

# miR-433-3p通过靶向下调GALNT1调控肺癌细胞的生物学行为

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**摘要** 为了探讨微小RNA-433-3p(miR-433-3p)对肺癌细胞增殖、迁移、侵袭和凋亡的影响及其分子机制,该研究在体外培养人正常肺上皮细胞BEAS-2B以及肺癌细胞系H1299、Calu-3和Calu-6。采用定量逆转录PCR(RT-qPCR)检测上述细胞的miR-433-3p和N-乙酰氨基半乳糖转移酶1(GALNT1) mRNA的表达情况,采用Western blot检测上述细胞的GALNT1蛋白水平,筛选miR-433-3p和/或GALNT1 mRNA和蛋白表达相对较高的肺癌细胞系,并将筛选的细胞采用转染技术分为miR-NC组(空白转染对照组)、miR-433-3p组(miR-433-3p过表达组)、si-NC组(空白沉默对照组)、si-GALNT1组(GALNT1沉默组)、miR-433-3p+pcDNA组(miR-433-3p与pcDNA共转染组)、miR-433-3p+pcDNA-GALNT1组(miR-433-3p与pcDNA、pcDNA-GALNT1共转染组)。采用MTT、Transwell、流式细胞术和Western blot检测细胞活性、迁移、侵袭、凋亡及相关蛋白表达情况;采用双荧光素酶报告实验检测miR-433-3p和GALNT1的靶向关系。研究发现,与BEAS-2B比较,肺癌细胞中miR-433-3p表达水平显著较低( $P<0.05$ ), GALNT1表达显著升高( $P<0.05$ ),肺癌细胞H1299的miR-433-3p最低, GALNT1 mRNA和蛋白表达相对较高,因而选择肺癌细胞H1299进行研究。过表达miR-433-3p或干扰GALNT1均显著降低肺癌H1299细胞的增殖、迁移、侵袭和凋亡过程,且CyclinD1、MMP-2、MMP-9和Bcl-2表达水平显著降低( $P<0.05$ ), p21和Bax表达水平显著升高( $P<0.05$ )。miR-433-3p靶向调控GALNT1表达( $P<0.05$ )。上调GALNT1逆转了过表达miR-433-3p对肺癌H1299细胞增殖、迁移、侵袭和凋亡的影响( $P<0.05$ )。该研究得出,miR-433-3p通过负调控GALNT1影响肺癌H1299细胞的增殖、迁移、侵袭和凋亡行为。

**关键词** 肺癌; miR-433-3p; GALNT1; 增殖; 迁移; 侵袭; 凋亡

## miR-433-3p Regulates the Biological Behavior of Lung Cancer Cells by Down-Regulating GALNT1

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**Abstract** To explore the effects of miR-433-3p (miRNA-433-3p) on proliferation, migration, invasion and apoptosis of lung cancer cells and its molecular mechanism, human normal lung epithelial cells BEAS-2B and lung cancer cell lines H1299, Calu-3 and Calu-6 were cultured *in vitro*. The RT-qPCR (quantitative reverse transcription) was used to detect the expression of miR-433-3p and *GALNT1* (N-acetylgalactosamine transferase 1) mRNA in

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the above cells; Western blot was used to detect the GALNT1 protein in the above cells. The lung cancer cell which had relatively high expression of miR-433-3p and/or GALNT1 mRNA and protein were selected into the study. The selected cells were divided into the miR-NC group (blank transfection control group), miR-433-3p group (miR-433-3p overexpression group), si-NC group (blank silent control), si-GALNT1 group (GALNT1 silence group), miR-433-3p+pcDNA group (miR-433-3p and pcDNA co-transfection group), and miR-433-3p+pcDNA-GALNT1 group (miR-433-3p and pcDNA, pcDNA-GALNT1 co-transfection group). The MTT, Transwell, flow cytometry and Western blot assay were used to detect the cell proliferation, migration, invasion, apoptosis and related protein expression. Dual luciferase reporter assay was used to detect the targeting relationship between miR-433-3p and GALNT1. In this study, it was found that compared with BEAS-2B, the expression level of miR-433-3p in lung cancer cells was significantly lower ( $P<0.05$ ), and the expression of GALNT1 was significantly increased ( $P<0.05$ ). Overexpression of miR-433-3p or interference with GALNT1 significantly reduced the process of lung cancer H1299 cells. The expression levels of CyclinD1, MMP-2, MMP-9 and Bcl-2 were significantly reduced ( $P<0.05$ ), and the expression levels of p21 and Bax were significantly increased ( $P<0.05$ ). miR-433-3p targeted the expression of GALNT1 ( $P<0.05$ ). The up-regulation of GALNT1 reversed the effects of miR-433-3p overexpression on the proliferation migration, invasion and apoptosis of lung cancer H1299 cells ( $P<0.05$ ). In this study, it concludes that miR-433-3p regulates proliferation, migration, invasion and apoptosis of lung cancer H1299 cells by down-regulating the expression of GALNT1.

