



The use of hemostatic spray as an adjunct to conventional hemostatic measures in high-risk nonvariceal upper GI bleeding (with video)

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Background: Endoscopic management of nonvariceal upper GI bleed (NVUGIB) can be challenging. Hemospray is a novel endoscopic hemostatic agent for NVUGIB. Its efficacy in attaining hemostasis in NVUGIB is promising, particularly with respect to technically difficult lesions. However, most of the currently available data are focused on its application as monotherapy. The aim of this study was to evaluate its efficacy as a second agent to adrenaline, or as an addition to the combination of adrenaline with either clips or a thermal device in NVUGIB.

Methods: Consecutive patients with Forrest 1a and 1b ulcer treated with hemostatic spray as an adjunct to conventional endoscopic hemostatic measures between July 2013 and June 2015 were included in this retrospective analysis. The endpoints were initial hemostasis, 7-day rebleeding, 30-day rebleeding, all-cause, and GI-related 30-day mortality.

Results: A total of 20 patients (median age, 75 years, 50% men, 60% Forrest 1a ulcer) were treated with hemostatic spray as a second agent to adrenaline, or as an adjunct to the combination of adrenaline with either clips or a thermal device. Hemostatic spray was used as a second agent to adrenaline in 40% and as a third agent to combined dual therapy in 60%. Initial hemostasis was attained in 95% with an overall rebleeding rate at 7 days of 16%. There was no difference between the 7-day and 30-day rebleeding rates. The combination of hemostatic spray and adrenaline resulted in 100% initial hemostasis and 25% 7-day rebleeding. Similarly, initial hemostasis was achieved in 92% with a 9% rebleeding rate when hemostatic spray was used as the third agent to 2 of the conventional measures. All-cause mortality was 15% with 1 GI-related death (3%).

Conclusions: In our single-center retrospective analysis, hemostatic spray appears promising as an adjunct to conventional methods for NVUGIB, although prospective controlled trials are needed to confirm this. (Gastrointest Endosc 2016;84:900-6.)

(footnotes appear on last page of article)

Mortality associated with acute upper GI bleeding remains high at 10%.^{1,2} This figure has not changed appreciably since the 1950s, in part due to an aging population. In a recent UK-wide audit, 1 in 4 patients with acute upper GI bleeding were greater than 80 years of age.² Because mortality from upper GI bleeding increases steeply with age, peptic ulcer bleeding will continue to pose a significant therapeutic

challenge.³ Recent advances in endoscopic techniques have enabled effective hemostatic interventions to be deployed. The combination of adrenaline with a mechanical method (clips) or with a thermal device is the preferred strategy to achieve hemostasis.⁴⁻⁶ Indeed, monotherapy with adrenaline has largely been superseded by this approach due to an unacceptably high rate of rebleeding.⁷ However, in 10% to 20% of



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patients, rebleeding occurs despite initial hemostasis with combined therapy.¹

Hemostatic sprays are a relatively new addition to the established hemostatic agents. Hemospray (Cook Medical, Winston-Salem, NC) is the first to be licensed in Europe, but it is not as yet U.S. Food and Drug Administration approved. It is a proprietary inorganic hemostatic powder approved for use in nonvariceal upper GI bleed (NVUGIB). The powder is propelled through a carbon dioxide pressurized catheter fed through the working channel of an endoscope and sprayed at a distance of 1 to 2 cm from the bleeding site until complete coating of the lesion and an obliteration of fresh blood is achieved. When put in contact with moisture (eg, blood or tissue) in the GI tract, the powder becomes cohesive and adhesive.⁸ Its hemostatic mechanisms are 2-fold. First, it exerts a tamponade effect by forming a confluent mechanical barrier at the bleeding site. Second, it promotes thrombus formation by enhancing platelet aggregation and increasing the concentration of clotting factors.⁹ In addition, it has been shown to shorten coagulation time in vitro.¹⁰

