



## ORIGINAL ARTICLE

# Identifying risk factors for post-operative bleeding in women undergoing loop electrosurgical excision procedure for cervical dysplasia

Jemima Feddersen<sup>1</sup> , Jonathan Carter<sup>2</sup>, Selvan Pather<sup>3</sup> and Samir A. Saidi<sup>3</sup> 

<sup>1</sup>Clinical Medical School, University of Sydney, Sydney, New South Wales, Australia

<sup>2</sup>Royal Prince Alfred Hospital, Sydney, New South Wales, Australia

<sup>3</sup>Chris O'Brien Lifehouse Hospital, Sydney, New South Wales, Australia

*Correspondence:* Dr Jemima Feddersen, 2A James St, Merewether, NSW 2291, Australia.  
Email: [jemimafeddersen@gmail.com](mailto:jemimafeddersen@gmail.com)

*Conflict of Interest:* The authors report no conflicts of interest.

Received: 10 November 2021;  
Accepted: 19 May 2022

**Background:** Loop electrosurgical excision is a procedure utilised in the treatment of high-grade squamous intraepithelial lesion (HSIL) of the cervix. Post-operatively women may experience immediate and/or delayed per vaginal bleeding.

**Aims:** The objective of this prospective pilot study was to assess the feasibility of identifying and quantifying patients' subjective experiences of post-operative bleeding following a loop electrosurgical excision procedure (LEEP) for HSIL. In addition, an analysis of demographical, lifestyle and surgical factors was undertaken to assess for any statistically significant correlation with post-operative bleeding.

**Materials and Methods:** This study included 110 patients who underwent a LEEP for biopsy-proven or suspected HSIL between 2017 and 2020. Subjective data were collected from weekly post-operative surveys and correlated with procedural data. Primary outcome assessed was the subjective rate of bleeding experienced. Baseline demographics were age, body mass index (BMI), specimen size, human papilloma virus variant and histopathology. Other variables of interest collected were exercise intensity, and alcohol intake.

**Results:** No association of statistical significance was discovered between age, BMI, or day of menstrual cycle. There was a statistically significant association between exercise intensity or specimen size (greater than the median) and increased bleeding, primarily in the first 2 weeks.

**Conclusions:** Women who undergo intense or prolonged exercise in the post-operative period may experience heavier bleeding particularly in the first 2 weeks post-LEEP. Heavy bleeding was also associated with a larger specimen size. There was no correlation between BMI, age or any other demographical factor.

**KEYWORDS**

LEEP, CIN, HSIL, cervix, bleeding, cervical dysplasia, LLETZ

**INTRODUCTION**

Cervical dysplasia (squamous intraepithelial lesion/SIL), is a condition characterised by abnormal epithelial cell growth and division of the squamous cells in the endocervical canal and on the surface

of the cervix itself.<sup>1</sup> This abnormal growth can be caused by several factors and is strongly associated with human papilloma virus (HPV) infection, of which there are over 200 different strains/variants.<sup>2</sup> Certain strains of HPV increase the likelihood that abnormal dysplasia of cervical cells will progress to a high-grade

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2022 The Authors. *Australian and New Zealand Journal of Obstetrics and Gynaecology* published by John Wiley & Sons Australia, Ltd on behalf of Royal Australian and New Zealand College of Obstetricians and Gynaecologists.

squamous intraepithelial lesion (HSIL), as well as decrease the time taken for dysplastic change to progress.<sup>3-5</sup> In chronic HPV infections, smoking has also been strongly associated with progression to HSIL.<sup>6</sup> Other associated risk factors include early initiation of sexual activity, multiple sexual partners, immunosuppression, and infection with human immunodeficiency virus.<sup>2,5</sup>

Loop electrosurgical excision procedure (LEEP) is a procedure utilised to treat HSIL by removing the section of the cervix which contains dysplastic cells with a small wire loop heated with electrical current.<sup>2</sup> Current literature suggest that a varied number of patients experience heavy per vaginal bleeding in the post-operative period which can significantly impact their recovery and in certain cases require readmission to hospital and further treatment.<sup>7,8</sup> In Australia LEEP is generally performed where either HSIL has been proven on biopsy or there is discordance between a Pap smear cytology and biopsy, raising a strong suspicion of HSIL. In some instances where the LEEP has been performed for a high-grade lesion, the final pathology shows a low-grade lesion or no residual dysplasia.

