fever revealed a vault haematoma of 151.85 ml. All three

Table 5. Presentation and management of vault haematoma (n=56)

	Chief complaint
Presentation	
Vaginal bleeding	16 (28.6%)
Fever	29 (51.8%)
Vaginal discharge	1 (1.8%)
Abdominal pain	2 (3.6%)
Acute retention of urine	4 (7.1%)
Urinary symptoms	3 (5.4%)
Drop in haemoglobin	1 (1.8%)
Readmission	26 (46.4%)
Management	
Oral antibiotics alone	31 (55.3%)
Intravenous antibiotics ± oral antibiotics	24 (42.9%)
Drainage and intravenous antibiotics	3 (5.4%)
No treatment	1 (1.8%)

patients were prescribed antibiotics as first-line treatment, and drainage was subsequently performed when fever persisted beyond 5 days of intravenous antibiotics. Two patients required haematoma drainage by Foley catheter and one was drained by pipelle.

Volume of the vault haematoma was calculated from three dimensions. Data were incomplete in eight of the 56 cases who had only two dimensions recorded on the ultrasound report. They were excluded from analysis. Of the remaining 48 patients, vault haematoma volume was ≥20 ml in 22 and <20 ml in 26. Among those with vault haematoma ≥20 ml, the volume ranged from 20.64 ml to 267.59 ml. Among the three patients who required drainage, two had the largest volume of vault haematoma among those ≥20 ml.

Discussion

The overall incidence of vault haematoma in this study was 7.04%, far lower than that reported by other studies (19.4-98%)[2,3]. One possible explanation is that our incidence reflects the true incidence of symptomatic vault haematoma. Kulkarni and Vijaya[6] suggested that asymptomatic vault haematoma could be diagnosed in the early postoperative period and would subsequently resolve without ever becoming symptomatic. Therefore, our incidence reflects the incidence of vault haematoma that required clinical attention and management.

In the current study, the incidence of vault haematoma was highest following RA radical hysterectomy and VH compared with other types of hysterectomy (14.3% and 14.0%, respectively). Vault haematoma is the most common complication of vaginal hysterectomy[7]; therefore the incidence was expected to be highest in VHs. The incidence was comparable with that reported by Cheung and Pun[5] in their first study period (12%) but was higher than that in their second study period (1%). This may be due to the use of gonadotrophin-releasing hormone agonist (GnRHa) in their second study period and not given to our patients prior to VH. The incidence of vault haematoma after RA radical hysterectomy was high but the sample size was small and might not reflect the true incidence. The incidence of vault haematoma after TAH (6.0%) was similar to TLH (5.7%) and RATLH (7.9%) as shown in the current study. Rosen and Cario[8] suggested that the incidence of vault haematoma after TLH is comparable to that after TAH as the laparoscopic approach provides a magnified view of vault anatomy and enables precise haemostasis to avoid formation of vault haematoma. The incidence of vault haematoma after LAVH was 0%, far lower than that reported by Yuen and Rogers[4] (31%) as this study also included patients who were asymptomatic. Furthermore, the study[4] was carried out in the early 1990s, and advances in the design of instruments used for haemostasis in laparoscopic surgery in recent decades could have led to a reduction in vault haematoma.

The current study showed that the route of hysterectomy was associated with the occurrence of vault haematoma and only VH was associated with the occurrence of vault haematoma. Wood et al[9] suggested that the vaginal vault is the most frequent site of bleeding after VH. Due to limited access and poor visualisation during surgery, haemostasis is difficult in VH with consequent formation of vault haematoma.

An interesting observation in the current study was the timing of vault haematoma diagnosis: longest time from hysterectomy to presentation of vault haematoma was 40 days. This implies that vault haematoma can persist long after operation and takes time to resolve if no treatment is given. This justifies a need for timely diagnosis and treatment.

A vault haematoma consists of a collection of blood at the vault after hysterectomy and presumably forms as a result of residual bleeding at the end of surgery. It can be postulated that patient factors that increase bleeding tendency or increase difficulty of haemostasis during operation may be associated with the occurrence of vault haematoma. Surprisingly, the current study showed that vault haematoma was not associated with parity, history of LSCS, menopausal status, use of antiplatelet agents and anticoagulants, or a history of DM. In patients prescribed antiplatelet agents or anticoagulants, we usually take extra precautions for haemostasis and withhold the drugs prior to operation. This may explain the lack of an association of use of antiplatelet agents and anticoagulants with formation of vault haematoma. The same may also apply to patients with a history of LSCS, as surgeons usually take extra precautions in these patients to achieve meticulous haemostasis during operation. DM is known to be associated with poor wound healing but the association with bleeding tendency is not well established. Hence, no association was found between history of DM and formation of vault haematoma in the current study. Finally, the current study was a retrospective study that focused on symptomatic vault haematoma; asymptomatic vault haematoma associated with these risk factors would not have been detected or included.

The review by Cheung and Pun[5] found that uterine

size (in weeks) was statistically different in their two study periods (p≤0.001) but not the uterine weight (p=0.308). The median uterine size was larger in the first study period than the second with a lower incidence of vault haematoma noted in the latter. The study showed an inverse relationship between uterine size and the incidence of vault haematoma over the two study periods[5]. The authors attributed this observation to the use of GnRHa in the second study period. In this study, we directly analysed uterine size and found no association between uterine size and occurrence of vault haematoma across all routes of hysterectomy or after VH. It may be interesting to study the preoperative use of GnRHa in other routes of hysterectomy with occurrence of vault haematoma in future studies.