The effect of hemostatic spray on hemostasis in NVUGIB cases so far has been encouraging. Initial hemostasis was achieved in 81% to 100% with a rebleeding rate of 5% to 39%.¹¹⁻¹⁵ However, most of these data were focused on the use of Hemospray as monotherapy. Moreover, the study populations were heterogeneous with respect to the underlying cause. Data on the use of hemostatic spray as a second-line hemostatic agent to adrenaline or as an adjunct to combined therapy are limited. Intuitively, these strategies could offer a significant advantage; hemostatic spray may augment hemostasis achieved by standard therapy. This approach is attractive in cases in which the application of dual therapy is challenging. Adrenaline injection occasionally masks the bleeding lesion. More frequently, the position of the ulcer renders the effective application of clips or a heater probe impossible. Finally, the fibrous nature of the ulcer base or large size of a visible vessel may mean that attempting to apply clips or a heater probe would be unlikely to succeed or potentially dangerous.

In this study, we evaluated the effect of this hemostatic spray on initial hemostasis, rebleeding rate, and mortality when used in high-risk patients (Figure 1) with peptic ulcer bleed. Here, hemostatic spray was used as a second agent to adrenaline, or as an adjunct to the combination of adrenaline with either clips or a thermal contact device (Figure 2).

METHODS

Study population

This retrospective analysis reviewed 30 consecutive patients who had been treated with hemostatic spray for GI bleeding between July 1, 2013, and June 30, 2015, in a large tertiary unit. One case of hemostatic spray application to lower GI bleeding, 1 case with incomplete clinical

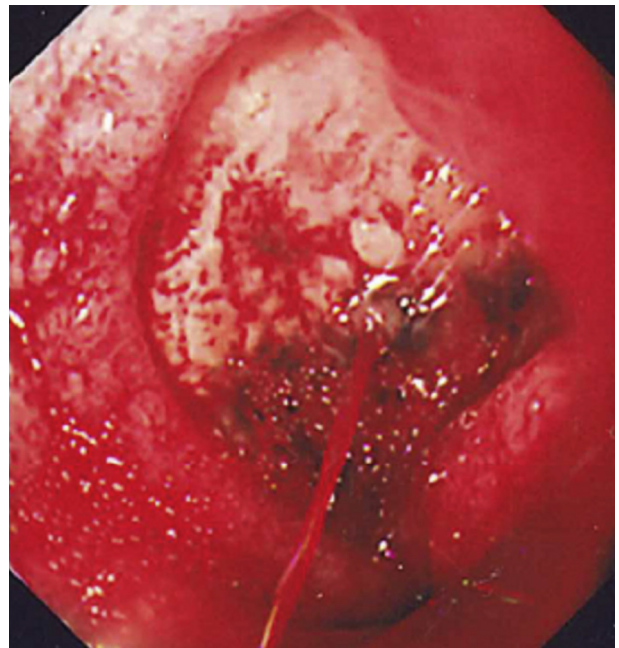


Figure 1. Forrest 1a duodenal ulcer.

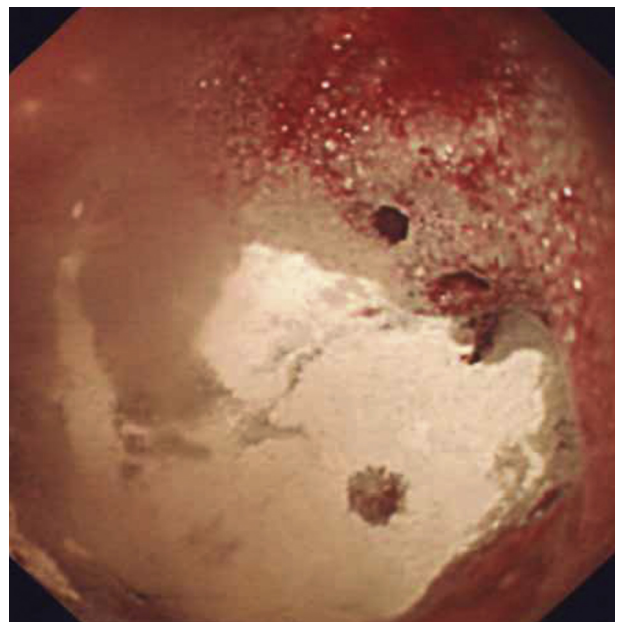


Figure 2. Forrest 1a duodenal ulcer after a triple therapy (a combination of adrenaline, thermal device, and hemostatic spray).

information, and 4 cases with the following underlying causes, gastroesophageal carcinoma, Mallory-Weiss tear without visible vessel, angiodysplasia, and pancreatitis, were excluded. Four patients with Forrest 2a and 2b ulcers were excluded due to the small sample size.