The literature on the incidence of post-operative bleeding is limited, as most studies currently published have looked at the incidence of recurrence of HSIL as the most important post-operative complication. Of the remaining papers, there is a wide range of post-operative bleeding reported in the literature, varying between 2% to 78%.<sup>7-19</sup> Of note in the studies found was a meta-review of  $n = 857$ , conducted in Thailand, which found a reported post-operative bleeding rate of 5.5%.<sup>7</sup>

The largest single study found involved  $n = 929$  in 2009 which looked at the after-effects of both colposcopy and LEEP over post-operative six weeks.<sup>8</sup> This study found reported rates for post-operative bleeding of 87%, but did not differentiate between light or heavy bleeding.<sup>8</sup> A study by Paraskevaidis *et al.*<sup>14</sup> focused on post-operative bleeding and correlation with menstrual cycle and found that women who underwent LEEP during the luteal phase of their menstrual cycle experienced more post-operative bleeding than women treated during the follicular phase. No other studies appear to focus on any potential lifestyle or demographic cause for this post-operative bleeding.<sup>7-18</sup> The most recent of the studies identified was a quality improvement study in Perth, Australia ( $n = 75$ ) which reported 36% of women experienced post-operative bleeding in the first week, which then decreased to 10.7% by post-operative four weeks.<sup>20</sup>

It is therefore clear that there is limited research which focuses solely on post-operative bleeding in this area of gynaecological surgery, with rates varying widely in their findings (5.4% to 87% respectively). In addition, there is a paucity of Australian research into this area.<sup>7-18</sup>

## MATERIALS AND METHODS

This prospective pilot study was registered and approved by Royal Prince Alfred (RPA) Human Research Ethics Committee (HREC) (X17-0172 & HREC/17/RPAH).

Data was collected by recruiting patients who presented to the Chris O'Brien Lifehouse Colposcopy Clinic for treatment of HSIL. Inclusion criteria included women aged 18–80, with a biopsy-proven or suspected (from high-grade cytology) diagnosis of HSIL requiring LEEP and with a willingness to give online consent and participate in a series of short surveys. Exclusion criteria include women lactating, pregnant or of childbearing potential who were not willing to avoid becoming pregnant during the study. Unfortunately, women who were unable to access email communication, or communicate and understand the English language were also excluded from this study as we did not have the funding and ability to offer alternative options.

The weekly emailed surveys began at post-operative 7 days. The surveys were identical except for the first one which included questions of height, weight, and menstrual period cycles. All four surveys collect data on bleeding rates, days of bleeding experienced, contraceptive use, and lifestyle factors including smoking, exercise and alcohol intake. Data were also collected from the electronic medical record, including pathology specimen dimensions, HPV status, histopathology results and the age of the participant as these were not captured in the survey.

As this was a novel study, for which similar data are limited in the literature, a formal power calculation was not feasible. It was estimated that to detect a 30% reduction in the proportion of patients exhibiting a lifestyle factor such as exercise or drinking alcohol (eg from 60% to 30%), a total sample size of 120 would be required assuming a 1:4 ratio of excessive bleeding. Thus, it was anticipated that a sample size of 100–120 patients would be appropriate.

Participants were defined as having heavy bleeding if they had both moderate or heavy bleeding (plus or minus clots) with >3 days bleeding per week†. The option chosen by participants was subjective; however, examples were given, eg, changing a pad every 2 hours, or passing clots would be considered heavy. To investigate the association of characteristics with heavy bleeding, generalised estimating equations (GEE) were used. Specimen size was calculated by individually reviewing histopathology, and using the measurements obtained to determine the size of the specimen (or specimens with multiple fragments) of the cumulative amount of cervix taken. The median tissue size based on these results was determined to be 689.19 mm<sup>3</sup>. The baseline demographics of interest were age, body mass index (BMI) and LEEP size.