**Keywords** lung cancer; miR-433-3p; GALNT1; proliferation; migration; invasion; apoptosis

肺癌(lung cancer, LC)是世界上最常见的恶性肿瘤之一,可分为小细胞肺癌(small cell lung cancer, SCLC)和非小细胞肺癌(non-small cell lung cancer, NSCLC)。NSCLC占比较高,临床发病率可达肺癌的85%,具有恶性程度高、侵袭性强的特点,晚期易发生淋巴结和不同器官的转移<sup>[1-2]</sup>。NSCLC是导致患者死亡的主要肺癌类型,严重威胁人类健康。尽管手术、放疗和化疗等治疗手段已取得较大进展,但NSCLC患者的5年生存率仍不尽如人意,且因耐药或肿瘤转移,其复发率较高<sup>[3]</sup>。因此,亟需研究和探索新且有效的肺癌治疗方法。微小RNA(miRNA)是一类长度仅为18~22 bp的非编码RNA,参与了人类多种肿瘤细胞的恶性生物学行为。研究发现,miR-433-3p在肺癌中发挥肿瘤抑制作用,miR-433-3p可抑制NSCLC细胞的恶性行为<sup>[4-6]</sup>。本研究通过TargetsCan预测发现,miR-433-3p与GALNT1具有结合位点。乙酰半乳糖胺基转移酶1(*N*-acetylgalactosamine transferase 1, GALNT1)是高尔基体多肽*N*-乙酰半乳糖胺(GalNAc)-转移酶(GALNT)大家族的成员。已有研究报道,GALNT1在多种肿瘤中高表达,促进肿瘤生长和转移,且与肿瘤,包括肝细胞癌<sup>[7]</sup>、胃癌<sup>[8]</sup>、肾细胞癌<sup>[9]</sup>、乳腺癌<sup>[10]</sup>等预后不良相关。有报道显示<sup>[11]</sup>,miR通过

调节GALNT1发挥增强结直肠癌的增殖及肝转移能力,那么miR-433-3p是否通过调控GALNT1表达发挥参与肺癌发生发展还尚未可知。本实验旨在研究miR-433-3p是否通过靶向调控GALNT1表达影响肺癌细胞的增殖、迁移、侵袭和凋亡。

## 1 材料与方法

### 1.1 材料

人正常肺上皮细胞BEAS-2B和肺癌细胞系H1299、Calu-3和Calu-6购自中科院上海细胞库;胎牛血清、DMEM培养基、胰蛋白酶均购自美国的GIBCO公司;Lipofectamine 2000购自美国Invitrogen公司;Trizol试剂、反转录、定量逆转录PCR(RT-qPCR)试剂盒均购自TaKaRa公司;Transwell小室购自美国Merckmillipore公司;MTT和Annexin V-FITC/PI试剂盒购自上海晶抗生物工程有限公司;RIPA蛋白裂解液、BCA试剂盒购自上海研谨生物科技有限公司;双荧光素酶报告试剂盒购自美国Promega公司;miR-NC、miR-433-3p、anti-miR-NC、anti-miR-433-3p、si-NC、si-GALNT1均购自上海吉玛制药技术有限公司;pcDNA、pcDNA-GALNT均购自上海索宝生物科技有限公司。

## 1.2 方法

1.2.1 细胞筛选 采用“RT-qPCR”和“Western blot”方法分别检测肺癌细胞系H1299、Calu-3和Calu-6中miR-433-3p和GALNT1 mRNA和蛋白表达,选择miR-433-3p和GALNT1 mRNA和蛋白表达相对较高的细胞系进行下一步研究。

1.2.2 细胞转染与分组 分别将miR-NC、miR-433-3p、si-NC、si-GALNT1转染至“1.2.1”筛选出的对数生长期X细胞,使用Lipofectamine 2000试剂进行转染实验,设置如下(每组有6个平行样):miR-NC组(空白转染对照组)、miR-433-3p组(miR-433-3p过表达组)、si-NC组(空白沉默对照组)、si-GALNT1组(GALNT1沉默组);miR-433-3p分别与pcDNA、pcDNA-GALNT1共转染至X细胞中,记为miR-433-3p+pcDNA组(miR-433-3p与pcDNA共转染组)、miR-433-3p+pcDNA-GALNT1组(miR-433-3p与pcDNA、pcDNA-GALNT1共转染组)。