The final analysis included the remaining 20 cases of Forrest 1a and 1b ulcers. Of these, 1 patient had post-ampullectomy GI bleeding, but a spurting arterial vessel was identified on the index gastroscopy. Similarly,

another patient who had a Mallory-Weiss tear was included in this group because a visible vessel was treated. The nature of the lesions in these 2 cases was akin to that of a peptic ulcer, and therefore they were considered as Forrest 1a and 1b, respectively. In these cases, hemostatic spray was used either as a second agent to adrenaline or as an adjunct to the combination of adrenaline with either clips or a thermal contact device.

The outcomes were as follows: initial hemostasis, defined as adequate hemostasis confirmed on observation and to the satisfaction of endoscopist; 7-day and 30-day rebleeding, defined as (1) clinical presentation of hematemesis or melena; (2) hemodynamic instability; and (3) drop in hemoglobin ≥ 2 g/L, blood transfusion of ≥ 4 units, necessitating further investigation such as repeat endoscopy or radiologic intervention; all-cause and GI bleed-related 30-day mortality; adverse event; and equipment failure relating to the use of hemostatic spray.¹²

For comparison, we reviewed the outcomes of 20 consecutive patients with Forrest 1a and 1b ulcer who received conventional treatment before the introduction of hemostatic spray in our department between August 2010 and June 2013.

Patients were identified using the endoscopy logbook entries. Endoscopy reports and clinical information were obtained from Unisoft (Unisoft Medical Systems, Enfield, UK) and Trakcare (Intersystem Corporation, Cambridge, Mass), respectively. Demographics, Rockall, and Blatchford scores, antiplatelet use, findings at endoscopy, endoscopic therapeutic interventions, use of proton pump inhibitor infusions, *Helicobacter pylori* status, and the study endpoints were recorded. All identifiable data were replaced with study identification numbers to preserve confidentiality. The use of these data was approved by the Confidentiality (Caldicott) Guardian for NHS Lothian.

This study was considered as a retrospective review by the local committee in our institution; hence, no formal ethical approval from the NHS Research Ethics Committee was necessary.

Clinical procedure

The choice of treatment was at the discretion of the attending endoscopist. All patients were adequately resuscitated before the endoscopic procedure. Hemostatic spray was used to achieve complete hemostasis if there was evidence of continued oozing after conventional therapy (adrenaline with either hemostatic clips or thermal devices). Similarly, hemostatic spray was used after adrenaline injection if the lesion was inaccessible for application of hemostatic clips or thermal devices. Hemostatic spray was delivered through a 10F catheter (Cook Medical, Winston-Salem, NC) fed through the working channel of an endoscope (Olympus, Tokyo, Japan or Fujifilm, Tokyo, Japan). Adequacy of hemostasis was confirmed on observation of the treated lesion and to the satisfaction of the endoscopist. All patients received intravenous

TABLE 1. Demographics and clinical characteristics of patients treated with hemostatic spray

Clinical characteristics	Adrenaline + hemostatic spray (AH) (n = 8)	Dual therapy + hemostatic spray (DH) (n = 12)	P value
Age (years)	75	71	.73
Women	3	7	.65
Rockall score	8	8	.75
Blatchford score	14	15	.51
Use of antithrombotic therapy	5	5	.64
Pathology			.65
Duodenal ulcer	4	8	
Esophageal ulcer	3	1	
Dual pathology	0	1	
Gastric ulcer	0	1	
Others*	1	1	

Data presented as median (interquartile range) or number.