## RESULTS

In total 215 participants were invited with 110 full responses being recorded, 74 of these completed the full 4 weeks of the survey (see Table 1). There was a wide range of age features in these responses, with the youngest participant being 23 and the oldest 77. Mean age was 33. Participants underwent LEEP for HSIL (high-grade squamous intraepithelial lesion) as described earlier;

however, around 10% of the final pathology specimens yielded only LSIL which is consistent with published standards<sup>21</sup> (see Tables 1 and 2).

A majority (67%) of participants were treated for dysplasia secondary to 'HPV Other' (indicating a HPV strain that is not 16/18). There were 69% of women who reported some form of bleeding in their first post-operative week, which increased to 75.2% in the second week. Of these women 30.9% and 31.9% categorised their bleeding as severe in the first and second weeks respectively. In addition, over 50% of participants reported some form of vaginal bleeding up to and including the fourth post-operative week.

Results were analysed using cross tabulation and GEE looking at reported bleeding rates and also within a defined group of responses categorised as heavy bleeding (as previously categorised). The results are detailed in Tables 3 and 4.

While no correlation was discovered between age, BMI, or day of menstrual cycle, there was a statistically significant correlation between exercise intensity (as defined by >3 days per week and medium to high-intensity sessions) and increased bleeding (95% CI) (See Table 3). A significant association was seen between LEEP size as expressed as a dichotomous variable (greater than median size) and the risk of reported heavy bleeding. There was also a correlation between decreased alcohol consumption and increased bleeding; however, this was not evident after the first week. A further association was also seen between HPV 16/18 strains and increased bleeding in the first week; however, this was not evident in the following weeks.

## DISCUSSION

This study was limited by its small sample size; however, this was an intense survey with a significant time and commitment from the participants over 4 weeks. This is reflected in the number invited  $n = 215$  and the number that successfully completed at least one of the surveys ( $n = 110$ ). In addition, the self-reporting nature of recall of bleeding rates is subjective.

While subjective reporting of bleeding loss does positively correlate with blood loss objectively measured, its positive predictive value is low.<sup>22,23</sup> There are many factors that influence this, including number of days bleeding, positive or negative experiences associated with this blood loss, number of sanitary products utilised and pain experienced.<sup>22,23</sup> Women with a high health literacy, who have experienced menorrhagia, or given birth vaginally may be subjectively unconcerned about using a high number of sanitary products in an eight-hour window.<sup>22</sup> This same consumption of sanitary products could be distressing to women who previously have experienced only light menstrual bleeding.<sup>22</sup>

These concerns and deficits in subjective data could have been augmented by the collection of qualitative data about perceived blood loss which may have assisted distinguishing why participants who reported high blood loss did so.<sup>24</sup> Factors including first language spoken, health literacy, and individual experiences

of the blood loss would have allowed for understanding and to an extent, more accurately quantifying how heavy bleeding was.<sup>24</sup> Socioeconomic concerns remain a confounding factor as those with more time and availability are more likely to participate than those who are financially or time poor. A useful addition would have been the parity of the participant, due to both the changes that occur in the cervix, especially in multiparous women. As previously mentioned, women who did not have access to email communication, or were unable to communicate in the English language were also excluded. We acknowledge that this has the potential to effect the quality of the data received and reflect a predominantly Western society. Qualitative data also acknowledges that this bleeding experience is retrospectively reported, and can thus augment the quantitative data reported.<sup>24</sup>

Recall bias is of a moderate concern in our study as participants who have moderate to severe bleeding could potentially be more likely to participate in the survey process due to their symptoms. This reflects the retrospective nature of the data collection although the survey was sent out within a narrow time window from the procedure. Participants without significant bleeding could be lost to follow-up if they do not finish the surveys due to their lack of symptoms, thus leading to an over-representation of moderate to severe bleeding in the data. Due to the time-critical nature of the survey it was not appropriate to send repeat invitations out and therefore the low response rate was an accepted consequence. Response bias is also important in this cohort study as those who volunteer to enrol in this study may represent a population of people who are more aware and involved in their medical health, as evidenced by their willingness to be involved in medical research.<sup>25</sup> These patients could potentially be more likely to over-report their bleeding symptoms and create a picture of increased episodes of bleeding which may not reflect the actual population.<sup>25</sup> By utilising contemporaneous survey design in which we split the data collection into four separate surveys weekly, we have attempted to limit the effect of recall bias and potentially attempt to collect subjective data that reflect more closely the lived experience of the patient.