1.2.3 采用定量逆转录PCR(quantitative reverse transcription polymerase chain reaction, RT-qPCR)检测miR-433-3p和GALNT1 mRNA 使用Trizol裂解液提取收集各组细胞的总RNA,操作如下:细胞悬液经离心去上清,加入裂解液,使用振荡器振荡混匀数下,将样品离心留上清,放入无RNase离心管中,加入氯仿,振荡均匀,离心取水相,加入异丙醇混合,放入-20 °C中30 min,1 200 ×g离心5 min,加入RNase-Free ddH<sub>2</sub>O溶解。使用TaKaRa反转录试剂盒对总RNA(约500 ng)进行逆转录,检测miR-433-3p和GALNT1 mRNA的表达水平,分别以U6和GAPDH为内参,相对表达量采用2<sup>-ΔΔC<sub>t</sub></sup>法计算,检测各组miR-433-3p和GALNT1 mRNA水平以验证转染效果。miR-433-3p上游引物序列:5'-GGA GAA GTA CGG TGA GCC TGT-3',下游引物序列:5'-GAA CAC CGA GGA GCC CAT CAT-3';GALNT1 mRNA上游引物序列:5'-CGC TGC AAT CCA GAC AGT AA-3',下游引物序列:5'-TCC CAG ATC CTG ATC CAG AG-3';U6上游引物序列:5'-CGC TTC GGC AGC ACA TAT ACT AAA AT-3',下游引物序列:5'-CGC TTC ACG AAT TTG CGT GTC AT-3';GAPDH上游引物序列:5'-TGG TAT CGT GGA AGG ACT CAT GAC-3',下游引物序列:5'-ATG CCA GTG AGC TTC CCG TTC AGC-3'。引物的合成均由上海生工生物工程有限公司完成。

1.2.4 Western blot检测GALNT1蛋白水平 将各组细胞样本用PBS清洗,RIPA裂解液冰上裂解,300 ×g离心5 min,测上清中蛋白的浓度,加入适量的1× SDS缓冲液,煮沸,采用不连续系统蛋白质SDS-PAGE进行电泳实验,待转膜完成后,将PVDF膜放入TBST中漂洗,加入5%脱脂奶粉封闭液,室温下封闭1 h。孵育GALNT1抗(工作浓度1:1 000),先按蛋白Marker将PVDF膜剪开,转膜后加入一抗,4 °C孵育过夜,加入TBST洗涤液清洗;孵育辣根过氧化物酶(horseradish peroxidase, HRP)标记的二抗(工作浓度1:1 000),向PVDF膜中加入二抗,室温下孵育60 min,TBST洗涤,显色后拍照,使用Image J软件分析蛋白的表达量。

1.2.5 MTT检测细胞活性 各个组别中分别取H1299细胞(2.5×10<sup>4</sup>个/mL),接种于96孔板(100 μL/孔),进行48 h培养,每孔加入MTT溶液20 μL,继续培养,4 h后弃上清液,每孔加入150 μL DMSO,室温孵育,5 min后使用酶标仪检测450 nm处D值。

1.2.6 Transwell检测细胞迁移和侵袭 各个组别中分别取H1299细胞,于Transwell上室接种H1299,每孔5×10<sup>4</sup>个,在下室加入培养液600 μL,37 °C孵育,24 h后用棉签擦去未穿膜的细胞。多聚甲醛固定,0.1%结晶紫染液染色,置于显微镜下计数。

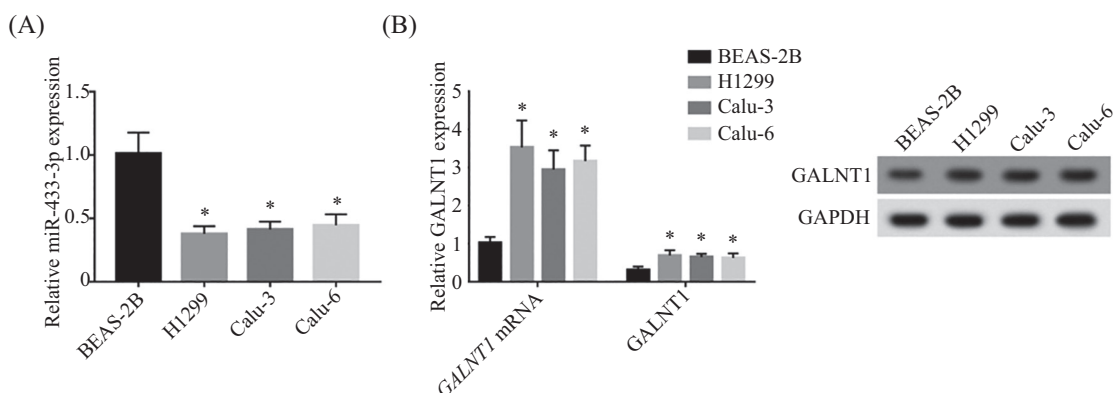
1.2.7 Western blot检测细胞迁移相关蛋白CyclinD1、p21水平 步骤同“1.2.4”,CyclinD1、p21为一抗(工作浓度1:500)。

1.2.8 Western blot检测细胞侵袭相关蛋白MMP-2、MMP-9水平 步骤同“1.2.4”,MMP-2、MMP-9为一抗(工作浓度1:500)。

1.2.9 Annexin V检测细胞凋亡情况 收集各个组别细胞,PBS漂洗2次,0.25%胰蛋白酶进行消化,结合缓冲液重悬后,加入Annexin V-FITC、碘化丙啶(PI)各5 μL,37 °C避光孵育15 min,使用流式细胞仪检测细胞凋亡情况。