*Others: Mallory-Weiss with visible vessel, ampullectomy with arterial spurt.

proton pump inhibitor infusion for 72 hours (Hong Kong regimen) after endoscopy.

Statistical analysis

Statistical analysis was performed using IBM SPSS for Macintosh version 22.0 (IBM Corporation, Armonk, NY). The Mann-Whitney *U* test was used to compare continuous variables between 2 populations. The Fisher exact test was used to compare categorical variables between 2 groups. Data are presented as median interquartile range (IQR) or frequency (percentage of the total study population). A 2-sided *P* value of less than .05 was considered to be statistically significant.

RESULTS

Hemostatic spray group

A total of 20 patients (median age, 75 years; IQR = 11 years, 50% men) were included in the final analysis. Of these, 60% (12/20) had Forrest 1a and 40% (8/20) had Forrest 1b ulcers. The median Rockall score and Blatchford score were 8 (IQR = 2) and 14 (IQR = 6), respectively. Ten (50%) patients were on antiplatelet agents at the time of presentation.

Hemostatic spray was used as a second agent to adrenaline (AH) in 8 patients (40%) and as an addition to combined therapy (DH) in 12 patients (60%) (Table 1). The reasons for hemostatic spray application in the AH group were as follows: lesion in a difficult site, suboptimal views, and concerns regarding perforation or torrential hemorrhage, all of which had precluded effective deployment of hemostatic clips or a thermal contact device. Hemostatic

TABLE 2. Initial hemostasis, rebleeding events, and 30-day mortality stratified according to the Forrest classification in the hemostatic spray and conventional treatment groups

Forrest classification	Hemostatic spray treatment (July 2013 to August 2015)				Conventional treatment (August 2010 to June 2013)				Risk of rebleeding after endoscopic treatment ²⁸ in the literature
	Study population, n (%)	Initial hemostasis, n (%)	7-day rebleeding, n (%)	Mortality at 30 days, n (%)	Study population, n (%)	Initial hemostasis, n (%)	7-day rebleeding, n (%)	Mortality at 30 days, n (%)	
1a	12 (60) AH 5 (42)	5 (100)	2 (40)	1 (20)	A 0 (0)	0 (0)	–	0 (0)	0%-69% ^{13,29,30}
	DH 7 (58)	6 (86)	1 (17)	0 (0)	D 12 (100)	9 (75)	1 (11); 2* (22)	2 (22)	
1b	8 (40) AH 3 (38)	3 (100)	0 (0)	0 (0)	A 3 (38)	2 (66)	2 (100)	3 (100)	0%-25% ^{13,29}
	DH 5 (62)	5 (100)	0 (0)	2 (40)	D 5 (62)	5 (100)	1 (20)	1 (20)	

AH, Adrenaline plus hemostatic spray; DH, conventional dual therapy plus hemostatic spray; A, adrenaline alone; D, conventional dual therapy (a combination of adrenaline with hemostatic clips or a thermal device).

*30-day rebleeding.

spray was used as a third agent with persistent oozing or in cases where the risk of rebleeding remained significant despite conventional dual therapy. Descriptions of individual cases are provided in [Supplementary Table 1](#), available online at www.giejournal.org.

Initial hemostasis and rebleeding. Initial hemostasis was achieved in 19 of 20 patients (95%). One patient (5%) who did not achieve initial hemostasis despite the use of hemostatic spray in the DH group subsequently had gastroduodenal artery embolization to achieve hemostasis. Seven-day rebleeding occurred in 16% (3/19; median day 0, IQR = 3). Rebleeding events in the AH and DH groups were 25% (2/8) and 9% (1/11), respectively [Table 2](#). Two of the patients with rebleeding were treated with gastroduodenal artery embolization. One patient was too frail for further intervention and subsequently died. There was no rebleeding recorded beyond day 7. Thus, the 30-day rebleeding rate remained at 15%.