The process of studying and following up patients itself influences the outcome and is of potential concern. In this observational bias, participants potentially could over-report their bleeding as they are more aware of it due to the study highlighting it as a post-operative experience. Unfortunately, it is impossible for this bias to be completely removed as we were unable to blind the participants to the intent of the study.

Specimen size, was defined by calculating the relative volume of a specimen based on histopathology measurements which was necessary due to the retrospective nature of collection of this data. In many of our participants, more than one pass with the electrosurgical loop was required, which would have complicated any data regarding size of loop utilised. This data point does not include the type of transformation zone or accurate measurement of removed tissue volume relative to the existing cervical volume but was considered the most suitable measure given the number

**TABLE 1** Demographics

		All study participants			
Parameter	Summary	Week 1	Week 2	Week 3	Week 4
		n = 110	n = 97	n = 83	n = 74
Age, years	Age < 40	86 (78.1%)	76 (78.3%)	65 (78.3%)	58 (78.3%)
	Age > 40	26 (23.6%)	21 (21.6%)	18 (21.6%)	16 (21.6%)
	Mean age	35	34	35	34
	Median age	33	33	33	33
	Range	23–75	23–66	23–66	23–66
Body mass index (BMI)	BMI < 20	20 (18.3%)	17 (17.5%)	14 (16.8%)	13 (6.7%)
	BMI 20–25	63 (57.9%)	55 (56.8%)	47 (56.7%)	41 (66.3%)
	BMI > 25	26 (23.8%)	25 (25.7%)	22 (26.5%)	20 (27%)
	Median BMI	22.05	22.31	21.92	21.69
	Mean BMI	23.3	23.59	23.82	23.6
	Unquantified	1	0	0	0
Excessive bleeding, >3 days + heavy	Excessive bleeding	34 (30.9%)	31 (31.9%)	14 (16.8%)	5 (6.7%)
Specimen size	Median LEEP, mm <sup>3</sup> constant	689.19	689.19	689.19	689.19
	LEEP size_ < median	54 (49%)	48 (49.4%)	40 (48.2%)	36 (48.6%)
	LEEP size_ > median	56 (51%)	49 (50.6%)	43 (51.8%)	38 (51.4%)
	Mean LEEP size, mm <sup>3</sup>	858.73	815.08	828.07	823.97
Lifestyle – smoking status	Current smokers	16 (14.5%)	13 (13.4%)	11 (13.2%)	10 (13.5%)
	Non-smoking	94 (85.5%)	84 (86.6%)	72 (86.8%)	64 (86.5%)
Lifestyle – alcohol consumption	No alcohol	46 (41.8%)	36 (37.1%)	31 (37.4%)	25 (33.8%)
	Consumed alcohol < 5 std drinks	42 (38.2%)	37 (38.1%)	31 (37.4%)	34 (46%)
	Consumed alcohol > 5 std drinks	22 (20%)	24 (24.7%)	21 (25.3%)	15 (20.2%)
	Total % consuming alcohol	58.10%	62.80%	62.60%	66.20%
Lifestyle – exercise activity	No/light exercise	102 (92.8%)	87 (89.7%)	66 (79.6%)	53 (73%)
	Heavy exercise	8 (7.2%)	10 (10.3%)	17 (20.4%)	21 (27%)
Lifestyle – intercourse	None	107 (97.3%)	91 (94%)	66 (79.5%)	39 (52.7%)
	Once	3 (2.7%)	3 (3%)	8 (9.7%)	18 (24.3%)
	More than once	0 (0%)	3 (3%)	9 (10.8%)	17 (23%)
HPV status	HPV 16/18	27 (24.5%)	20 (20.5%)	17 (20.5%)	15 (20.3%)
	HPV other	63 (57.3%)	60 (62%)	51 (61.4%)	46 (62.2%)
	Both	11 (10%)	10 (10.3%)	8 (9.6%)	7 (9.5%)
	HPV negative	9 (8.2%)	7 (7.2%)	7 (8.5%)	6 (8%)
Grade	CIN 2/3 (HSIL)	97 (88.2%)	85 (87.6%)	73 (87.9%)	66 (89.2%)
	LSIL	11 (10%)	10 (10.3%)	9 (10.8%)	8 (10.8%)
	Both	2 (1.8%)	2 (2.1%)	1 (1.3%)	0 (0%)
Margins	Positive	26 (23.6%)	21 (21.6%)	19 (22.9%)	59 (79.7%)
	Clear	84 (76.4%)	76 (78.4%)	64 (77.1%)	15 (20.3%)
Total	Total participants	110	97	83	74
	Lost to follow-up	0	13 (11.8%)	27 (24.5%)	36 (32.7%)