1.2.10 Western blot检测细胞凋亡相关蛋白Bax、Bcl-2水平 步骤同“1.2.4”,Bax、Bcl-2为一抗(工作浓度1:500)。

1.2.11 靶基因预测及双荧光素酶报告基因测定 靶基因预测采用Targetscan软件预测miR-433-3p靶基因,采用双荧光素酶报告基因检测:将细胞接种于24孔板,使用Lipofectamine 2000混合miR-433-3p mimic和含有野生型与突变型GALNT1 3'UTR的报告基因质粒共转染H1299细胞。培养48 h,将细胞液氮



A: miR-433-3p表达; B: *GALNT1* mRNA及GALNT1蛋白表达。x±s, n=9; \*P<0.05, 与BEAS-2B组比。

A: expression of miR-433-3p; B: expression of *GALNT1* mRNA and GALNT1 protein. x±s, n=9; \*P<0.05 compared with BEAS-2B group.

图1 人正常肺上皮细胞BEAS-2B和肺癌细胞中miR-433-3p和GALNT1的表达

Fig.1 Expression of miR-433-3p and GALNT1 in human normal lung epithelial cells BEAS-2B and lung cancer cells

反复冻融2次,离心收集上清,获得细胞提取液。将细胞提取液及Luciferase反应底物25 °C水浴10 min,加入Luciferase反应底物及细胞提取液,读数。

### 1.3 统计学处理

采用SPSS 23.0统计学软件分析,计量资料以( $\bar{x}\pm s$ )表示,组间比较采用t检验,使用单因素分析多组间比较,P<0.05为差异有统计学意义。

## 2 结果

### 2.1 人正常肺上皮细胞BEAS-2B和肺癌细胞中miR-433-3p和GALNT1的表达情况

肺癌细胞H1299、Calu-3和Calu-6中miR-433-3p表达水平显著低于正常上皮细胞,而GALNT1 mRNA和蛋白表达显著高于正常肺上皮细胞(P<0.05),其中肺癌细胞H1299的miR-433-3p最低,GALNT1 mRNA和蛋白表达相对较高,因而选择肺癌细胞H1299进行下一步研究(图1)。

### 2.2 过表达miR-433-3p对肺癌H1299细胞增殖、迁移、侵袭和凋亡的影响

与miR-NC组比,miR-433-3p组miR-433-3p水平显著增高(P<0.05),细胞活性、CyclinD1表达水平显著降低(P<0.05),p21表达水平显著增高(P<0.05);迁移和侵袭细胞数、MMP-2、MMP-9表达水平显著降低(P<0.05),细胞凋亡率、Bax表达水平显著升高(P<0.05),Bcl-2表达水平显著降低(P<0.05)(图2)。

### 2.3 miR-433-3p靶向调控GALNT1表达

根据Targetscan预测结果,发现GALNT1与3'UTR均有核苷酸序列与miR-433-3p进行互补(图

3A)。WT-GALNT1中,与转染miR-NC比较,转染miR-433-3p的荧光素酶活性显著降低(P<0.05),MUT-GALNT1的荧光素酶活性无显著差异(图3B)。miR-433-3p组的GALNT1表达显著低于miR-NC组(P<0.05);anti-miR-433-3p组的GALNT1表达水平显著高于anti-miR-NC组(P<0.05)(图3C)。