Mortality. All-cause mortality at 30 days in the hemostatic spray group was 15% (3/20) ([Table 2](#)). GI bleed-related mortality at 30 days was 5% (1/20). Other causes of death were septicemia and aspiration pneumonia.

Rebleeding event and mortality according to the severity of bleed. *Forrest 1a.* Forty-two percent (5/12) of those with Forrest 1a lesions received hemostatic spray as a second line to adrenaline therapy (AH) ([Table 2](#)). In this group, initial hemostasis was achieved in 100%. However, rebleeding was noted in 40% (2/5). The 30-day mortality in this group was 20% (1/5). The remaining 58% (7/12) had hemostatic spray in conjunction with the combined therapy (DH). Of these, the initial hemostasis rate was 86% (6/7). Rebleeding occurred in 17% (1/6). There was no mortality in this group.

Forrest 1b. Thirty-eight percent (3/8) of patients with Forrest 1b lesions had AH therapy, with initial hemostasis of 100%, 0% rebleeding, and 0% 30-day mortality

([Table 2](#)). The remaining 62% (5/8) received DH therapy. Initial hemostasis was 100%, and there were no rebleeding episodes. However, 30-day mortality was 40% (2/5). One death was due to septicemia and another was due to aspiration pneumonia.

Other adverse events and technical failure with hemostatic spray. There was no significant hemostatic spray-related equipment failure. On occasion, it was necessary to use the second catheter supplied to achieve adequate therapy. This was due to blockage within the first catheter induced by moisture within the endoscope channel or the gut lumen. The former can be minimized by vigorous flushing of the endoscope channel with air before catheter insertion. No other adverse event was observed.

Conventional therapy group outcomes (August 2010 to June 2013)

Baseline characteristics (age, gender, cause, preceding antithrombotic use, Rockall and Blatchford scores) were similar in both groups ([Table 3](#)). Descriptions of individual cases are provided in [Supplementary Table 2](#), available online at www.giejournal.org.

Initial hemostasis and rebleeding. Initial hemostasis was achieved with conventional strategies in 16 of 20 patients (80%) and rebleeding occurred in 4 of 16 patients (25%) and 5 of 16 patients (31%) at 7 days and 30 days, respectively. Three of 4 patients with failed initial hemostasis required emergency laparotomy. One died of ongoing bleeding. Three patients were treated with adrenaline monotherapy due to technical difficulties in deploying clips or a thermal device. Rebleeding occurred in 2 of 3 (67%) of these cases. Among those who received the standard dual therapy (adrenaline and hemostatic clips [AC] or adrenaline and a thermal device [AT]), initial hemostasis was achieved in 14 of 17 patients (82%). The 30-day rebleeding rate of 21% (3/14) was comparatively

TABLE 3. Clinical characteristics of patients with Forrest 1a and 1b ulcers in the hemostatic spray and conventional therapy groups

Clinical characteristics	Hemostatic spray group (July 2013 to August 2015) (n = 20)	Conventional therapy (August 2010 to June 2013) (n = 20)	P value
Age (years)	75 (11)	73 (21)	.72
Women	10	9	1.00
Rockall score	8 (2)	7 (3)	.30
Blatchford score	14 (6)	14 (4)	.82
Use of antithrombotic therapy	10	12	.75

Data presented as median (interquartile range) or number.

higher than that seen with the combination of hemostatic spray and standard dual therapy (9%).

Mortality. The overall 30-day mortality with conventional therapy was 30% (6/20), and GI bleed-related death occurred in 15% (3/20).

DISCUSSION

Our study examined the efficacy of Hemospray as a second agent to adrenaline and as a third agent to combined therapy in high-risk patients with NVUGIB. These patients were truly high risk with median Rockall and Blatchford scores of 8 and 14, respectively. In this context, our rationale was to use hemostatic spray to maximize the hemostatic effect. Our data highlight 2 important points. First, using this approach, hemostatic spray was effective in attaining initial hemostasis as shown by the favorable rate of 95%. Second, hemostatic spray offers good protection against rebleeding. Indeed, the overall rebleeding rate in our cohort was 16%, and when used in combination with dual conventional treatment modalities, the rebleeding rate was 9%.