CIN, cervical intraepithelial neoplasia; HPV, human papilloma virus; HSIL, high-grade squamous intraepithelial lesion; LEEP, loop electrosurgical excision procedure; LSIL, low-grade squamous intraepithelial lesion.

(Continues)

**TABLE 2** Heavy bleeding subset demographics

Parameter	Summary	Week 1 n = 34 <sup>†</sup>	Week 2 n = 31 <sup>†</sup>	Week 3 n = 14 <sup>†</sup>	Week 4 n = 3 <sup>†</sup>
Age, years	Age < 40	25 (73.5%)	26 (83.9%)	11 (78.6%)	Unable to analyse
	Age > 40	9 (26.5%)	5 (16.1%)	3 (21.4%)	
	Mean age	36	34	37	
	Median age	34	33	35	
	Range	23–66	23–66	27–66	
Body mass index (BMI)	BMI < 20	3 (8.8%)	6 (19.3%)	3 (21.4%)	
	BMI 20–25	21 (61.8%)	20 (64.5%)	8 (57.1%)	
	BMI > 25	10 (29.4%)	5 (16.1%)	3 (21.4%)	
	Median BMI	22.37	21.7	21.8	
	Mean BMI	23.7	22.6	23.5	
Specimen size	Median LEEP, mm <sup>3</sup> constant	689.19	689.19	689.19	689.19
	LEEP size_ < median	11 (32.3%)	12 (38.7%)	3 (21.4%)	
	LEEP size_ > median	23 (67.7%)	19 (61.3%)	11 (78.6%)	
	Mean LEEP size, mm <sup>3</sup>	1036.12	933.8	997.3	
HPV status	HPV 16/18	8 (23.5%)	4 (12.9%)	3 (21.4%)	
	HPV other	16 (47.1%)	22 (71%)	8 (57.1%)	
	Both	8 (23.5%)	4 (12.9%)	3 (21.4%)	
	HPV negative	2 (5.9%)	1 (3.2%)	0 (0%)	
Grade	CIN 2/3, HSIL	29 (85.3%)	27 (87.1%)	12 (85.7%)	
	LSIL	5 (14.7%)	4 (12.9%)	2 (14.3%)	
Margins	Positive	9 (26.5%)	6 (19.4%)	4 (28.6%)	
	Clear	25 (73.5%)	25 (80.6%)	10 (71.4%)	
Lifestyle – smoking status	Current smokers	4 (11.8%)	2 (6.5%)	0 (0%)	
	Non-smoking	30 (88.2%)	29 (93.5%)	14 (100%)	
Lifestyle – alcohol consumption	No alcohol	20 (58.8%)	13 (41.9%)	8 (57.1%)	
	Consumed alcohol < 5 std drinks	12 (35.3%)	15 (48.4%)	2 (14.3%)	
	Consumed alcohol > 5 std drinks	2 (5.8%)	3 (9.6%)	4 (28.5%)	
	Total % consuming alcohol	41.10%	58%	42.80%	
Lifestyle – exercise activity	No/light exercise	30 (88.2%)	24 (77.4%)	10 (71.4%)	
	Heavy exercise	4 (11.8%)	7 (22.6%)	4 (28.6%)	
Lifestyle – Intercourse	None	34 (100%)	30 (96.8%)	11 (78.6%)	
	Once	0 (0%)	1 (3.2%)	1 (7.1%)	
	More than once	0 (0%)	0 (0%)	2 (14.3%)	

CIN, cervical intraepithelial neoplasia; HPV, human papilloma virus; HSIL, high-grade squamous intraepithelial lesion; LEEP, loop electrosurgical excision procedure; LSIL, low-grade squamous intraepithelial lesion.