### 2.4 干扰GALNT1对肺癌H1299细胞增殖、迁移、侵袭和凋亡的影响

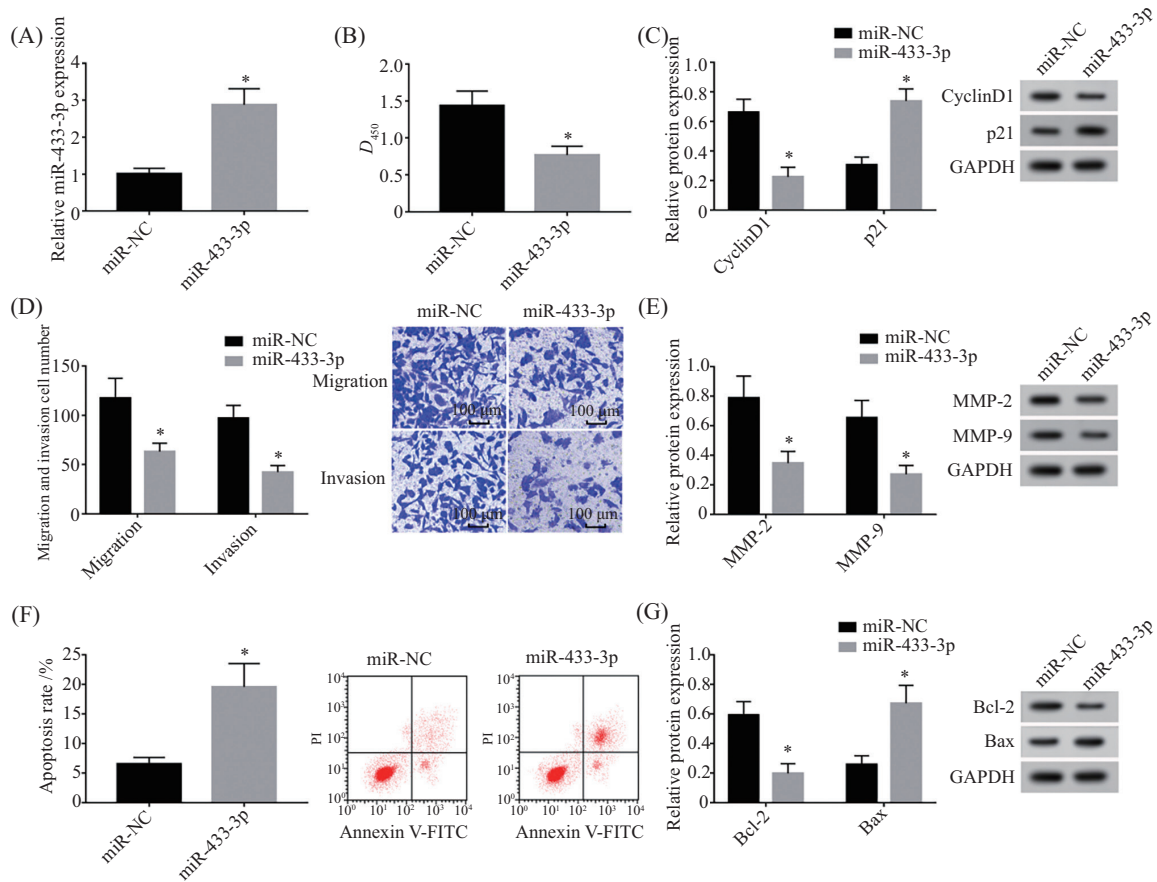
与si-NC组比较,si-GALNT1组GALNT1的表达水平显著降低(P<0.05),细胞活性、CyclinD1表达水平显著降低(P<0.05),p21表达水平显著升高(P<0.05),迁移和侵袭细胞数、MMP-2、MMP-9表达水平显著降低(P<0.05);细胞凋亡率、Bax表达水平显著升高(P<0.05),Bcl-2表达水平显著降低(P<0.05)(图4)。

### 2.5 上调GALNT1逆转了过表达miR-433-3p对肺癌H1299细胞增殖、迁移、侵袭和凋亡的影响

与miR-433-3p+pcDNA组比较,miR-433-3p+pcDNA-GALNT1组GALNT1的表达水平显著升高,细胞活性、CyclinD1表达水平显著升高(P<0.05),p21表达水平显著降低(P<0.05),迁移和侵袭细胞数、MMP-2、MMP-9表达水平显著升高(P<0.05),细胞凋亡率、Bax表达水平显著降低(P<0.05),Bcl-2表达水平显著升高(P<0.05)(图5)。

## 3 讨论

越来越多的证据表明,miRNA参与恶性肿瘤的发生、增殖、转移、复发和耐药等过程<sup>[12-13]</sup>。miR-433是miRNA家族中研究较多的成员,参与多种恶性

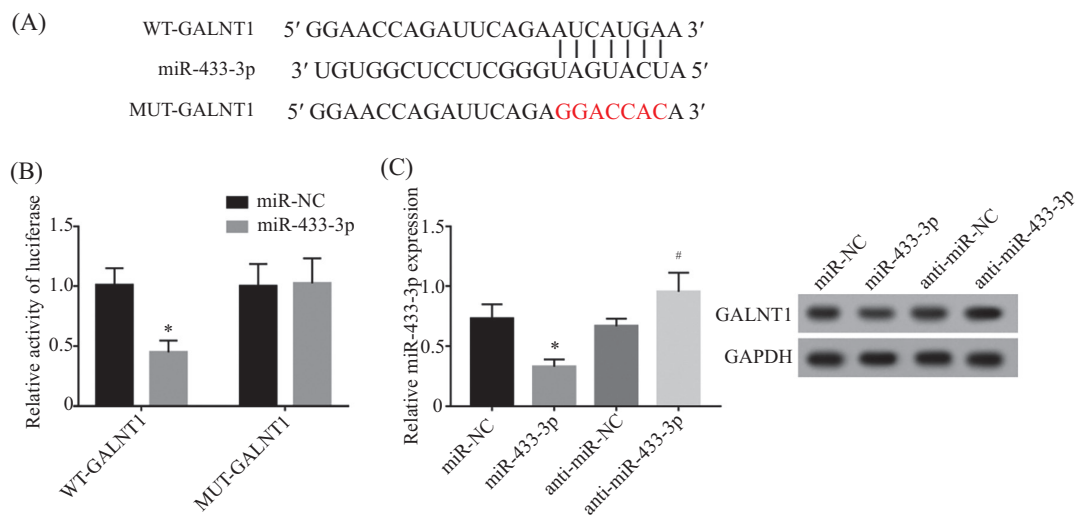


A: miR-433-3p表达; B:  $D$ 值; C: CyclinD1、p21蛋白表达; D: H1299细胞的迁移和侵袭; E: MMP-2、MMP-9蛋白表达; F: 细胞凋亡率; G: Bcl-2、Bax蛋白表达。  $\bar{x} \pm s$ ,  $n=9$ ; \* $P<0.05$ , 与miR-NC组比。

A: miR-433-3p expression; B:  $D$  value; C: CyclinD1 and p21 expression; D: migration and invasion of H1299 cells; E: MMP-2 and MMP-9 expression; F: apoptosis rate; G: Bcl-2 and Bax expression.  $\bar{x} \pm s$ ,  $n=9$ ; \* $P<0.05$  compared with miR-NC group.