In this study, hemostatic spray was used as a second agent to adrenaline in 40% of cases in which the deployment of clips or thermal contact devices was not technically feasible. Initial hemostasis achieved in combination with adrenaline was 100%, even in high-risk lesions. Importantly, the rebleeding rate of 25% in Forrest 1a and Forrest 1b ulcers with this combination was better than that seen with adrenaline monotherapy for similar lesions.^{16,17} When compared with our previous experience in a group of patients with Forrest 1a and 1b lesions before the introduction of hemostatic spray in our unit, rebleeding occurred in 67% when the therapeutic option was technically limited to adrenaline monotherapy. Therefore, hemostatic spray may be a viable alternative for lesions inaccessible to hemostatic methods that require precise targeting. To this end, hemostatic spray can be applied without direct mucosal contact or en face view of a lesion. Prior injection of adrenaline can provide immediate clear

visualization for a targeted application of hemostatic spray and complement its hemostatic effect. Thus, hemostatic spray offers ease of application, particularly in technically challenging cases. It obviates the need for more advanced techniques such as the use of a duodenoscope or a cap-assisted approach, for which the required skills may not be widely available.

Sustained hemostasis with a combination of hemostatic spray and adrenaline in our cohort was comparatively lower than that reported with conventional measures, particularly for Forrest 1a ulcers.¹⁸⁻²² Although Hemospray has been licensed as monotherapy for NVUGIB, its efficacy in Forrest 1a lesions has not been adequately studied. Our experience of hemostatic spray as monotherapy was limited to a single case where it was successfully used to control a significant bleeding episode from pangastritis. In a porcine model, hemostatic spray induces 100% hemostasis with 20% rebleeding within 24 hours.¹⁹ These findings were corroborated by subsequent clinical studies. For example, Sung et al¹² achieved 95% initial hemostasis with 85% sustained hemostasis at 72 hours in patients with Forrest 1a and 1b ulcers. Similarly, Smith et al¹¹ reported initial hemostasis in 85% and a rebleeding rate of 15% using hemostatic spray as monotherapy. However, in a subsequent case series, the rate of rebleeding with hemostatic spray monotherapy was considerable prompting authors to recommend either a second re-look or prolonged hospital observation.²³ This raises the question as to whether hemostatic spray as monotherapy is a cost-effective approach. This was addressed in a recent study, which showed that the combination of hemostatic spray with conventional hemostatic measures was more cost-effective than hemostatic spray as monotherapy.²⁴ In a recent case series, the use of hemostatic spray as monotherapy in Forrest 1a lesions was associated with 100% rebleeding, necessitating further endotherapy or interventional radiology.²⁵ Therefore, the available evidence suggests that hemostatic spray monotherapy is unlikely to replace conventional hemostatic therapy.

In our series, hemostatic spray was used as an adjunct to the standard dual therapy in cases where the risk of rebleeding was deemed to be significant. This triple therapy approach resulted in overall initial hemostasis of 92% with a rebleeding rate of 9%. Even among those with Forrest 1a ulcers, the initial hemostasis and the rebleeding rate were encouraging. Furthermore, in Forrest 1a and 1b lesions, the rebleeding rate of 9% was comparatively less than the rebleeding rate reported with the conventional approaches for similar lesions.^{13,17,26} Indeed, the hemostatic effect with the triple therapy surpassed the initial hemostasis of 82% and the rebleeding rate of 21% previously observed with conventional dual therapy in our institution. This effect might be explained by the ability of hemostatic spray to cover large areas and address multiple bleeding points from feeding vessels simultaneously. It could be

surmised that the spray provides a sealant barrier that complements tamponade, vasoconstriction, and mechanical or thermal coagulation resulting from conventional combination therapy. [Video 1](#) illustrates a typical case.