<sup>†</sup>Heavy bleeding refers to participants who bled for >3 days with blood ± clots.

of patients. In weeks one, two and three the rates of heavy bleeding reported were significantly higher in those who had a LEEP size greater than the median (42% vs 20%, 39% vs 26% and 25% vs 8% for each week respectively). This might therefore be a consideration when advising patients on care following LEEP, particularly where other identified risk factors for bleeding are present.

Women who had increased exercise intensity (as defined by >3 days per week and medium to high-intensity sessions) reported significantly increased bleeding ( $P = 0.013$ , Table 3).

Exercises which put strain in the pelvis, such as a bicycle seat, leg squats and lunges, intense sprinting/running, and high-intensity interval workouts, could also be a contributing factor due to the increased possibility of cervical clot disruption and interruption of healing of the tissue of the cervix. The strenuous nature of different exercises may also be a factor. The increased heart rate, cardiac output and dilation of blood vessels generated by intense exercise could contribute to an increase in ongoing bleeding once clot disruption has occurred.

**TABLE 3** Statistical analysis

Univariate model	P-value		
	Week 1	Week 2	Week 3
BMI	0.618	0.172	0.799
Age	0.545	0.704	0.308
LEEP size	0.100	0.18	0.277
LEEP size binary	0.013	0.144	0.024
Smoking	0.939	0.476	0.191
Alcohol	0.021	0.073	0.191
Exercise days	0.295	0.989	0.072
Exercise intensity	0.243	0.018	0.172
Sexual activity	0.133	0.221	0.912
LMP	0.253	0.024	0.825
HPV 16/18	0.068	0.45	0.266
HPV other	0.716	0.069	0.488
Margins	0.642	0.705	0.587
HSIL	0.285	0.571	0.66
LSIL	0.537	0.913	0.782
Characteristic	OR	95% CI	P-value
Multivariate model week 1			
LEEP size binary	2.84	1.15, 7.40	0.023
Alcohol			0.036
1	—	—	
2	0.44	0.17, 1.11	
3	0.1	0.01, 0.62	
4	0.21	0.01, 1.55	
HPV 16/18	2.91	1.16, 7.65	0.023
Multivariate model week 2			
Exercise intensity			0.013
1	—	—	
2	0.38	0.08, 1.39	
3	2.8	0.99, 8.26	
Multivariate model week 3			
LEEP size binary	8.16	1.74, 60.7	0.006
Exercise intensity			0.039
1	—	—	
2	4.48	0.44, 48.4	
3	7.55	1.55, 57.0	

BMI, body mass index; CI, confidence interval; HSIL, high-grade squamous intraepithelial lesion; LEEP, loop electrosurgical excision procedure; LMP, last menstrual period; LSIL, low-grade squamous intraepithelial lesion; OR, odds ratio.

Of concomitant interest in this cohort, a majority (67%) of participants were treated for dysplasia secondary to 'HPV Other' (indicating a HPV strain that is not 16/18). This most likely reflects a relative rise in HSIL from non-16/18 strain HPV due to the widespread vaccination program in Australia against HPV 16/18. This vaccination program began over ten years ago and targeted high school-aged teenagers in a mass vaccination. Other countries have also adopted this vaccination scheme. A cross-sectional study<sup>26</sup> displayed a declining trend in HPV 16/18 diagnoses and found that women born after 1994 (who therefore

underwent mass vaccination at or before the age of 13), had a near 90% risk reduction of HPV 16/18. However, the same study has shown no risk reduction currently, of developing 'HPV Other' (non-vaccinated genotypes). This reflects an area of interest which could benefit from future research into identifying ongoing rise in cervical neoplasia arising from non-16/18 type HPV in the era of vaccine suppression of 16/18 type HPV.