图2 过表达miR-433-3p对肺癌H1299细胞增殖、迁移、侵袭和凋亡的影响

Fig.2 Effects of overexpression of miR-433-3p on proliferation, migration, invasion and apoptosis of lung cancer H1299 cells

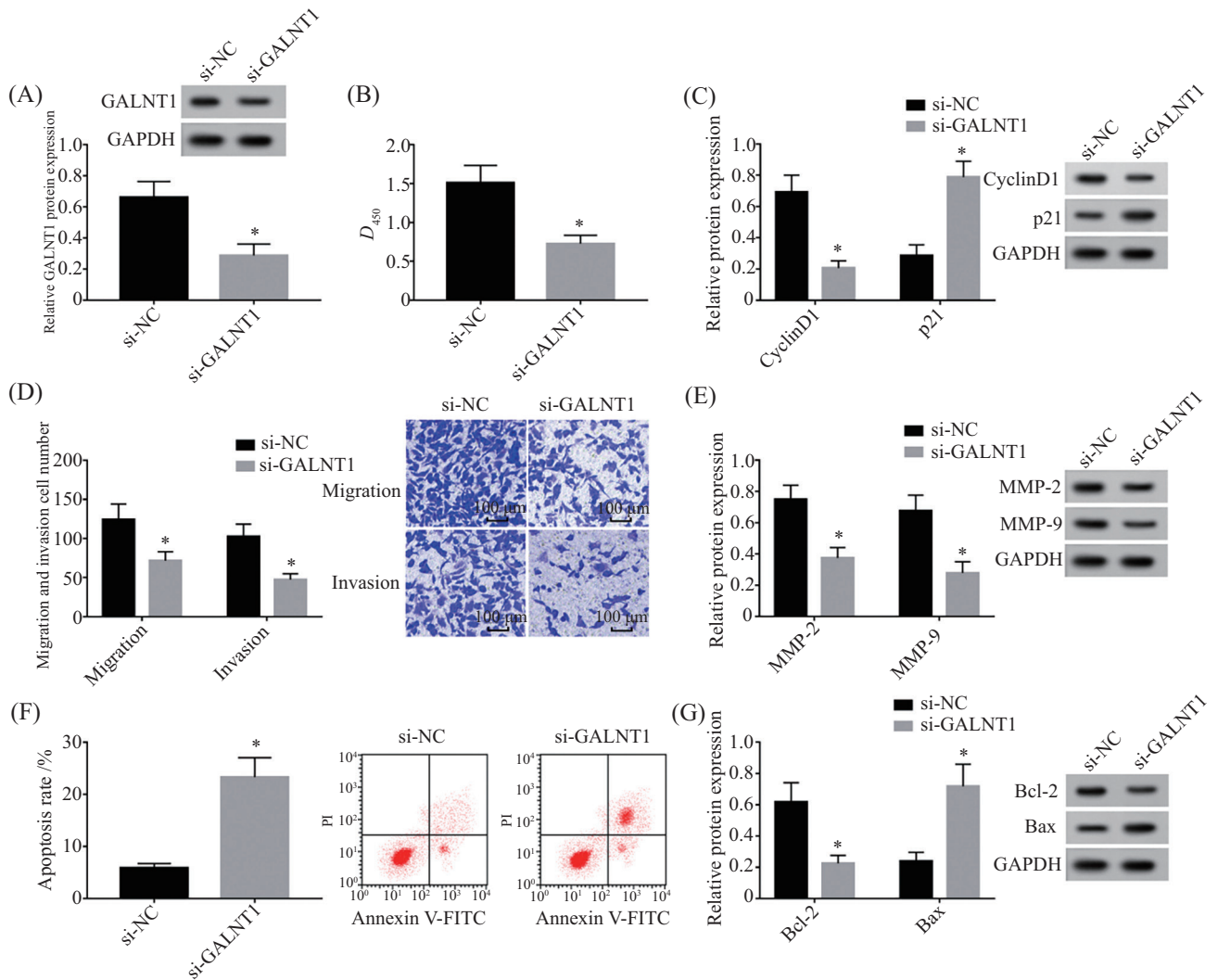


A: GALNT1的3'UTR中, 有核苷酸序列与miR-433-3p进行互补, 标红处是GALNT1突变的核苷酸碱基; B: 双荧光素酶报告实验; C: miR-433-3p调控GALNT1表达。  $\bar{x} \pm s$ ,  $n=9$ ; \* $P<0.05$ , 与miR-NC组比; # $P<0.05$ , 与anti-miR-NC组比。

A: in the 3'UTR of GALNT1, nucleotide sequences were complementary to miR-433-3p. The nucleotide base of GALNT1 mutation was marked in red; B: double luciferase report assay; C: miR-433-3p regulates the expression of GALNT1.  $\bar{x} \pm s$ ,  $n=9$ ; \* $P<0.05$  compared with miR-NC group; # $P<0.05$  compared with anti-miR-NC group.