Cheung and Pun[5] also suggested that surgeon experience was important in the formation of vault haematoma after VH. This was not studied in the current study as we included all routes of hysterectomy that required different levels of surgical expertise. Owing to the retrospective nature of the study, data about the number of same procedures performed by the same surgeon were lacking. Therefore, it may be better to repeat the study and examine surgeon factors in formation of vault haematoma following specific routes of hysterectomy performed by the same group of surgeons.

A prospective observational study by Dane et al[2] suggested that febrile morbidity occurred more in cases with vault haematoma after VH, affecting up to 40% of such patients. This was comparable to the findings of the current study wherein 51.8% of patients with vault haematoma had febrile morbidity. Batish et al[7] suggested that patients with vault haematoma may present with postoperative vaginal bleeding, abdominal distension, paralytic ileus, fever, foul smelling discharge, tenesmus, and abscess formation. The current study showed that those with vault haematoma mostly presented with fever and vaginal bleeding. Thomson et al[10] suggested that 25.5% of patients with vault haematoma after vaginal hysterectomy were readmitted. The readmission rate was higher in the current study. We usually aim for early discharge to achieve an enhanced recovery pathway but the readmission rate is thus expected to be higher. For unexplained fever after hysterectomy, vault haematoma should be at the top of the differential list to be excluded.

There is a complete lack of literature comparing the management of vault haematoma[1]. In this study, the mainstay treatment was oral antibiotics alone (55.3%), an evidence that a trial of oral antibiotics may be sufficient to treat most symptomatic vault haematomas. Nonetheless, drainage of vault haematoma may be necessary under some circumstances, such as larger vault haematoma (≥20 ml)[1]. Drainage can be done using a Foley catheter or pipelle, and further study will be needed to assess the efficacy of both tools.

There were several limitations in this study. Firstly, there was a lack of a universally accepted protocol on management of vault haematoma and the plan of management was at the discretion of the gynaecologist providing postoperative care or the admitting gynaecologist. Second, the retrospective nature of this study prevented randomisation of patients. Third, the missing data due to the retrospective nature of the study limited accurate statistical analysis of the risk factors. Last but not least, the low incidence of symptomatic vault haematoma requires a larger study population to assess the clinical significance of factors, such as the size of vault haematoma and the morbidities. In the last few years, there has been a shift in trend of hysterectomy to laparoscopic surgery. A larger study population cannot be obtained through a longer study period as the sample size will be more heterogeneous. Therefore, a larger sample size can be better achieved with a multicentre study.

Conclusion

The overall incidence of vault haematoma in this study population was 7.04%. The route of hysterectomy was significantly associated with occurrence of vault haematoma (p=0.03), notably VH (p=0.004). Patient characteristics such as parity, history of LSCS, uterine size, menopausal status, use of antiplatelet agents or anticoagulants, and a history of DM were not associated with the occurrence of vault haematoma. As VH is the preferred route of hysterectomy in gynaecological surgery, it is important to consider the possibility of vault haematoma in patients with persistent fever or vaginal bleeding after VH.

Acknowledgments

The author would like to thank Dr S Liu and Ms Grace Kwok for advice on statistical analysis. The author would also like to acknowledge Dr Daniel Wong and Dr S Liu for their helpful comments on the manuscript.

Declaration

No potential conflict of interest relevant to this article was declared.

References

1. Thomson AJ, Farquharson RG. Vault haematoma and febrile morbidity after vaginal hysterectomy. *Hosp Med* 2000; 61:535-8.
2. Dane C, Dane B, Cetin A, Yayla M. Sonographically diagnosed vault hematomas following vaginal hysterectomy and its correlation with postoperative morbidity. *Infect Dis Obstet Gynecol* 2009; 2009:91708.
3. Kuhn RJ, de Crespigny LC. Vault haematoma after vaginal hysterectomy: an invariable sequel? *Aust N Z J Obstet Gynaecol* 1985; 25:59-62.
4. Yuen PM, Rogers MS. Is laparoscopically-assisted vaginal hysterectomy associated with low operative morbidity? *Aust N Z J Obstet Gynaecol* 1996; 36:39-43.
5. Cheung KW, Pun TC. Vaginal hysterectomies in patients without uterine prolapse: ten-year experience. *Hong Kong Med J* 2013; 19:323-7.
6. Kulkarni S, Vijaya N. Detection of vault hematoma by ultrasound scan following hysterectomy and its correlation with morbidity. *J Obstet Gynecol India* 2006; 56:507-10.
7. Batish A, Sathiyathasan S, Jeyanthan K. Vault haematoma after vaginal hysterectomy. *Nepal J Obstet Gynaecol* 2015; 9:70-2.
8. Rosen DM, Cario GM. Vault haematoma following laparoscopic hysterectomy. *Aust N Z J Obstet Gynaecol* 1997; 37:220-2.
9. Wood C, Maher P, Hill D. Bleeding associated with vaginal hysterectomy. *Aust N Z J Obstet Gynaecol* 1997; 37:457-61.
10. Thomson AJ, Sproston AR, Farquharson RG. Ultrasound detection of vault haematoma following vaginal hysterectomy. *Br J Obstet Gynaecol* 1998; 105:211-5.