Based on the interesting findings of this pilot study we have identified two areas for potential future research. These include a definitive study into the correlation between bleeding pattern

**TABLE 4** Generalised estimating equations model

Characteristic	OR	95% CI	P-value
LEEP size binary	2.60	1.27, 5.32	0.009
Week			
1	—	—	
2	0.70	0.36, 1.35	0.3
3	0.13	0.03, 0.53	0.005
Exercise intensity			
1	—	—	
2	0.55	0.21, 1.39	0.2
3	0.28	0.06, 1.29	0.10
Week * Exercise intensity			
2 * 2	0.79	0.16, 3.95	0.8
3 * 2	5.52	0.64, 47.4	0.12
2 * 3	8.88	1.60, 49.1	0.012
3 * 3	16.1	2.08, 125	0.008

CI, confidence interval; OR, odds ratio.

and LEEP volume as well as the correlation between patterns of exercise and post-LEEP bleeding.

In conclusion, post-operative bleeding risk factors in women undergoing LEEP remain elusive in the literature. Women who undergo intense or prolonged exercise in the post-operative period may experience heavier bleeding, particularly in the first two weeks post-LEEP. The size of the specimen removed is also likely to be a significant factor in post-LEEP bleeding risk. We found no correlation between age, BMI or any other demographic factor and heavy bleeding in our analysis.

## ACKNOWLEDGEMENTS

Gillian Heller (statistical analyst, Sydney Local Health District, NSW Health). Open access publishing facilitated by The University of Sydney, as part of the Wiley - The University of Sydney agreement via the Council of Australian University Librarians.

## REFERENCES

- Al-Nafussi A, Rebello G, Al-Yusif R, McGoogan E. The borderline cervical smear: colposcopic and biopsy outcome. *J Clin Pathol* 2000; **53**: 439–444.
- Massad SL, Markwell S, Cejtin HE, Collins Y. Risk of high-grade cervical intraepithelial neoplasia among young women with abnormal screening cytology. *J Low Genit Tract Dis* 2005; **9**: 225–229.
- D'Ottaviano M, Discacciati M, Andreoli M *et al.* HPV 16 is related to the progression of cervical intraepithelial neoplasia grade 2: a case series. *Obstet Gynecol Int* 2013; **2013**: 5.
- Schlecht N, Platt R, Duarte-Franco E *et al.* Human papillomavirus infection and time to progression and regression of cervical Intraepithelial Neoplasia. *JNCI* 2003; **95**: 1336–1343.
- Warwick AP, Redman CW, Jones PW *et al.* Progression of cervical intraepithelial neoplasia to cervical cancer: interactions of cytochrome P450 CYP2D6 EM and glutathione s-transferase GSTM1 null genotypes and cigarette smoking. *Br J Cancer* 1994; **70**: 704–708.
- Vink M, Bogaards J, van Kemenade F *et al.* Clinical progression of high-grade cervical intraepithelial neoplasia: estimating the time to preclinical cervical cancer from doubly censored national registry data. *Am J Epidemiol* 2013; **178**: 1161–1169.
- Kietpeerakool C, Srisomboon J, Khobjai A *et al.* Complications of loop electrosurgical excision procedure for cervical neoplasia: a prospective study. *J Med Assoc Thailand* 2006; **89**: 583–587.
- Sutthichon P, Kietpeerakool C. Perioperative complications of an outpatient loop electrosurgical excision procedure: a review of 857 consecutive cases. *Asian Pac J Cancer Prev* 2009; **10**: 351–354.
- Fan QK, Tay S, Shen K. Loop electrosurgical excision procedure: a valuable method for the treatment of cervical intraepithelial neoplasia. 2001.
- Dunn TS, Killoran K, Wolf D. Complications of outpatient LLETZ procedures. *Obstet Gynecol Surv* 2004; **59**: 431–432.
- El-Nashar SA, Shazly SA, Hopkins MR *et al.* Loop electrosurgical excision procedure instead of cold-knife conization for cervical intraepithelial neoplasia in women with unsatisfactory colposcopic examinations: a systematic review and meta-analysis. *J Low Genit Tract Dis* 2017; **21**: 129–136.
- Duesing N, Schwarz J, Choschzick M *et al.* Assessment of cervical intraepithelial neoplasia (CIN) with colposcopic biopsy and efficacy of loop electrosurgical excision procedure (LEEP). *Arch Gynecol Obstet* 2012; **286**: 1549–1554.
- Ferenczy A, Choukron D, Arseneau J. Loop electrosurgical excision procedure for squamous intraepithelial lesions of the cervix: advantages and potential pitfalls. *Obstet Gynaecol* 1996; **87**: 332–337.
- Mitchell MF, Tortolero-Luna G, Cook E, Whittaker L, Rhodes-Morris H, *et al.* A randomized clinical trial of cryotherapy, laser vaporization, and loop electrosurgical excision for treatment of squamous intraepithelial lesions of the cervix. *Obstet Gynecol* 1998; **92**(5): 737–744.
- Nuovo J, Melnikow J, Willan AR, Chan BKS. Treatment outcomes for squamous intraepithelial lesions. *Int J Gynecol Obstet* 2000; **68**(1): 25–33.
- Paraskevaidis E, Davidson E, Koliopoulos G *et al.* Bleeding after loop electrosurgical excision procedure performed in either the follicular or luteal phase of the menstrual cycle: a randomized trial. *Obstet Gynaecol* 2002; **99**: 997–1000.
- Perlman SE, Lubianca JN, Kahn JA. Characteristics of a group of adolescents undergoing loop electrical excision procedure (LEEP). *J Pediatr Adolesc Gynecol* 2003; **16**(1): 15–20.
- Sharp L, Cotton S, Cochran C *et al.* The tombola group – After-effects reported by women following colposcopy, cervical biopsies and LLETZ: results from the TOMBOLA trial. *BJOG* 2009; **116**: 1506–1514.
- Wright TC Jr, Gagnon S, Richart RM, Ferenczy A. Treatment of cervical intraepithelial neoplasia using the loop electrosurgical excision procedure. *Obstet Gynecol* 1992; **79**: 173–178.
- Yap S, Nathan E, Farrell L. LLETZ make it simple: anxiety, pain and treatment outcomes with outpatient large loop excision of the transformation zone under local anaesthesia. *Aust N Z J Obstet Gynaecol* 2020; **60**: 438–443.
- England Public Health. NHS cervical screening programme, colposcopy and programme management. In: Service NH, ed. *PHE Publications Gateway Number* 2016; 2015734.
- Quinn SD, Higham J. Outcome measures for heavy menstrual bleeding. *Womens Health* 2016; **12**(1): 21–26.
- Warrilow G, Kirkham C, Ismail K *et al.* Quantification of menstrual blood loss. *Obstet Gynaecol* 2004; **6**: 88–92.
- Hancock A, Weeks AD, Lavender DT. Is accurate and reliable blood loss estimation the 'crucial step' in early detection of