图3 miR-433-3p靶向调控GALNT1表达

Fig.3 miR-433-3p targeted the expression of GALNT1



A: GALNT1蛋白表达水平; B:  $D_{450}$ 值; C: CyclinD1、p21蛋白表达水平; D: H1299细胞的迁移和侵袭; E: MMP-2、MMP-9蛋白表达水平; F: 细胞凋亡率; G: Bcl-2、Bax蛋白表达水平。  $\bar{x} \pm s, n=9; *P<0.05$ , 与si-NC组比。

A: GALNT1 protein expression level; B:  $D$  value; C: CyclinD1 and p21 protein expression levels; D: migration and invasion of H1299 cells; E: MMP-2 and MMP-9 protein expression levels; F: apoptosis rate; G: Bcl-2 and Bax protein expression levels.  $\bar{x} \pm s, n=9; *P<0.05$  compared with si-NC group.

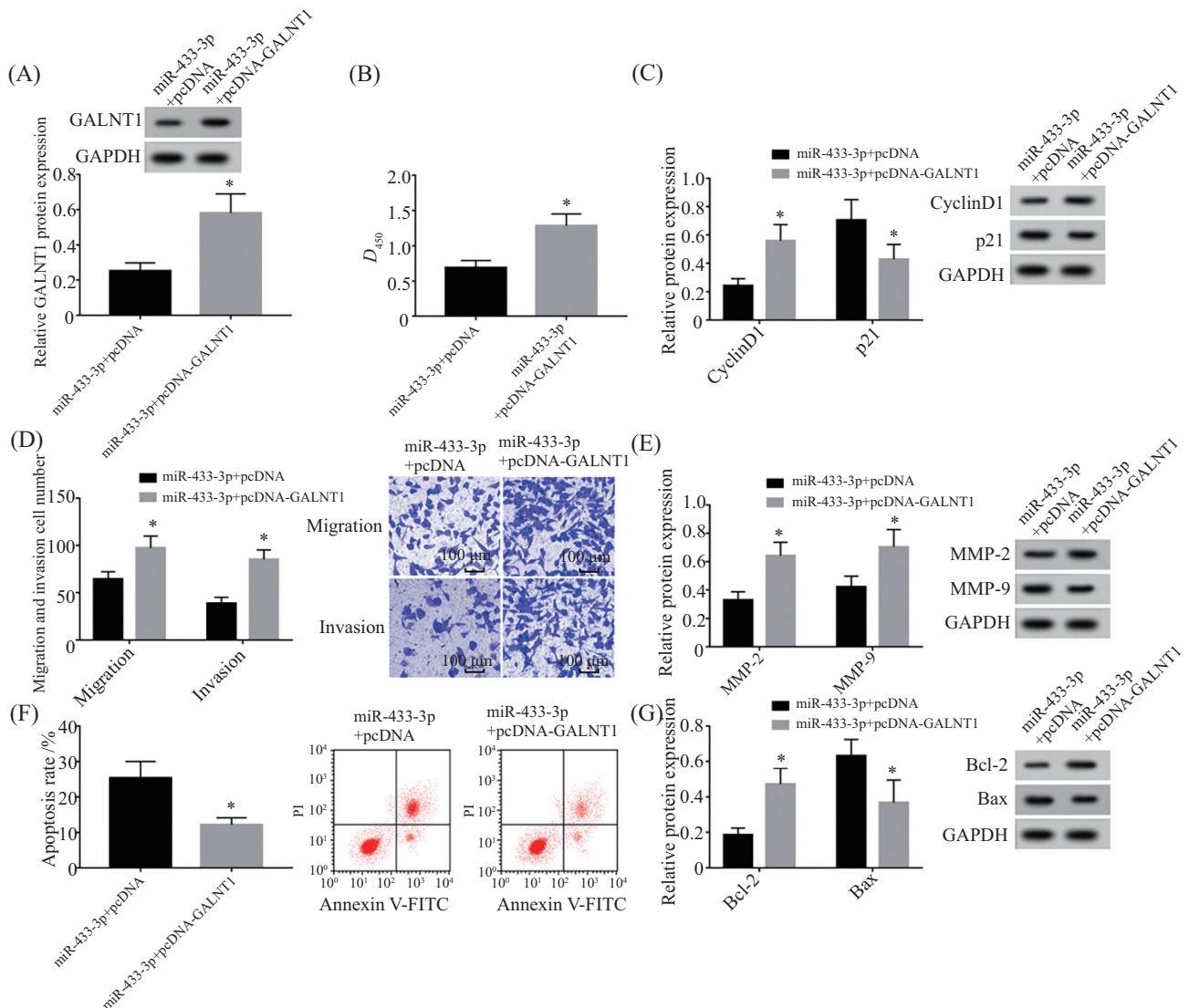
图4 干扰GALNT1对肺癌H1299细胞增殖、迁移、侵袭和凋亡的影响

Fig.4 Effects of interfering GALNT1 expression on proliferation, migration, invasion and apoptosis of lung cancer H1299 cells