Similar to the findings of a recent UK-wide audit, the patients in our cohort were elderly (median age of 75 years) and the mortality observed was largely related to decompensation of comorbid conditions.² One GI bleed-related death was attributable to rebleeding of a duodenal ulcer. In this case, no further intervention was deemed appropriate due to significant frailty. In our study, there was no difference in mortality when hemostatic spray was used as an adjunct to adrenaline or incorporated into the standard combination therapy. Even though there have been reports of perforated viscus, biliary orifice obstruction, and splenic infarct associated with the use of hemostatic spray, we did not observe any adverse events in our cohort.^{14,27}

This study has several limitations. The retrospective nature precludes a comparison of the efficacy of hemostatic spray as monotherapy compared with its use as an adjuvant to dual therapy. Cases were highly selected and treatment was at the discretion of the endoscopist rather than directed by a specific protocol. Data regarding the exact amount of hemostatic spray applied are unavailable. Our case series, albeit small, is the largest to date that reports the complementary role of hemostatic spray, either as a second agent after adrenaline injection or as a third agent after conventional dual therapy in high-risk NVUGIB.

In conclusion, our data support the use of hemostatic spray in high-risk peptic ulcer bleeding, particularly when the application of additional hemostatic agents after adrenaline injection may not be technically feasible. Its use as an adjunct can be considered when primary hemostasis is not achieved with standard combination therapy. Whether it can replace conventional measures remains to be seen, and its role in additionally securing hemostasis in high-risk patients remains unclear. Future prospective randomized controlled trials comparing hemostatic spray alone and in various combinations with conventional therapies in high-risk bleeding lesions are required to establish its optimal place in the hemostatic armamentarium.

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Abbreviations: AH, adrenaline plus Hemospray; DH, dual therapy plus Hemospray; IQR, interquartile range; NHS, National Health Service; NVUGIB, nonvariceal upper GI bleed.

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SUPPLEMENTARY TABLE 1. Endoscopic treatment and outcomes of 20 consecutive patients with Forrest 1a and 1b ulcers treated with hemostatic spray from July 2013 to August 2015

No.	Age (years)	Sex	Rockall score	Blatchford score	ATT	Cause	Forrest classification	Endoscopic treatment	Initial hemostasis	Rebleeding	Outcome
1	81	M	10	7	Yes	Duodenal ulcer	1b	DH	Yes	No	Survived 30 days
2	70	F	9	16	No	Duodenal ulcer	1a	DH	No; embolized	No	Survived 30 days
3	84	M	10	16	Yes	Duodenal ulcer	1a	DH	Yes	No	Survived 30 days
4	87	F	9	8	Yes	Dual pathology	1b	DH	Yes	No	Non-GI-bleed-related death
5	55	M	5	10	No	Duodenal ulcer	1a	DH	Yes	No	Survived 30 days
6	86	F	9	19	No	Duodenal ulcer	1a	AH	Yes	Day 0; too frail for treatment	GI bleed death
7	71	F	8	15	Yes	Duodenal ulcer	1a	DH	Yes	No	Survived 30 days
8	75	F	6	9	No	Esophageal ulcer	1a	AH	Yes	No	Survived 30 days
9	52	F	8	15	No	Esophageal ulcer	1b	DH	Yes	No	Non-GI-bleed-related death
10	68	F	6	17	No	Duodenal ulcer	1a	DH	Yes	Yes; day 6 embolization	Survived 30 days
11	64	M	8	9	Yes	Esophageal ulcer	1b	AH	Yes	No	Survived 30 days
12	74	M	8	14	Yes	Duodenal ulcer	1b	AH	Yes	No	Survived 30 days
13	56	M	5	13	Yes	Duodenal ulcer	1a	AH	Yes	No	Survived 30 days
14	76	F	6	15	Yes	Duodenal ulcer	1a	AH	Yes	Yes; day 0 embolization	Survived 30 days
15	76	F	6	17	No	Gastric ulcer	1b	DH	Yes	No	Survived 30 days
16	27	M	4	10	No	Duodenal ulcer	1a	DH	Yes	No	Survived 30 days
17	76	M	8	12	Yes	Esophageal ulcer	1b	AH	Yes	No	Survived 30 days
18	75	M	8	14	No	Ampullectomy	1a	AH	Yes	No	Survived 30 days
19	79	M	6	17	No	Mallory-Weiss	1b	DH	Yes	No	Survived 30 days
20	66	F	8	14	Yes	Duodenal ulcer	1a	DH	Yes	No	Survived 30 days

ATT, Antithrombotic therapy; M, male; AH, adrenaline plus hemostatic spray; F, female; DH, conventional dual therapy plus hemostatic spray.