- postpartum haemorrhage: an integrative review of the literature. *BMC Pregnancy Childbirth* 2015; **15**: 230.
25. Pannucci CJ, Wilkins EG. Identifying and avoiding bias in research. *Plast Reconstr Surg* 2010; **126**: 619–625.
26. Saldanha C, Vieira-Baptista P, Costa M. Impact of a high coverage vaccination rate on human papillomavirus infection prevalence in young women: a cross-sectional study. *J Low Genit Tract Dis* 2020; **24**: 363–366.



**FSEP**  
FETAL SURVEILLANCE EDUCATION PROGRAM

Now available in NSW

(HETI approved)

About	Workshops	OFSEP	Resources
<p>Excellence in fetal surveillance education</p> <p>Working to improve perinatal outcomes</p> <p>For all clinicians in antenatal and intrapartum care</p>	<p>&gt;350 face-to-face sessions a year</p> <p>Experienced clinical educators</p> <p>Group discussion</p> <p>CPD accreditation</p>	<p>FSEP online program</p> <p>Free for all clinicians</p> <p>Interactive contents and graphics</p> <p>Detailed explanations</p>	<p>Book and e-book</p> <p>IFS Clinical Guideline</p> <p>Teaching tools</p> <p>Mobile app</p> <p>Assessment</p> <p>Webinars</p>



The Royal Australian and New Zealand College of Obstetricians and Gynaecologists  
Excellence in Women's Health



www.fsep.edu.au