癌症的发生发展过程, 如miR-433-3p通过靶向上调SCD1促进鼻咽癌细胞的增殖、迁移和脂质积聚<sup>[14]</sup>; miR-433-3p可抑制胰腺癌细胞的增殖、迁移、侵袭和谷氨酰胺代谢, 并促进细胞凋亡<sup>[15]</sup>; miR-433-3p在膀胱癌细胞中表达下调, 过表达miR-433-3p可抑制膀胱癌细胞的增殖、迁移、侵袭和上皮细胞-间充质转化(epithelial-mesenchymal transition, EMT)<sup>[16]</sup>; miR-433-3p在乳腺癌中具有抗增殖、抗迁移和抗侵袭能力<sup>[17]</sup>。但关于miR-433-3p在肺癌发生发展中扮演什么角色的研究相对较少。本研究采用转染技术制备的肺癌细胞H1299过表达miR-433-3p可降低肺癌细胞H1299活性、迁移和侵袭细胞数, 增加细

胞凋亡率, 对应的迁移、侵袭和凋亡蛋白CyclinD1、p21、MMP-2、MMP-9、Bcl-2和Bax均有相应的变化, 可见miR-433-3p过表达可抑制H1299细胞, 促进肺癌细胞凋亡, miR-433-3p有望成为治疗肺癌的重要靶点, 该结果与文献报道类似<sup>[18]</sup>。

相关研究指出, 通过靶向分子3'UTR的中介作用, miRNA可通过调控关键蛋白表达实现抗癌或促癌作用<sup>[19]</sup>。根据TargetsCan预测结果, 发现GALNT1与3'UTR中均有核苷酸序列与miR-433-3p进行互补, 在WT-GALNT1中, miR-433-3p组的双荧光素酶活性显著降低, 且miR-433-3p负调控GALNT1表达, 即miR-433-3p靶向负调控GALNT1的表达。研究



A: GALNT1蛋白表达水平; B:  $D$ 值; C: CyclinD1、p21蛋白表达水平; D: H1299细胞的迁移和侵袭; E: MMP-2、MMP-9蛋白表达水平; F: 细胞凋亡率; G: Bcl-2、Bax蛋白表达水平。  $\bar{x} \pm s$ ,  $n=9$ ; \* $P < 0.05$ , 与miR-433-3p+pcDNA组。

A: GALNT1 protein expression level; B:  $D$  value; C: CyclinD1 and p21 protein expression levels; D: migration and invasion of H1299 cells; E: MMP-2 and MMP-9 protein expression levels; F: apoptosis rate; G: Bcl-2 and Bax protein expression levels.  $\bar{x} \pm s$ ,  $n=9$ ; \* $P < 0.05$  compared with miR-433-3p+pcDNA group.

图5 上调GALNT1逆转了过表达miR-433-3p对肺癌H1299细胞增殖、迁移、侵袭和凋亡的影响

Fig.5 The up-regulation of GALNT1 reversed the effects of miR-433-3p overexpression on the proliferation, migration, invasion and apoptosis of lung cancer H1299 cells

表明, GALNT1的高表达与肿瘤细胞的恶性行为有关, 如GALNT1在肝细胞癌中表达上调, 与患者低生存率有关, 敲除GALNT1抑制细胞的迁移和侵袭<sup>[20]</sup>; GALNT1在骨肉瘤细胞中高表达, 敲除GALNT1可抑制细胞的侵袭能力<sup>[21]</sup>。与上述研究结果类似, 本实验结果亦显示, 与人正常肺上皮细胞BEAS-2B相比, 肺癌细胞系中GALNT1的表达水平显著升高。低表达的GALNT1可降低肺癌细胞H1299的活性、迁移和侵袭数目, 增加细胞凋亡率, 上调GALNT1可

逆转过表达miR-433-3p对肺癌H1299细胞增殖、迁移、侵袭和凋亡的作用并影响相关蛋白表达, 证实了Targetscan的预测结果: miR-433-3p靶向负调控GALNT1的表达, miR-433-3p通过靶向调控GALNT1表达影响肺癌H1299细胞的增殖、迁移、侵袭和凋亡。但本研究仅探讨了miR-433-3p在肺癌H1299细胞体外靶向负调控GALNT1, miR-433-3和GALNT1在体内的作用及其相关调控机制有待进一步研究与验证。

综上所述, miR-433-3p和GALNT1在肺癌H1299细胞中分别呈现低表达和高表达, miR-433-3p通过负调控GALNT1影响肺癌H1299细胞的增殖、迁移、侵袭和凋亡行为。

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