SUPPLEMENTARY TABLE 2. Endoscopic treatment and outcomes of 20 consecutive patients with Forrest 1a and 1b ulcers from August 2010 to June 2013 before the introduction of hemostatic spray

No.	Age (years)	Sex	Rockall score	Blatchford score	ATT	Cause	Forrest classification	Endoscopic treatment	Initial hemostasis	Rebleeding	Outcome
1	73	F	9	16	Yes	Duodenal ulcer	1b	A	Yes	Day 1; treated endoscopically	GI bleed death
2	68	M	6	14	Yes	Duodenal ulcer	1b	AT	Yes	Day 6; treated endoscopically	Survived 30 days
3	84	M	7	12	Yes	Duodenal ulcer	1b	AC	Yes	No	Non-GI bleed death
4	55	M	5	12	No	Duodenal ulcer	1a	AC	No; proceeded to laparotomy	No	Survived 30 days
5	86	F	9	20	Yes	Duodenal ulcer	1b	AT	Yes	No	Survived 30 days
6	71	M	6	12	Yes	Duodenal ulcer	1b	A	Yes	Day 1; treated endoscopically	Non-GI bleed death
7	91	F	7	17	No	Duodenal ulcer	1b	A	No	No	GI bleed death
8	52	M	4	13	Yes	Duodenal ulcer	1b	AT	Yes	No	Survived 30 days
9	86	F	9	15	Yes	Gastric ulcer	1b	AT	Yes	No	Survived 30 days
10	58	F	5	9	No	Duodenal ulcer	1a	AT	No; proceeded to laparotomy	No	Survived 30 days
11	74	M	6	10	Yes	Duodenal ulcer	1a	AT	Yes	No	Survived 30 days
12	64	F	8	12	No	Sphincterotomy	1a	AC	Yes	No	Survived 30 days
13	72	F	4	14	No	Duodenal ulcer	1a	AC	Yes	No	Survived 30 days
14	50	M	3	11	No	Duodenal ulcer	1a	AT	Yes	No	Survived 30 days
15	79	F	9	17	No	Duodenal ulcer	1a	AC	Yes	Day 8; too frail for treatment	GI bleed death
16	71	F	6	13	No	Duodenal ulcer	1a	AT	No; proceeded to laparotomy	No	Non-GI bleed death
17	89	M	9	16	Yes	Duodenal ulcer	1a	AT	Yes	No	Survived 30 days
18	62	M	8	16	Yes	Duodenal ulcer	1a	AT	Yes	No	Survived 30 days
19	91	M	7	14	Yes	Duodenal ulcer	1a	AT	Yes	No	Survived 30 days
20	77	M	6	15	Yes	Duodenal ulcer	1a	AT	Yes	Day 2; treated endoscopically	Survived 30 days

ATT, Antithrombotic therapy; F, female; A, adrenaline only; M, male; AT, adrenaline plus a thermal device; AC, adrenaline plus hemostatic clip.

SUPPLEMENTARY TABLE 3. Previous studies on hemostatic spray as a monotherapy in high-risk nonvariceal upper gastrointestinal bleed

No. of patients	Lesion	Initial hemostasis (%)	7-day rebleeding (%)	30-day mortality (%)	Reference
10	Spurting vessel*	100	0	NA	19
20	Forrest 1a and 1b	95	11	0	12
7	Forrest 1a and 1b	100	14	NA	13
16	Forrest 1a and 1b	–	19	NA	11
12	Forrest 1a and 1b	58	29 [†]	NA	25

NA, Not available.

*In animal (pig) model.

†Unsustained primary hemostasis.